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A STUDY ON RADIO FREQUENCY TEST FACILITIES DEVELOPMENT
FOR CUBIC ELECTRONICS SDN. BHD.

NORAZURA BINTI MD. NOR

This Report is submitted in Partial Fulfillment of Requirements for Degree of Bachelor in
Electronic Engineering with honors (Industrial Electronic)

Fakulti Kejuruteraan Elektronik dan Kejuruteraan Komputer
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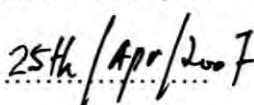
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“Saya akui bahawa telah membaca tesis ini dan pada pandangan saya tesis ini memadai dari skop dan kualiti untuk tujuan penganugerahan ijazah Sarjana Muda Kejuruteraan Elektronik dan Kejuruteraan Komputer (Elektronik Industri)”

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Special dedicated to my beloved parents, family and fellow friends, who had strongly encouraged and supported me in my entire journey of learning.

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ABSTRACT

The growth of the mobile communications market is clearly in the newer digital wireless products. Every manufacturer of new products is significant to improved transmission quality, accessibility, security, and operating time. In order to improve these things, Cubic Electronic Sdn Bhd must ensure that Minimo M2 multimedia Handphone meet the standard required before launch in marketing. With the aim to meet standard regulation, Cubic Electronic Sdn Bhd CESB should measure the product performance. There are various types of test equipment available in the market such as spectrum analyzer, signal generator and test set. However, this study will focus on Rohde & Schwarz CMU200 Universal Radio Communication Analyzer and Willtek 4400 Mobile Phone Tester applications. This study will introduce the process of mobile phone measurement and carry out acquired decision for comparison over two test equipment from different manufacturer. This study will show the performance comparison of selected test equipment in conducting process of measurement. The comparison made based on the Cubic Electronic Sdn Bhd requirement testing. In the same time, we refer to the specification from *European Telecommunications Standards Institute*, ETSI standard. This will also help the test system developer at Cubic Electronic Sdn Bhd to select the suitable RF test system.

ABSTRAK

Pertumbuhan pasaran komunikasi semakin berkembang dengan pesat terutamanya pengeluaran produk-produk wayarles baru termasuklah telefon bimbit. Adalah penting bagi setiap pengeluar untuk meningkatkan kualiti transmisi, kebolehcapaian, keselamatan, dan masa operasi bagi sesebuah produk baru yang dihasilkan. Oleh yang demikian, Cubic Electronic Sdn Bhd, CESB perlu memastikan produk Minimo M2 Multimedia Handphone telah menepati piawai yang telah ditetapkan sebelum di pasarkan. Sebagai langkah untuk memenuhi ketetapan piawai, Cubic Electronic Sdn Bhd, CESB perlu mengukur prestasi produk tersebut. Terdapat pelbagai peralatan pengukuran yang berada dipasaran untuk mengukur prestasi telefon bimbit seperti Penganalisa Spektrum, Penjana Signal dan Set Pengujian. Namun begitu, kajian ini hanya menumpukan perhatian terhadap *Rohde & Schwarz CMU200 Universal Radio Communication Analyzer* dan juga alat pengujian telefon bimbit Willtek 4400. Kajian ini akan memperkenalkan langkah-langkah untuk membuat pengujian terhadap telefon bimbit dan menjalankan perbandingan keputusan yang diperolehi melalui dua jenis alat pengujian dari pengeluar yang berbeza. Kajian ini akan menunjukkan bagaimana perbandingan prestasi bagi dua alat pengujian yang terpilih di dalam menjalankan proses pengujian. Faktor-faktor yang akan di ambil kira di dalam proses perbandingan adalah berdasarkan keperluan pengujian yang dikehendaki oleh Cubic Electronic Sdn Bhd dan dalam masa yang sama memenuhi ketetapan yang disediakan di dalam piawaian *European Telecommunications Standards Institute*, ETSI. Ini juga akan membantu pereka sistem ujian Cubic Electronic Sdn Bhd untuk membuat pemilihan sistem ujian Signal Radio yang bersesuaian.

