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Analysis of IGBT from Steep C-Rio to Slashed Plc

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Abstract: *This paper describes the analysis of high cost C-RIO to low cost PLC(Programmable Logic Controller).To accomplish with this we have gathered the required knowledge of PLC as a replacement for the C-RIO (Compact-Reconfigurable Input Output).The selection of PLC is made due to its reliability, cost effectiveness and its feasibility. This paper focuses on dynamic behavior of IGBT and comparative study and evaluation of the parameter measurements. Hence PLC plays a vital role with pneumatic controls in the industrial automation for handling high power applications.*

Keywords*: C-RIO, Dynamic, Evaluation, IGBT, PLC.*

I. Introduction

The semiconductor plays a vital role in Power electronics applications. As the new innovations have emerged highly advanced devices are replaced by the existing device. Hence IGBT's are replaced in many applications where high power loads have to be handled. Therefore it is essential to analyze the Static parameters of the IGBT such that the study can convey the suitable application platform where the IGBT's can be used such as UPS, Frequency divider, Inverters etc. The static voltage parameters will decide the segregation of the igbt's. The measuring technique was automated using C-RIO technique.

The implementation of C-RIO provides accuracy, but handling of this required a complete knowledge of NI tools and the C-RIO. Even it is cost-ineffective, so that the PLC automation is designed which successfully replaces the C-RIO to measure the static parameters. We have used PLC as a choice of automation as it was rugged enough to perform reliability in the plant floor environment with extreme temperature and humidity, airborne dust and particulates. Another significant feature involved its straight forward connection between the host and the computer. The tremendous success of PLC's is because of its programming language chosen i.e. relay ladder logic.Since PLC are feasible and economical they can be easily replaced in controlling of test circuit. This paper describes how the automation can be replaced in the test circuit and a comparison between the C-RIO based testing circuit and PLC testing circuit.

II. Block Diagram

2.1 C-RIO based system

An NI based C-RIO system is used for designing the testing IGBT. A Compact real I/O system (C-RIO) is RISC hardware architecture includes I/O modules, a reconfigurable FPGA chassis, and an embedded controller for communication and processing, and real time deterministic data acquisition. It has a user-programmable FPGA which is reconfigurable, I/O modules which can be swapped for acquiring data and control, and graphical Lab VIEW software for Programming real-time, Windows, and FPGA programming. The below figure represents the NI based C-RIO testing system.

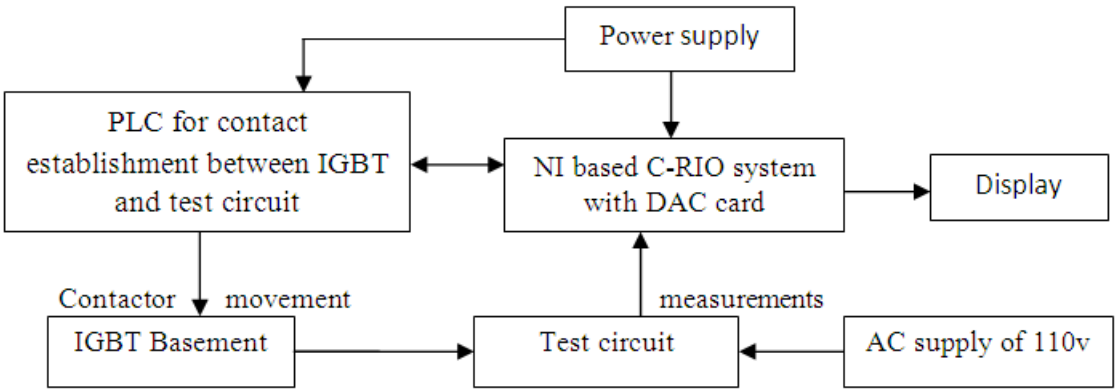

Figure 1- C-RIO based system

The fig 1 represents the testing set up of the C-RIO based system .The placement of the IGBT in the test circuit plays a major role in this circuit. Therefore a PLC is used as a part of the test circuit which provides the contact establishment between the IGBT and the test circuit. A setup with the sense probes and a power probes are used for a contact establishment. The movement of a setup is automated with the PLC automation provided with a suitable precautions and safety measures since an high current is applied in the circuit .The movement of the contactor is indirectly controlled by the C-RIO i.e.., the controlling signals along with the acknowledgement signals are generated by PLC via C-RIO. The typical view of the layout is as shown in figure 2.

