

Understanding Basic Concept of Electrical and Electronic Systems

Asadullah Shah



IIUM PRESS

INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

UNDERSTANDING BASIC CONCEPT OF ELECTRICAL AND ELECTRONIC SYSTEMS

Editors

Asadullah Shah



IIUM Press

Published by:
IIUM Press
International Islamic University of 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

Bibliography p.
Includes Index
ISBN

ISBN: 978-967-418-116-1

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

CONTENTS

DEDICATION	<i>iii</i>
PREFACE	xiii
ACKNOWLEDGEMENT	<i>xiv</i>
1. FAMILIARIZATION WITH MULTIMETER	1
1.0 Abstract.....	1
1.1 Introduction.....	1
1.2 Types of Multimeters:.....	2
1.2.1 Digital MMs.....	2
1.2.2 Analog MMs.....	2
1.3 Accuracy	3
1.4 Safety Information	3
1.5 References:.....	5
2. USING THE MULTIMETER	6
2.0 Abstract:.....	6
2.1 Range	6
2.2 Automatic Touch Hold Mode	7
2.3 Continuity Test.....	10
2.4 Current	11
2.5 References:.....	12
3. FAMILIARIZATION WITH OSCILLOSCOPE	13
3.0 Abstract.....	13
3.1 Introduction.....	13
3.2 Analog and Digital.....	14
3.3 Types of Waves.....	15
3.4 Sine Waves	16
3.5 Square and Rectangular Waves.....	16
3.6 Sawtooth and Triangle Waves	17

3.7	References:	17
4.	SIGNALS	18
4.0	Abstract	18
4.1	Step and Pulse Shapes	18
4.2	Waveform Measurements	19
4.3	Frequency and Period	19
4.4	Voltage	20
4.5	Phase	20
4.6	References:	22
5.	PROBES	23
5.0	Abstract	23
5.1	Using Passive Probes	24
5.2	Using Active Probes	26
5.3	Using Current Probes	26
5.4	Where to Clip the Ground Clip	27
5.5	Setting the Controls	27
5.6	References:	28
6.	CONTROL PANEL OF AN OSCILLOSCOPE	29
6.0	Abstract:	29
6.1	Front Panel Control Sections of an Oscilloscope	29
6.2	Vertical Controls	30
6.3	Position and Volts per Division	31
6.4	Bandwidth Limit	32
6.5	Channel Invert	32
6.6	Alternate and Chop Display	32
6.7	References:	33
7.	OPERATION OF AN OSCILLOSCOPE	34
7.0	Abstract:	34
7.1	Math Operations	34

7.2	Display Controls	35
7.3	Horizontal Controls.....	35
7.4	Position and Seconds per Division	36
7.5	Time Base Selections	37
7.6	Trigger Position	37
7.7	Magnification	38
7.8	XY Mode.....	38
7.9	References:	38
8.	MEASUREMENT TECHNIQUES	39
8.0	Abstract:	39
8.1	Oscilloscopes display	39
8.2	Voltage Measurements	40
8.3	Time and Frequency Measurements	43
8.4	Pulse and Rise Time Measurements.....	44
8.5	Phase Shift Measurements.....	44
8.6	References:	46
9.	RESISTOR COLOR CODES	47
9.0	Abstract:	47
9.1	Introductory Information:.....	47
9.2	First the code	47
9.3	The mnemonic	48
9.4	How to read the code	48
9.4.1	Zero-ohm resistor	49
9.4.2	Rheostat	50
9.4.3	Potentiometer	50
9.5	References:	51
10.	SOLDERING IRON PRACTICE.....	52
10.0	Abstract:	52
10.1	Introduction:	52

10.2	Tools Needed:	53
10.2.1	Soldering Iron	53
10.2.2	The tip of iron	53
10.2.3	Soldering iron stand	54
10.2.4	Solder	54
10.2.5	Solder pump	54
10.3	Safety Precautions:	55
10.4	References:	55
11.	PROCEDURE OF SOLDERING IRON PRACTICE	56
11.0	Abstract:	56
11.1	Handling of soldering iron:	56
1.	Keep the iron in place	58
2.	First, pull the solder away	58
11.2	References:	59
12.	OHM'S LAW	60
12.0	Abstract:	60
12.1	Basic concepts:	60
12.2	Performing experiment of Ohm's law	61
12.3	References:	61
13.	USING THE MULTI-METER FOR OHM'S LAW:	62
13.0	Abstract:	62
13.1	Measuring the voltage across a resistor	62
13.2	Experimental set up	63
13.3	Exercise	64
13.4	References	64
14.	VOLTAGE DIVIDER RULE (VDR)	65
14.0	Abstract:	65
14.1	Basic concepts:	65
14.2	Equipment and materials required are as follows:	65