LIST OF CONTENTS

CHAPTER	TITLE	PAGE
	PROJECT TITLE	i
	DECLARATION	ii
	DEDICATION	vi
	ACKNOWLEDGEMENT	vii
	ABSTRACT	viii
	ABSTRAK	ix
	LIST OF CONTENTS	x
	LIST OF TABLES	xiii
	LIST OF FIGURES	xvi
	LIST OF ABBREVIATION	xviii
	LIST OF APPENDICES	xx
I	INTRODUCTION	
	1.1 Introduction	1
	1.2 Objective	4
	1.3 Scope Of Project	4
	1.4 Problem Statements	4
II	LITERATURE REVIEW	
	2.1 Background	6
	2.2 Validation Study	9
	2.2.1 Element Of Process Validation	10
	2.3 Product To Test	12

2.4	Parameter To Test	12
2.3.1	In Channel Measurement	13
2.3.2	Out of Channel	21
2.3.3	Out of Band	21
2.3.4	Receiver Test	21
2.5	Hardware And Software Requirement	22
2.5.1	Universal Radio Communication Tester CMU200	24
2.5.2	4400 Mobile Phone Tester	25
2.5.3	4920 RF Shield Box	26
2.6	Calibration	27
2.6.1	Benefit Of Calibration	28

III PROJECT METHODOLOGY

3.0	Project Methodology	30
3.1	Feature and Specification for consideration RF Test Equipment	32

IV IMPLEMENTATION

4.1	Pre Production Test	36
4.2	Test Location	37
4.3	Test Procedure	38
4.3.1	Test Setup	40

V RESULT AND ANALYSIS

5.1	Result	47
5.2	Analysis Result	54

VI CONCLUSION AND RECOMMENDATION

6.1	Conclusion	62
6.2	Recommendation	63
	REFERENCE	64
	APPENDIX A	69
	APPENDIX B	70
	APPENDIX C	71
	APPENDIX D	72
	APPENDIX E	73
	APPENDIX F	75
	APPENDIX G	79
	APPENDIX H	80
	APPENDIX I	83
	APPENDIX J	86
	APPENDIX K	89
	APPENDIX L	91
	APPENDIX M	93
	APPENDIX N	95
	APPENDIX O	97
	APPENDIX P	98
	APPENDIX Q	109
	APPENDIX R	112
	APPENDIX S	113
	APPENDIX T	115
	APPENDIX U	117

LIST OF TABLES

NO	TITLE	PAGE
2.1	Maximum output power	15
2.2	Extreme voltage specification	20
3.1.1	Frequency bands for GSM900 and DCS1800 Base Station Systems	34
3.1.2	Channel Numbering: Frequencies are in MHz	34
3.1.3	Definition of micro-BTS Power Classes	35
H.1	Test result transmit power using Rohde & Schwarz CMU200 at Channel 1	80
H.2	Test result transmit power using Willtek 4400 Tester at Channel 1	80
H.3	Test result transmit power using Rohde & Schwarz CMU200 at Channel 62	81
H.4	Test result transmit power using Willtek 4400 Tester at Channel 62	81
H.5	Test result transmit power using Rohde & Schwarz CMU200 at Channel 124	82
H.6	Test result transmit power using Willtek 4400 Tester at Channel 124	82
I.1	Test Result Peak Phase Error using Rohde & Schwarz CMU200 at Channel 1	83
I.2	Test Result Peak Phase Error using Willtek 4400 Tester at Channel 1	83