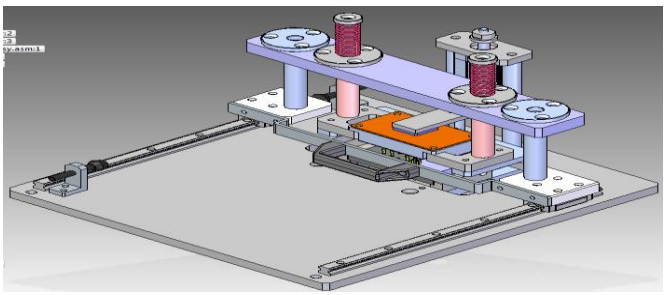

Figure 2- Pre-view of the IGBT test fixture

Once the contact establishment is done the static parameters are measured by the data acquisition system of C-RIO all these three parameters are measured based on the relay switching designed in the test circuit. The switching instant of the relay is initiated by the C-RIO programmed by the graphical tool Lab View. As the test is completed the test results via are recorded in the display unit is used to display the test results. The results are compared with the pre standard values and they are segregated. The segregation of IGBT is done manually. A C-RIO based system requires a prior knowledge of the system and also the tool for programming, it is not handy. This type of testing set up is not economical also. The system not only requires a programming of testing circuit via C-RIO but also needs a designing of the PLC for the contact establishment between the IGBT and test circuit. To overcome this drawback the entire test system can be designed and automated by using PLC Technique.

2.2 PLC based system

A PLC based system provides a competitive response in speed, reliability with respect to C-RIO system. As the designing of the testing control can be done easily by the ladder circuit in PLC , the time consumption is comparably minimised as that of C-RIO system. The replacement of the C-RIO with the PLC can be described by the below block diagram.

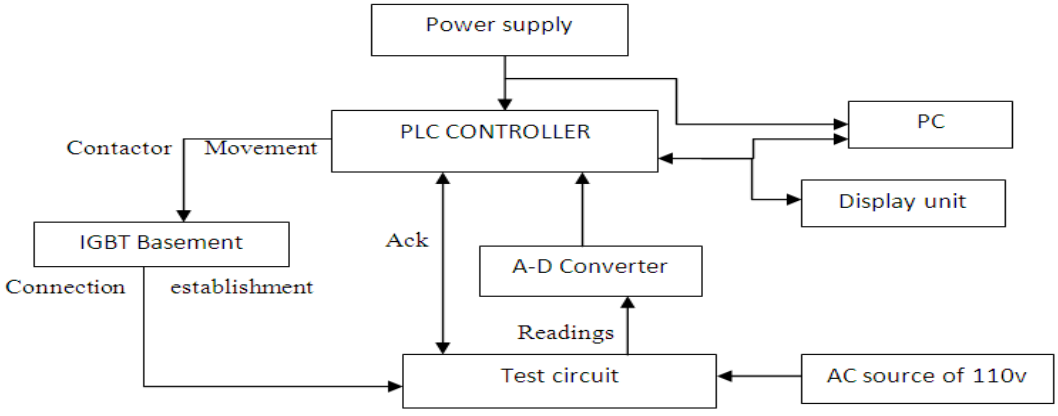

Figure 3-PLC based system

The PLC memory is used to store the test results. Since the plc supports the digital data, an analog to digital converter is used which converts the analog value of static parameters to its equivalent digital data using successive approximation. The test circuit is completely controlled by the PLC. The suitable relays are switched at desired instant such that the parameters are measured and these static values are then converted by the A-D converters. The major constraint which has to be taken care is the conversion accuracy, so a most reliable conversion has to be implemented since the IGBT's are segregated. The conversion process and the completion signal are initiated by the PLC. The placement of the IGBT to the relevant box is also designed through the PLC, where the IGBT is placed manually.

III. Methedology

The working principle of the PLC sorting system can analysed by the flow chart as given below.

