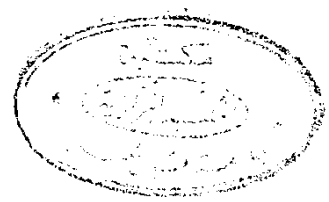
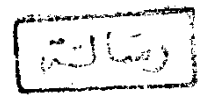
AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING



AUTOMATIC TESTING AND FAULT DETECTION FOR DIGITAL AND MICROPROCESSOR CIRCUITS



By

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A Thesis
Submitted in partial fulfillment of the
requirements of the degree of master of
science in electrical engineering

Supervised By

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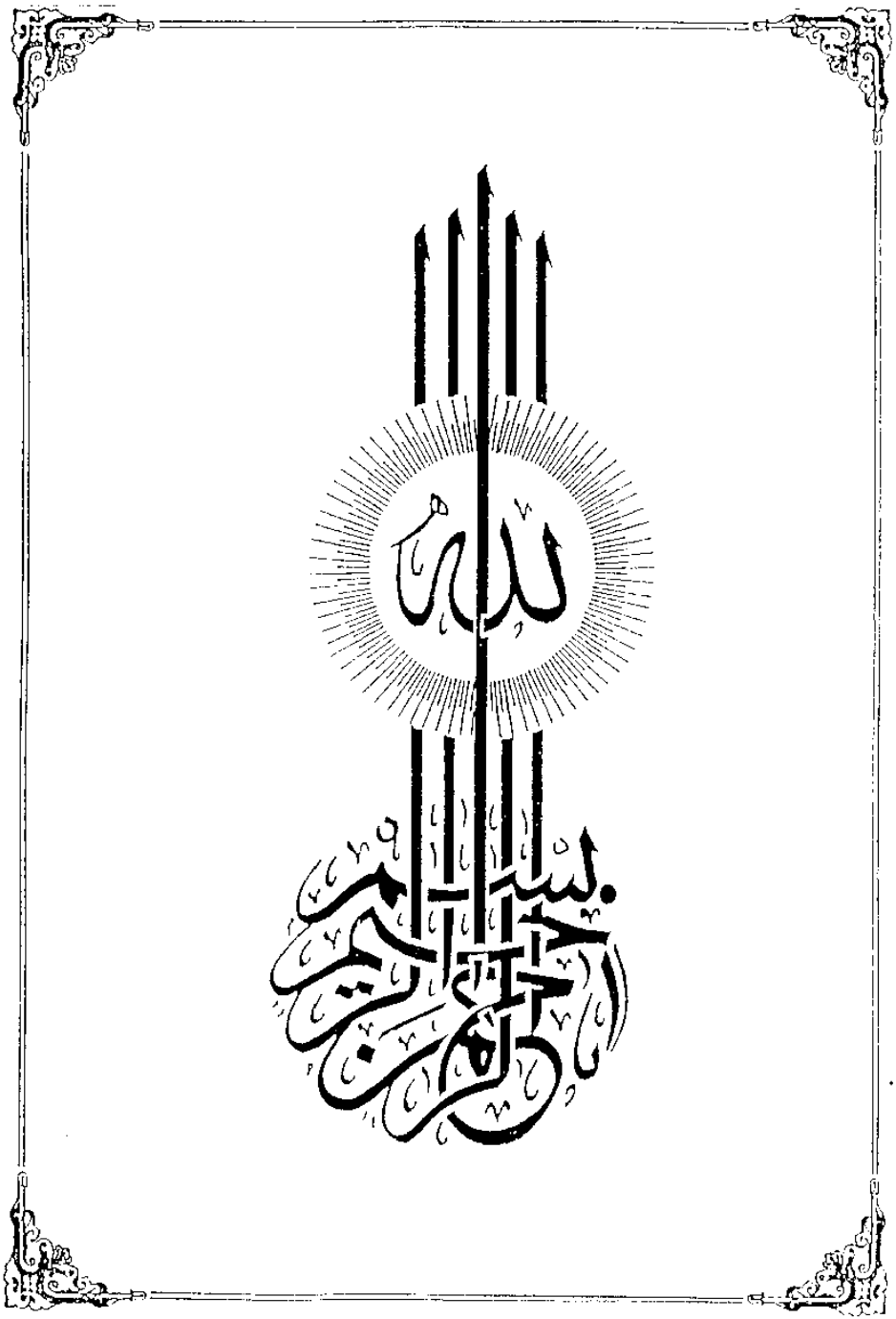

STATEMENT

This dissertation is submitted to Ain Shams University for the Degree of Master of Science in Electronics and Computer Engineering.

The work included in this thesis was carried out by the author in the Department of Electronics and Computer Engineering, Ain Shams University, from 1989 to 1991.

No part of this thesis has been submitted for or a qualification at any other University or Institution.