I.3	Test Result Peak Phase Error using Rohde & CMU200 at Channel 62	84
I.4	Test Result Peak Phase Error using Willtek 4400 Tester at Channel 62	84
I.5	Test Result Peak Phase Error using Rohde & Schwarz CMU200 at Channel 124	85
I.6	Test Result Peak Phase Error using Willtek 4400 Tester at Channel 124	85
J.1	Test Result RMS Phase Error using Rohde & Schwarz CMU200 at Channel 1	86
J.2	Test Result Peak Phase Error using Willtek 4400 Tester at Channel 1	86
J.3	Test Result RMS Phase Error using Rohde & Schwarz CMU200 at Channel 62	87
J.4	Test Result Peak Phase Error using Willtek 4400 Tester at Channel 62	87
J.5	Test Result RMS Phase Error using Rohde & Schwarz CMU200 at Channel 124	88
J.6	Test Result RMS Phase Error using Willtek 4400 Tester at Channel 124	88
K.1	Test Result Transmit Power for tenth sample at Channel 1	89
K.2	Test Result Transmit Power for tenth sample at Channel 62	89
K.3	Test Result Transmit Power for tenth sample at Channel 124	90
L.1	Test Result Frequency Error for tenth sample at Channel 1	91
L.2	Test Result Frequency Error for tenth sample at Channel 62	91
L.3	Test Result Frequency Error for tenth sample at Channel 124	92
M.1	Test Result Peak Phase Error for tenth sample at Channel 1	93

M.2	Test Result Peak Phase Error for tenth sample at Channel 62	93
M.3	Test Result Peak Phase Error for tenth sample at Channel 124	94
N.1	Test Result RMS Phase Error for tenth sample at Channel 1	95
N.2	Test Result RMS Phase Error for tenth sample at Channel 62	95
N.3	Test Result RMS Phase Error for tenth sample at Channel 124	96

LIST OF FIGURES

NO	TITLE	PAGE
1	Radio Frequency	12
2.1	Minimo M2 Mobile Phone	16
2.2	Phase Error	17
2.3	Frequency Error	25
2.4.1	Universal Radio Communication Tester	26
2.4.2	Willtek 4400 Mobile Phone Tester	27
2.4.3	4290 RF Shield Box	29
3.1	Process of developing Test Facilities	32
4.1	Final Assembly Line	38
4.2	Radio Frequency Functional Test	38
4.3	RF cable connection with Shielded Box	39
4.4	RF Cable Connection	40
4.5	Air connection with Antenna Coupler	40
4.6	Single Measurement	41
4.7	Process of installing software (CMUgo or Luxcor)	42
4.8.1	Setting the Test Specification	42
4.8.2	Setting the GSM900 Connection Control	43
4.8.3	Check the Connection Control	43
4.8.4	Basic Measurement using Luxcor	44
4.8.5	Setting the Mobile Phone Parameter	44
4.8.6	Setting of the RF Output	45
4.8.7	Set the Upper GSM band	45
4.9	Checking the coupling loss	46

4.1	Insert DUT in RF Shield Box	46
4.11	Close the RF Shield Box	47
5.1	Average Power using CMU200	48
5.2	Average Power using Willtek 4400	48
5.3	Average Power DUT 1 using CMU200	49
5.4	Average Power DUT 1 using Willtek 4400	49
5.5	Comparison in Average Power Measurement	50
5.6	Frequency Error using CMU200	50
5.7	Frequency Error using Willtek 4400	51
5.8	Comparison for Frequency Error DUT 1	51
5.9	RMS Phase Error using CMU200	52
5.10	RMS Phase Error using Willtek	52
5.11	Peak Phase Error using CMU200	53
5.12	Peak Phase Error using Willtek	53
5.13	Spectrum due to Switching using CMU200 and 4400	54
5.14	Average Power Measurement at Channel 1	57
5.15	Average Power Measurement at Channel 62	57
5.16	Average Power Measurement at Channel 124	58
5.17	Level Range of Tester	59
5.18	Level Accuracy of tester	60
5.19	Measurement Speed of tester	61
B.1	Transmit Power PCL	72
C.1	Power versus Time Measurement	73
E.1	Bit Error Rate Measurement Flow	74
E.2	Receiver Quality	75
F.1	Modulation Measurement	76
F.2	Spectrum due to Modulation	78
F.3	Spectrum due to Switching	79
F.4	Combined Spectrum Measurement	79