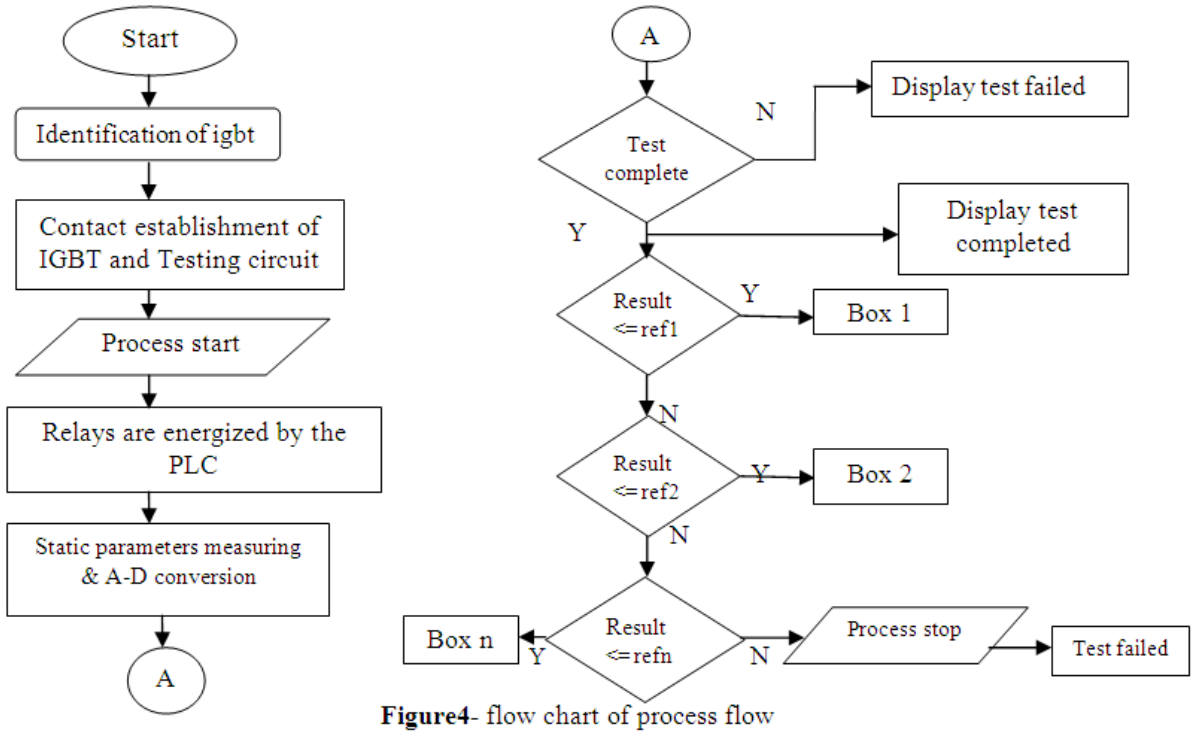

Figure4- flow chart of process flow

The significant controlling parameters can be discussed as below

Step1: IGBT placement and contact establishment:

Once the IGBT is aligned manually in the basement and contactor is pushed downwards which in turn creates a closed loop between the test circuit and the IGBT. Now the process start signal is generated by the plc which initiates the process.

Step2: Measurement of static parameters and conversion to digital equivalent data:

The static parameters of the IGBT are measured at the suitable instant and with the relay switching done by the PLC .The recorded parameters are then converted to their digital equivalent output by ADC.