14.3	Conclusion.....	68
14.4	References:.....	68
15.	COMMON EMITTER AMPLIFIER WITH FIXED BIAS	69
15.0	Abstract:.....	69
15.1	Introduction	69
15.2	Experimental setup	70
15.3	Merits:	73
15.4	Demerits:	73
15.5	Usage:	74
15.6	References:	74
16.	COMMON EMITTER AMPLIFIER WITH SELF BIAS.....	75
16.0	Abstract:	75
16.1	Basic Circuit:	75
16.2	Bias Design:	76
16.3	Merits	76
16.4	Mathematical Approach	77
16.5	References:	77
17.	COMMON COLLECTOR TRANSISTOR AMPLIFIER	78
17.0	Abstract:	78
17.1	Introduction:	78
17.2	Parts and equipment:.....	78
17.3	Experimental setup	79
17.4	Results and measurements:	79
17.5	References:	81
18.	DARLINGTON COMMON EMITTER.....	82
18.0	Abstract:	82
18.1	Experimental setup:	83
18.2	Biasing Design:.....	84
18.3	Design of R1& R2:	84

18.4	Tabular column:.....	84
18.5	Calculation:	85
18.6	Procedure:.....	85
18.7	Result:	86
18.8	References:	86
19.	CLASS-A AMPLIFIER	87
19.0	Abstract:	87
19.1	Apparatus Required	87
19.2	Bias design:	88
19.3	DESIGN OF R1 & R2:	88
19.4	Tabular column:.....	89
19.5	Theory:.....	90
19.6	Procedure:.....	90
19.7	Result:	91
19.8	References:	91
20.	CLASS – B POWER AMPLIFIER.....	92
20.0	Abstract:	92
20.1	Apparatus Required:	92
20.2	Theory:	93
20.3	Procedure:.....	93
20.4	Tabular column:.....	95
20.5	Formula:	96
20.6	Result:	96
20.7	References:	96
21.	VOLTAGE FOLLOWER.....	97
21.0	Abstract:	97
21.1	VOLTAGE FOLLOWER	97
21.2	Experiment:	98
21.3	Tabular column:.....	99

21.4	Formula:	99
21.5	References:	100
22.	INVERTING AMPLIFIER	101
22.0	Abstract:	101
22.1	Inverting amplifier:	101
22.2	EXPERIMENT:	102
22.3	References:	104
23.	SUMMING AMPLIFIER	105
23.0	Abstract:	105
23.1	Summing amplifier:	105
23.2	EXPERIMENT	107
23.3	References:	107
24.	SUBTRACTOR OR DIFFERENTIAL AMPLIFIER	108
24.0	Abstract:	108
24.1	Differential amplifier:	108
24.2	EXPERIMENT:	110
24.3	References:	110
25.	INTEGRATOR	111
25.0	Abstract:	111
25.1	INTEGRATOR	111
25.2	EXPERIMENT:	114
25.3	References:	114
26.	DIFFERENTIATOR	115
26.0	Abstract:	115
26.1	Description:	115
26.2	EXPERIMENT:	117
26.3	References:	120
27.	COMPARATOR	121
27.0	Abstract:	121

27.1	Description	121
27.2	References:	122
28.	ACTIVE LOW PASS FILTER.....	123
28.0	Abstract:	123
28.1	Description:	123
28.2	References:	128
29.	ACTIVE HIGH PASS FILTER.....	129
29.0	Abstract:	129
29.1	Description:	129
29.2	References:	135
30.	ACTIVE BAND PASS FILTER.....	136
30.0	Abstract:	136
30.1	Description:	136
30.2	Resonant Frequency	139
30.3	References:	141

4. SIGNALS

Asadullah Shah and Mohamad Sagir

Department of Computer Science, Kulliyyah of Information and
Communication Technology,
International Islamic University of Malaysia,
Malaysia

4.0 Abstract

Signals are electrical, electromagnetic and can be pressure signals. Signals exist in nature and can be transformed for processing purpose to understand some attributes and characteristics of signals. There are simple signals called pulses or can be step signal and they are used to be applied for very simple systems to operate upon. There are three things most commonly available in all the signals; these are amplitude, frequency, wavelength to characterize the signals of any type. There are three other attributes such as phase, magnitude and spectrum of the signals. In this lab some common measurement of the attributes of the signals is provided so that the beginners in the subject area can build there conceptual knowledge for the courses at advance level in their studies.

4.1 Step and Pulse Shapes

Signals such as *steps* and *pulses* that only occur once are called *single-shot* or *transient* signals. The step indicates a sudden change in voltage, like what you would see if you turned on a power switch. The pulse indicates what you would see if you turned a power switch on and then off again. It might represent one bit of information traveling through a computer circuit or it might be a *glitch* (a defect) in a circuit.

A collection of pulses travelling together creates a *pulse train*. Digital