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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

Universiti Teknikal Malaysia Melaka

April 2007

UNIVERSTI TEKNIKAL MALAYSIA MELAKA
FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

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Tajuk Projek : **A STUDY ON RF TEST FACILITIES DEVELOPMENT FOR CESB**

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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.

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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

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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].

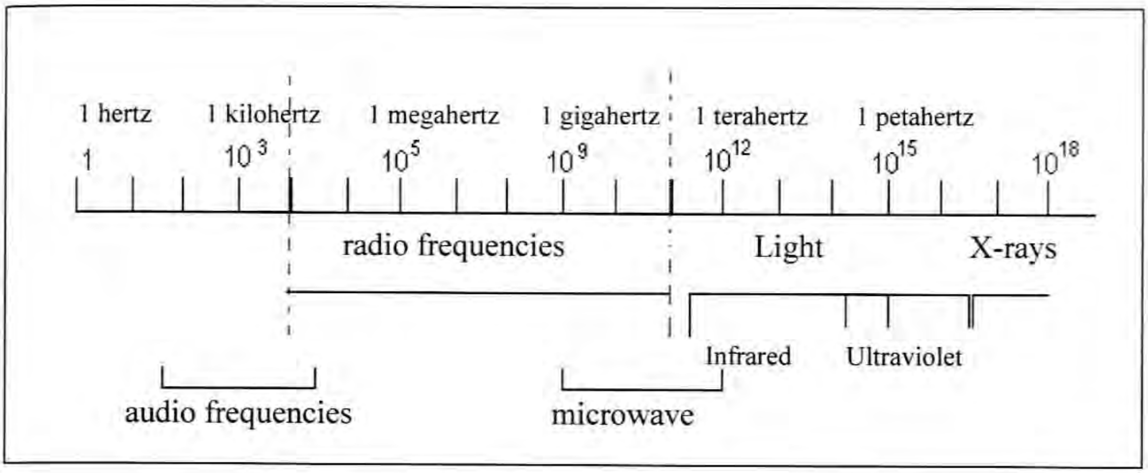

Figure 1: Radio Frequency

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