LIST OF ABBREVIATION

AMPS	-	Advanced Mobile Phone Service
ARFCN	-	Absolute Radio Frequency Channel Number
BA	-	BCCH Allocation
BCCH	-	Broadcast Control Channel
BCH	-	Broadcast Channel
BER	-	Bit Error Rate
BTS	-	Base Transceiver Station
BSS	-	Base Station Simulator
CCCH	-	Common Control Channel
CCH	-	Control Channel
CDMA	-	Spread spectrum Code Division Multiple Access
CESB	-	Cubic Electronic Sdn Bhd
DUT	-	Device Under Test
ETSI	-	European Telecommunication Standard Institute
FER	-	Frame Erasure Ratio
GSM	-	Global System for Mobile communications
IMEI	-	International Mobile station Equipment Identity
ITU	-	International Telecommunications Union
ME	-	Mobile Entity
MS	-	GSM Mobile Station
PCH	-	Paging Channel
PCN	-	Personal Communications Networks
PCS	-	Personal Communications Systems
RF	-	Radio Frequency
RMS	-	Root Mean Square (value)
RXLEV	-	Receive Level

RXQUAL	-	Receive Quality
SACCH	-	Slow Associated Control Channel
SCH	-	Synchronization Channel
SDCCH	-	Stand-alone Dedicated Control Channel
SIM	-	Subscriber Identity Module
SMS	-	Short Message Service
SS	-	System Simulator
TCH	-	Traffic Channel
TCH/FS	-	Full rate Traffic Channel for Speech
TCH/HS	-	Half rate Traffic Channel for Speech
TDMA	-	Time Division Multiple Access
TE	-	Terminal equipment
TI	-	Transaction Identifier
TMSI	-	Temporary Mobile Subscriber Identity
TN	-	Timeslot Number
TON	-	Type of Number
TSC	-	Traffic Synch Channel

LIST OF APPENDICES

NO	TITLE	PAGE
A.	Reference Letter from CESB	69
B.	Measuring Transmit Power	70
C.	Measuring Power versus Time	71
D.	Measuring Phase and Frequency Error	72
E.	Measuring Bit Error	73
F.	Measuring Output Radio Frequency Spectrum	75
G.	Measuring IQ Tuning	79
H.	Result Transmit Power for tenth test	80
I.	Test Result Peak Phase Error for tenth test	83
J.	Test Result RMS Phase Error for tenth test	86
K.	Test Result Transmit Power for tenth sample	89
L.	Test Result Frequency Error for tenth sample	91
M.	Test Result Peak Phase Error for tenth sample	93
N.	Test Result Peak Phase Error for tenth sample	95
O.	Rohde & Schwarz Customer List in Malaysia	97
P.	Rohde & Schwarz CMU200 Specification	98
Q.	Willtek 4400 Mobile Phone Tester Specification	109
R.	Email from Mr Sik Chong Weai	112
S. 1	Email from Rohde & Schwarz Sales Engineer	113
S. 2	Email from Rohde & Schwarz Sales Engineer	114
T.	Email from Willtek Communication Sales Engineer	116
U.	Discussion Session at CESB	117

CHAPTER I

INTRODUCTION

Radio Frequency (RF) test is becoming a production bottleneck as the complexity of the RF devices increase to satisfy demanding performance requirements. The most important factor that contributes to the RF test cost is the long test times and complex test equipment that are required to perform various performance characterizations. This chapter briefly explains about project detail.

1.1 Introduction

Radio frequency (RF) energy is another name for radio waves. It is one form of electromagnetic energy that makes up the electromagnetic spectrum as shown in figure 1.

Some of the other forms of energy in the electromagnetic spectrum are gamma rays, X-rays, and light. Electromagnetic energy (or electromagnetic radiation) consists of waves of electric and magnetic energy moving together (radiating) through space. The area where these waves are found is called an electromagnetic field [1][2][3].