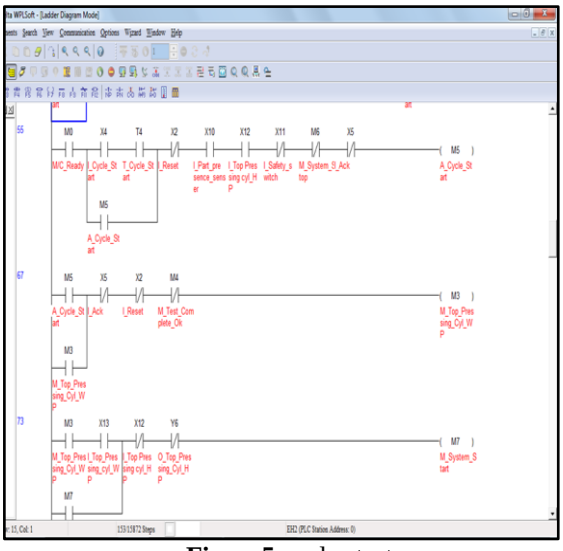

Figure5-cycle start

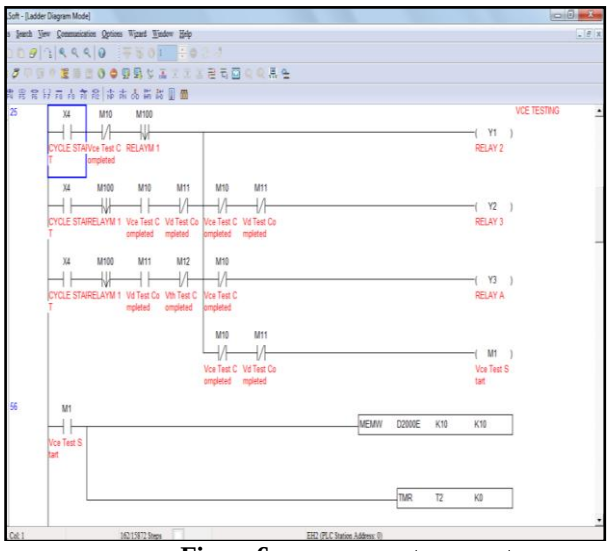

Figure6-measurement parameters

Step3: Comparison of the test result and placing of IGBT:

Once the digital output of all the three static parameters are ready the data is now compared with a reference value and the IGBT is sorted to the relevant box manually as displayed by the PLC. Finally the IGBT is released by moving contact upwards and hence the process is stopped.

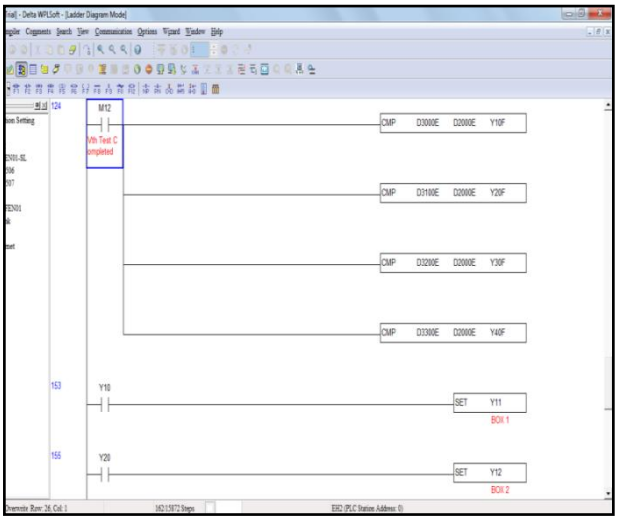

Figure7-comparision and placement

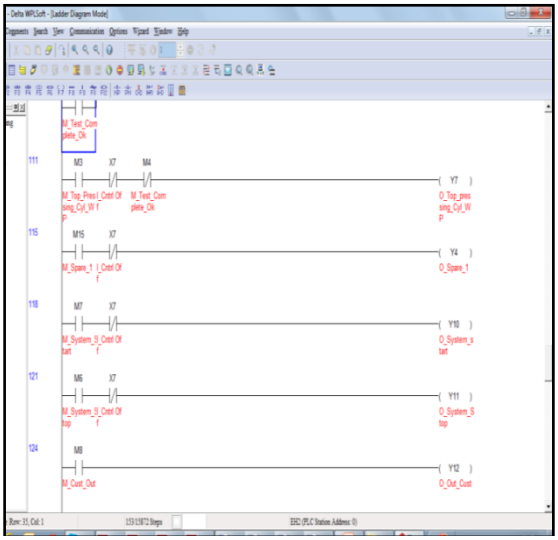

Figure8-process stop and IGBT release

IV. Conclusion

In this paper we have described a fully automated PLC based IGBT testing circuit in the replacement of the C-RIO system. This setup ensures the high reliability as that of C-RIO system and also is feasible and cost effective compared to the C-RIO system. The designing of the entire setup is narrated only through the relay ladder logic which helps in the easier debugging.

V. Future Scope

The application can be extended for testing the 2 to 3 IGBT's at a same instant using the IGBT Test Fixture under high controlled environment. Also the entire process can be made fully automated without the interruption of human.

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