

INTERFACING ELECTRONIC FOR MEASUREMENT,  
SIGNAL PROCESSING AND WIRELESS  
COMMUNICATION



Edited by

Sheroz Khan, International Islamic University Malaysia

AHM Zahirul Alam, International Islamic University Malaysia

Anis Nurashikin Nordin, International Islamic University Malaysia



IIUM PRESS

INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

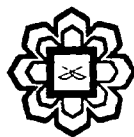
# **INTERFACING ELECTRONIC FOR MEASUREMENT, SIGNAL PROCESSING AND WIRELESS COMMUNICATION**

**Edited by**

**Sheroz Khan, International Islamic University Malaysia**

**AHM Zahirul Alam, International Islamic University Malaysia**

**Anis Nurashikin Nordin, International Islamic University Malaysia**



**IIUM Press**

Published by:  
IIUM Press  
International Islamic University Malaysia

First Edition, 2011  
©IIUM Press, IIUM

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without any prior written permission of the publisher.

Perpustakaan Negara Malaysia

Cataloguing-in-Publication Data

Sheroz Khan, AHM Zahirul Alam & Anis Nurashikin Nordin: Interfacing Electronic for Measurement, Signal Processing and Wireless Communication.

ISBN: 978-967-418-171-0

Member of Majlis Penerbitan Ilmiah Malaysia – MAPIM  
(Malaysian Scholarly Publishing Council)

Printed By:  
**IIUM PRINTING SDN.BHD.**  
No. 1, Jalan Industri Batu Caves 1/3  
Taman Perindustrian Batu Caves  
Batu Caves Centre Point  
68100 Batu Caves  
Selangor Darul Ehsan  
Tel: +603-6188 1542 / 44 / 45 Fax: +603-6188 1543  
EMAIL: [iiumprinting@yahoo.com](mailto:iiumprinting@yahoo.com)

## CONTENTS

Chapter	Title	Page
1	INDUCTIVE SENSOR Atika Arshad, RumanaTasnim, Sheroz Khan, AHM Zahirul Alam	1
2	WIRELESS TRANSFER OF LOW-POWER TO IMPLANTED BIOMEDICAL DEVICES: INTRODUCTION AND 2-D COIL PARAMETERS Imran M. Khan, Sheroz Khan, Othman O. Khalifa	8
3	WIRELESS TRANSFER OF POWER TO LOW-POWER IMPLANTED BIOMEDICAL DEVICES: 3-DIMENSIONAL COIL DESIGN CONSIDERATIONS Imran M. Khan, Sheroz Khan, Othman O. Khalifa	14
4	WIRELESS TRANSFER OF LOW-POWER TO IMPLANTED BIOMEDICAL DEVICES: INDUCTIVE LINK DESIGN Imran M. Khan, Aminullah Khan, Sheroz Khan, Othman O. Khalifa	22
5	WIRELESS TRANSFER OF LOW-POWER TO IMPLANTED BIOMEDICAL DEVICES: RECTIFIER DESIGN Imran M. Khan, Sheroz Khan, Othman O. Khalifa	28
6	DATA CONVERSION BASIC CONCEPTS Ma Li Ya, Sheroz Khan, Anis Nurashikin	36
7	NYQUIST-RATE ANALOG-TO-DIGITAL CONVERTER Ma Li Ya, Sheroz Khan, Anis Nurashikin	41
8	OVERSAMPLING ANALOG-TO-DIGITAL CONVERTER Ma Li Ya, Sheroz Khan, Anis Nurashikin	47
9	SWITCHED-CAPACITOR INTEGRATOR DESIGN Ma Li Ya, Sheroz Khan, Anis Nurashikin	53
10	CMOS OPERATIONAL AMPLIFIER DESIGN Ma Li Ya, Sheroz Khan, Anis Nurashikin	60

11	DIGITAL-TO-ANALOG CONVERTER Ma Li Ya, Sheroz Khan, Anis Nurashikin	68
12	CONVERTERS RESULTS VERIFICATIONS Ma Li Ya, Sheroz Khan, Anis Nurashikin	73
13	DEVELOPMENT OF WEARABLE REFLECTANCE PULSE OXIMETRY FOR TELEHEALTH MONITORING SYSTEM Muhammad Arham, Syed Zulfauzi, Othman O. Khalifa	77
14	DESIGN OF CAPACITIVE MEASURING SYSTEM FOR HIGH FREQUENCY BAND TRANSDUCER Nurul Arfah binti Che Mustapha, AHM Zahirul Alam, Sheroz Khan	83
15	PRINCIPLE OF CAPACITANCE TO VOLTAGE CONVERTER Nurul Arfah binti Che Mustapha, AHM Zahirul Alam, Sheroz Khan	89
16	CMOS OPERATIONAL AMPLIFIER TESTING FOR CAPACITIVE TO VOLTAGE CONVERTER Nurul Arfah binti Che Mustapha, AHM Zahirul Alam, Sheroz Khan	95
17	MATHEMATICAL MODEL FOR CONTACTLESS MEASUREMENT Nurul Arfah binti Che Mustapha, AHM Zahirul Alam, Sheroz Khan	102
18	FREQUENCY RESPONSE OF A CONTACTLESS MEASUREMENT Nurul Arfah binti Che Mustapha, AHM Zahirul Alam, Sheroz Khan	107
19	A MATHEMATICAL STUDY OF A THERMISTOR ASTABLE MULTIVIBRATOR IN A LINEARIZATION TECHNIQUE Nurul Arfah binti Che Mustapha, AHM Zahirul Alam, Sheroz Khan	113