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ABSTRACT

Fault detection and diagnosis is a complex process for circuit under test. where the most important tasks assigned to such process is the computer supervision. In the beginning of computer process control. most practical systems have contained some form of failure detection and diagnosis. In the majority of these systems. the detection and diagnostic function is rather simple and is based on limit of checking of the automatic testing equipment. Development of computational equipment and techniques has set the scene for the general application of more sophisticated and powerful methods for diagnosis and detection.

In this thesis an automatic testing system have been designed by proposing the hardware configuration and by developing control and system software. Also linear discrete time model for failure detection and isolation have been developed to control the quality of failure isolation process by considering isolability and sensitivity of circuit under test. System hardware is characterized by the main controller. The CPU is the most important part that in it. In order to control and communicate system devices and boards. It monitors the general purpose interface bus by sending various commands to the Controllable Measuring Instruments. Digital Analyses System and Test System Interface. Such

control is based on the system configuration and communication parameter setting for devices and boards interworking.

Control and system software has been classified into three categories. The first is the program design for system configuration and parameter setting. The next step is the Interface Bus Interactive Control Program which allow the user to send messages to any devices or a group of devices and receive the reflected messages. Once the sequence of setups of sending messages have been settled successfully, the application software in the last step, is executed to detect and isolate failure of the circuit under test. In this application program the circuit is analysed and signals are processed for selected test points. These points are selected optimally to speed up the diagnosis process. Such selection is based on a model which define the internal signal vector as well as the input and output vectors of the circuit under test. The proposed system and application program were executed and processed in a real-time for microprocessor controlled circuit board.

From this work we could conclude that the developed system has minimized the testing time of the fault detection and isolation processes. Also, data size and program module, which describe the circuit under test, has been minimized. Therefore the implementation of such techniques can be applied for large circuits boards. This could be achieved

with the comparison between the data acquisition for the circuit under test and the circuit library, which was implemented by using the test generated strategy.

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

1.1 General outline

Fault detection and isolation processes which performed by the automatic testing techniques have been applied to the digital circuits as well as the microprocessor based circuits. In this thesis, the testing process focuses on such circuits using the programmable instruments and their controller, which have a common bus, called the General Purpose Interface Bus. This hardware system configuration has different testing techniques, such as stored result process, comparison testing process, random testing process and signature analysis process. These techniques will be implemented by using an integrated software package, which is described in a modular base. Each program module performs either system controller function or system application function. The system controller function module executes the configuration programs, interactive communication programs, device or board selection programs and command control programs. Its software module will be classified into three categories. The first is the design and development for the configuration parameter settings and interworking the proposed testing system. The second is the interface bus interactive control program which allows the user to send

messages to any device or a group of devices. The third category receives the reflected messages from the devices or boards under test. The system application function module executes the digital bus testing programs, integrated circuit testing programs, memory testing programs and the in-circuit testing programs. The circuit will be analysed using these application programs in which signals are processed for selected test points, these test points are selected optimally to speedup the diagnosis process.

1.2 Thesis Outline

The proposed automatic testing equipment system and its hardware structure are described in chapter 2. Also a detailed discussion is outlined for the system interaction software and hardware using the General Purpose Interface Bus protocols. The signal routing technique acting as the interface between the circuits under test and the controller instruments, by which the commands are received from the system controller and passed to the circuit under test, as shown in chapter 2. Thereafter a brief information describing the Digital Analysis System which acts as the major part in the automatic testing equipment, where the logic patterns are generated for the testing requirements is given in chapter 2.

The testing strategy as well as implementation phase and evaluation techniques, are stated in chapter 3. Testability,

controllability and observability are also defined for test quality improvements.

A failure detection and isolation methods are developed in chapter 4. The model based methods structure is analysed and treated mathematically for sensitivity and residuals improvements.

Finally, In chapter 5 the proposed automatic test system and the developed modules are applied for microprocessor based board circuits in order to evaluate the testing process. The testing procedure are stated and lab implemented for such circuit, by using the test strategy mentioned in chapter 3. Also the results of the testing process are given in that chapter.

CHAPTER 2

AUTOMATIC TESTING SYSTEM DESCRIPTION

2.1 General Outline

Test equipment is useful in detecting several fault types that occur in electronic equipments. They only have a limited role for trouble shooting bus structured systems. This limitation is due to the parallel nature of information on many lines simultaneously and the rapid rate at which the information changes. General purpose test equipment specially designed for testing such systems are developed.

The Automatic Test Equipment typically does static logic test, dynamic logic test,and electrical test. The ATE systems vary in size and speed capabilities. They are difficult to be generalized. The hardware part of the automatic test equipment is mainly an IBM-PC Computer which acts as a controller.

The IBM- PC is enhanced with a standard General Purpose Interface Bus [GPIB] with its adapter card and with developed data acquisition and signal generation card. The controller is connected to the controllable instruments via the GPIB.

The Test System Interface switching network is proposed for connecting the instruments to the test points of the circuit under test [6].