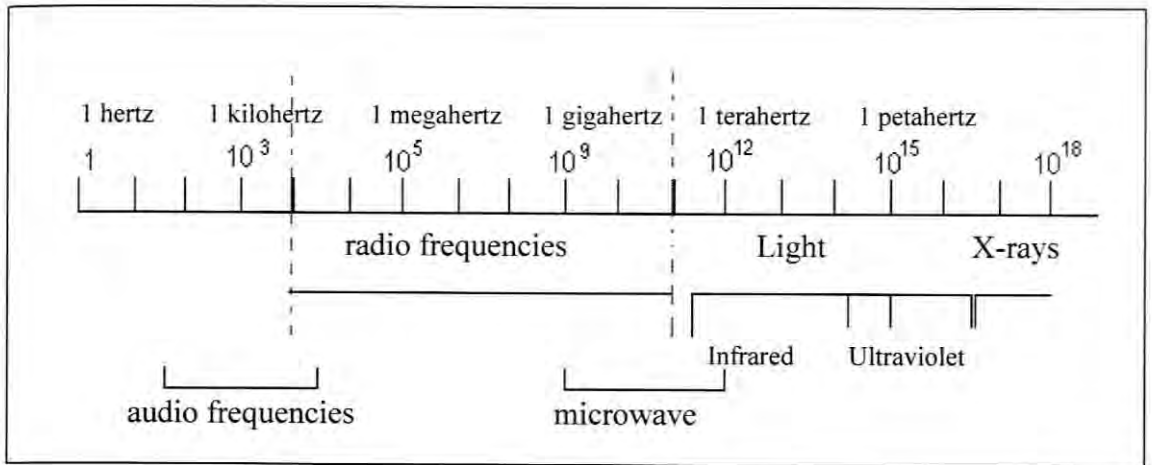


Figure 1: Radio Frequency

Radio frequencies are created due to the movement of electrical charges in antennas. As they are created, these waves radiate away from the antenna. All electromagnetic waves travel at the speed of light. The major differences between the different types of waves are the distances covered by one cycle of the wave and the number of waves that pass a certain point during a set time period. The wavelength is the distance covered by one cycle of a wave. The frequency is the number of waves passing a given point in one second. For any electromagnetic wave, the wavelength multiplied by the frequency equals the speed of light. The frequency of an RF signal is usually expressed in units called hertz (Hz). One Hz equals one wave per second. One kilohertz (kHz) equals one thousand waves per second, one megahertz (MHz) equals one million waves per second, and one gigahertz (GHz) equals one billion waves per second [1][2][3].

Radio frequency (RF) energy includes waves with frequencies ranging from about 3000 waves per second (3 kHz) to 300 billion waves per second (300 GHz) [1][2][3]. Microwaves are a subset of radio waves that have frequencies ranging from around 300 million waves per second (300 MHz) to three billion waves per second (3 GHz). Almost certainly the primary use of Radio Frequency energy is for telecommunications. Radio and television broadcasting, wireless phones, pagers, cordless phones, police and fire department radios, point-to-point links, and satellite communications all rely on Radio Frequency energy [4][5][6].

Radio frequency measurement is the precise measurement of frequencies above the audible range by any of various techniques, such as a calibrated oscillator with some means of comparison with the unknown frequency, a digital counting or scaling device which measures the total number of events occurring during a given time interval, or an electronic circuit for producing a direct current proportional to the frequency of its input signal [11].

As wireless communication base stations and transceivers become more highly integrated, it becomes more difficult to isolate the testing of the digital subsystem from that of the analog/radio frequency (RF) subsystem. In the past, the digital and RF subsystems might have been separate modules that could be tested individually before being assembled and tested as a complete system. Now, it is likely that portions of the digital and RF subsystems share a single circuit board. The migration of Radio Frequency (RF) communication systems to digital modulation poses additional challenges for RF testing. Some of the measurements and parameters that describe the performance of RF components in a system using analog modulation are not suitable for use with digitally modulated signals. System level RF tests may require a realistic digitally modulated test stimulus in order to maximize the correlation of test results with field performance. It may also be necessary to establish the relationships between system-level performance specifications and circuit-level design parameters in order to set test limits accurately for systems and components that use digitally modulated signals [13].

There are over one hundred performance tests for RF transceivers, many of which are quite complex and require long test times [14]. To reduce the cost of testing RF devices, it is desired to compact the long test list into a smaller list which provides the same coverage. Fortunately, the performance parameters of a module are interrelated, obviating the need to test the complete set of performance parameters. However, the determination and optimization of the tests that require measuring a subset of specification parameters while ensuring the product quality may be challenging. The optimum test set for a system generation may not be the optimum for another due to the distinct characteristics of these systems. Therefore, product-specific architectural and behavioral characteristics should be utilized to