20	A STUDY OF LINEARIZATION TECHNIQUE USING A NONLINEAR THERMISTOR  Nurul Arfah binti Che Mustapha, AHM Zahirul Alam, Sheroz Khan	117
21	COGNITIVE RADIO VS INTELLIGENT ANTENNA  Siti Rabani Mat Nawwi, Nurul Farhah Toha, Khaizuran Abdullah, M. Rafiqul Islam, Sheroz Khan	123
22	UWB PULSE GENERATION AND MODULATION CIRCUITS FOR BIOMEDICAL IMPLANTS  Mokhaled M., Mohammed, Sheroz Khan, Jalel Chebil, Khaled A. S. Al-Khateeb, Imran Moez Khan	134
23	UWB COMMUNICATIONS FOR BIOMEDICAL IMPLANTS  Mokhaled M. Mohammed, Sheroz Khan, Jalel Chebil, Khalid A. S. Al-Khateeb, Imran Moez Khan	141
24	UWB PULSE GENERATION FOR BIOMEDICAL IMPLANTS  Mokhaled M., Mohammed, Sheroz Khan, Jalel Chebil, Khaled A. S. Al-Khateeb, Imran Moez Khan	145
25	ULTRA-WIDE BAND TECHNOLOGY  Mokhaled M., Mohammed, Sheroz Khan, Jalel Chebil, Khaled A. S. Al-Khateeb, Imran Moez Khan	149
26	MVL ADC DESIGN AND SIMULATION  Soheli Farhana, AHM Zahirul Alam, Sheroz Khan	153
27	MVL DESIGN AND CURRENT MODE CIRCUIT ELEMENTS  Soheli Farhana, AHM Zahirul Alam, Sheroz Khan	159
28	NOISE MODULATED CRYPTOGRAPHIC GENERATION FOR USE IN UWB WIRELESS COMMUNICATION  Siti HazwaniYaacob, Sigit Puspito Wigati Jarot, Sheroz Khan	164
29	UWB PULSE GENERATION AND SHAPING: ANALYSIS AND SIMULATION RESULTS  Zeeshan Shahid, Sheroz Khan, AHM Zahirul Alam	173

30	SIMULATIONS OF RESISTANCE VARIATIONS TO PULSE GENERATOR CIRCUITS	177
	Zeeshan Shahid, Sheroz Khan, AHM Zahirul Alam	
31	PULSE OXIMETRY DESIGN USING ARDUINO BOARD	184
	Muhammad Arham, Syed Zulfauzi and Othman O. Khalifa	

## Chapter 16

# CMOS OPERATIONAL AMPLIFIER FOR CAPACITANCE TO VOLTAGE CONVERTER

NURUL ARFAH BINTI CHE MUSTAPHA, AHM ZAHIRUL ALAM, SHEROZ KHAN

### 16.1. INTRODUCTION

Operational amplifier (Op amp) is the most integral part of an embedded circuit building block. In this paper, the testing of an integrated Op amp suitable for capacitance and high speed measuring system has been made. The Op amp testing (such as large signal differential transfer characteristic, frequency response analysis, input common mode analysis, slew rate analysis) has been done using the PSpice OrCAD Version 16.0 circuit simulator and simulation results were compared with the design specification. The design of this Op amp for capacitive measuring system is to make use of 0.13  $\mu\text{m}$  complementary metal-oxide-semiconductor (CMOS) technology. The simulation results and design specification confirmed each other. This high speed and low power consumption system design is suitable use in a measuring system for detection a wide and lower range of capacitance.

### 16.2. THE OPERATIONAL AMPLIFIER BLOCK

The proposed Op amp building block as in Fig. 16.1 consists of three stages: two-stage Op-amp, bias, and start-up stages. Some of the procedures developed in (Chiang, Wang, & Huang, 2008) are followed and readjusted accordingly to facilitate the design of Op amp. Table 1 shows the details of each width,  $W$  with length,  $L = 0.13 \mu\text{m}$ .

Table 1: Summary of the Op-amp Transistors Width,  $W$

Transistor	Width, $W$ ( $\mu\text{m}$ )	Transistor	Width, $W$ ( $\mu\text{m}$ )
M1 and M2	0.195	M8	2.145
M3 and M4	6.11	M11 and M12	6.175
M5	3.25	M10 and M13	0.13
M6	21.905	M9, M14 and Ms1	1.625
M7	5.85	Ms2, Ms3 and Ms4	0.13