PRINCIPLES OF TRANSDUCER DEVICES AND COMPONENTS

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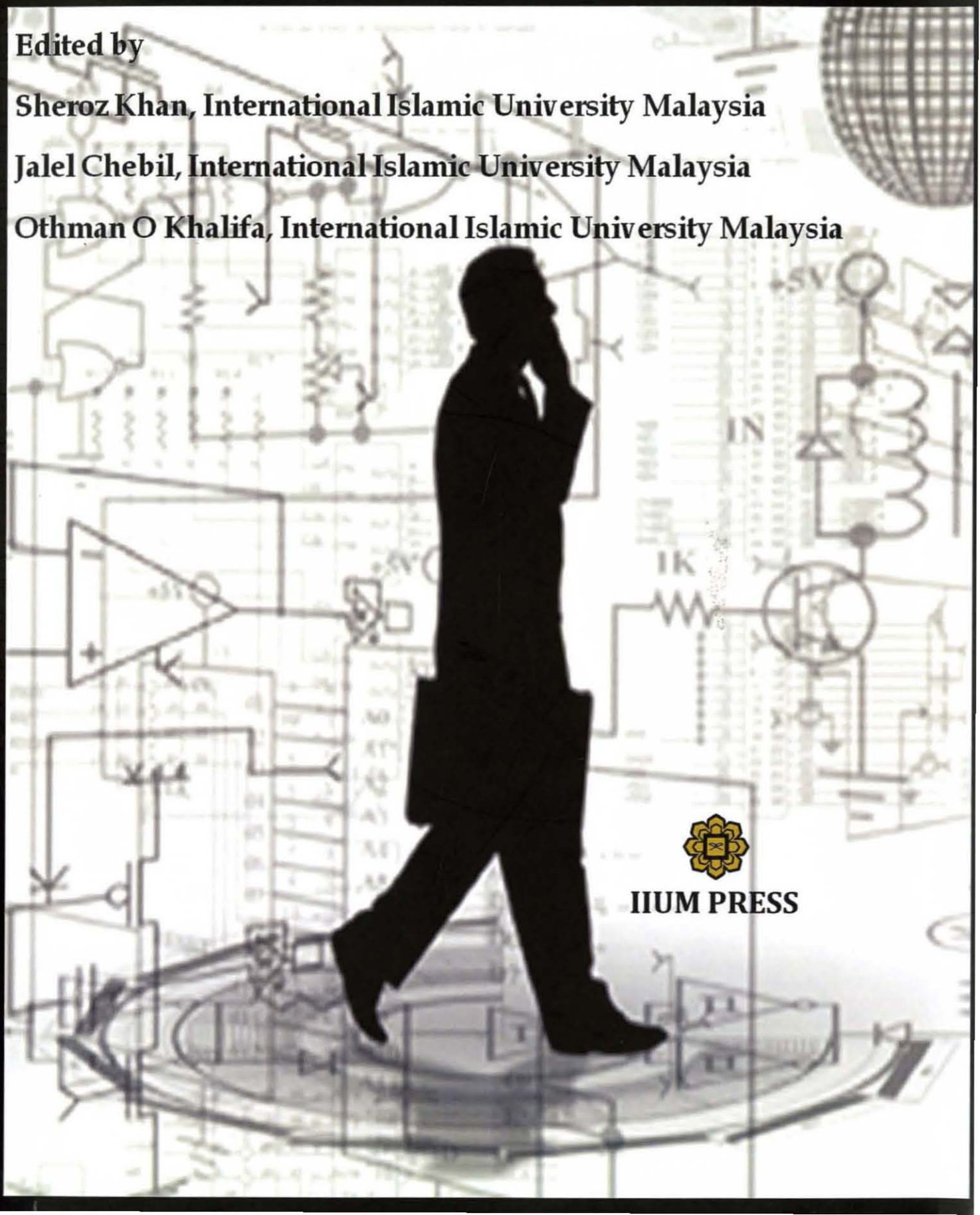

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CONTENTS

Chapter 30

DESIGN AND HARDWARE IMPLEMENTATION OF CONDITIONING CIRCUIT FOR ACCURATE READING FROM TRANSDUCERS WITH NONLINEAR RESPONSES

KHAIRUL HASAN, ALIZA AINI MD RALIB, MA LI YA, ATIKA ARSHAD, SHEROZ KHAN

30.0 INTRODUCTION

This chapter is about design and hardware implementation of a signal conditioning circuit that has the ability to read the output response of a non-linear sensor and produce corresponding linear results. This design is based on piecewise linearization technique. First the non-linear output of the sensor's curve divided into the linear segment each segment is identified by its corresponding slope. A couple of comparators has used for selecting the individual line segment (voltage range) and then by the help of instrumentation amplifier circuit the input voltage interpret into desired output voltage. The simulation of the whole circuit is done in order to make everything easy to understand and visible.

The quick development in both wired and wireless communication has boosted the improvement of analog to digital conversion which meeting linear requirement to achieve high accuracy conversion. One of the applications of ADC is sensors which are the fundamental elements in all measurements and circuits applied. Generally sensor will produce analog output and ADC is needed for conversion to produce smart sensor. Nowadays, most of the smart sensors have the inclusion of the ADC inside to improve the accuracy and flexibility of the sensor itself. An efficient and high accuracy smart sensor should be low cost, high sensitivity and having a good linear characteristic.

Analog to digital conversion is an important device and plays an important rule whether it is integrated or used as stand alone in any measurement and monitoring system. This is because that today's modern systems are digital that are programmed for more automation equipped with enhanced features. However, all conventional ADC work on linear fashion, and produce a digital code in direct proportional to the length to the length of the section of the analog input signal that is sampled to be digitized.

No matter how much accurate and quick ADCs are, they are associated with the errors inherited from the very basic mechanism in which they are designed to function. The errors are quantization error, offset errors and nonlinearity errors. Quantization error is due to the finite resolution present in all ADC conversion, and is an inherited in all types of ADC. Any analog input voltage that falls between two adjacent output codes will result inaccurate output code which gives quantization error. Offset error is the difference between the ideal LSB transitions to the actual transition point. For nonlinearity errors, all