

**DEVELOPMENT AN AM RADIO BOARD
FOR LABWORK BENG 2413**

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POWER ELECTRONICS AND DRIVES

APRIL 2009

“I hereby declare that I have read through this report and found that it has comply the partial fulfillment for awarding the degree of Bachelor Electrical Engineering (Power Electronics and Drives)”

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**A report submitted in partial fulfillment of requirements for the degree of Bachelor
In Electrical Engineering (Power Electronic and Drive)**

**Fakulti Kejuruteraan Elektrik
UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

April 2009

“I hereby declare that this report is a result of my own work except for the excerpts that have been cited clearly in the references”

Signature :
Name : Siti Suhaila Binti Salehan
Date :

To my parents, my brothers and sisters, my friends, and my lover.

ACKNOWLEDGEMENT

First of all, I am grateful because I was given a chance to take part in this project. This is a wonderful opportunity for me to use my skills in both the programming and hardware area.

In this segment, I wanted to thank my project supervisor, Mr. Hyreil Anuar Bin Kasdirin for allowing me to do this project. He had given me some idea on how to do our project and also in writing this report. He also had given me ideas in completing this project. Through his guidance, I was able to complete this project as expected.

And for the person that I forgot to mention in this segment, I would like to say a big thank you for you all. Without the support and help that you all gave me, this project would not be so fast accomplished.

ABSTRACT

This project explains the design and develop an AM radio board trainer that be used for students for practical work of BENG 2413. The finish product design of the project could be used for the student to have better understanding regarding the fundamental theory as well as practical work of the subject. At present, the FKE did not served an AM radio board trainer which can be used by student for practical work of BENG 2413. So, this project will be developed with some improvement where, some application of this trainer can be controller by PC. The main objective of this project is to develop an AM radio board as a Computer Based Trainer (CBT) at FKE. This project consists of an AM radio receiver circuit where it's include 5 stage; tuner, RF amplifier, detector, audio amplifier and speaker. Visual Basic 6.0 software is used as PC Graphical User Interface (GUI) and Serial Port RS232 is used as an interface between PC and AM radio board. An AM radio board will be develop and design as a CBT that be used for FKE's students for practical work of BENG 2413.

ABSTRAK

Projek ini menerangkan rekabentuk dan penghasilan *AM radio board trainer* yang boleh digunakan oleh pelajar untuk kerja amali BENG 2413. Hasil rekabentuk projek ini, pelajar dapat lebih memahami teori dan kerja amali berkaitan dengan matapelajaran ini. Pada ketika ini, FKE tidak menyediakan *AM radio board trainer* yang boleh digunakan oleh pelajar untuk melaksanakan kerja amali BENG 2413. Oleh itu, projek ini dibangunkan dengan beberapa penambahbaikan di mana sesetengah aplikasi pada *trainer* boleh dikawal oleh PC. Objektif utama projek ini adalah menghasilkan *AM radio board trainer* sebagai *Computer Based Trainer (CBT)*. Projek ini mengandungi litar Penerima AM Radio dimana ia mengandungi 5 peringkat iaitu penala, penguat isyarat radio, pengesan, penguat audio dan alat pembesar suara digunakan dalam projek ini. Dalam projek ini, perisian Visual Basic 6.0 digunakan sebagai *Graphical User Interface (GUI)*. Masukan sesiri RS232 dan pemacu sesiri MAX 232 digunakan sebagai penghubung diantara komputer dan perkakasan. Penghasilan *AM radio board trainer* ini sebagai CBT dapat digunakan oleh pelajar-pelajar FKE untuk kerja amali BENG 2413.

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LIST OF SYMBOL

AC	Alternating Current
AM	Amplitude Modulation
CB	Citizens Band
CBT	Computer Based Trainer
DC	Direct Current
DCE	Data Communication Equipment
GUI	Graphical User Interface
PC	Personal Computer
PCB	Print Circuit Board
PIC	Peripheral Interface Controller
RF	Radio Frequency
TRF	Tuned Radio Frequency
VR	Variable Resistor

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CHAPTER 1

INTRODUCTION

1.0 Introduction

An AM radio board trainer is a device or trainer that it is developed as Computer Based Trainer (CBT). The development of this trainer could be used for student to have better understanding regarding the fundamental theory of BENG subject by practical work. The combination between fundamental theory and practical work during lab section give student easier to understand the subject through comparison between both.

In this project, there are 3 main parts to be include that is hardware and software part and also integration between both. The hardware part is divided by AM Radio Transmitter (AM Modulation), AM Radio Receiver (Demodulator circuit) and integration circuit. Meanwhile, software part is focus on design Graphical User Interface and also simulation process. The interface between PC and hardware is completed by serial port RS 232 and serial driver MAX 232.

The development of an AM radio is present as an example of measurement product. The difficulties according in such a process development of this project are discussed; possible method and troubleshooting to overcome these problems are proposed and used.

1.6 Objectives of the project

The development of this project is to archive the following objectives:

- i. To develop an AM radio board trainer as a Computer Based Trainer (CBT).
- ii. The product development of this project can be used for the student to have better understanding regarding the fundamental theory of BENG subject.
- iii. To design Graphical User Interface (GUI) using Visual Basic software to give more understanding and explore the function of an AM radio.

1.7 Problem Statement

An Amplitude modulation (AM) topic is including in subject communication (BENG 2413). Suitable equipment or trainer is needed in order to help student learn and understand overall about an AM topic by practical work. At present, an AM radio trainer is not exists at Faculty of Electrical Engineering (FKE) which can be implementing by student for practical work in subject communication. So, this project is focus to develop and design an AM radio board for labwork of BENG 2413 which some improvement. The advantages of this trainer to another trainer that already exist at market are:

- i. This trainer has two functions as AM modulation and AM radio receiver (demodulator) at the same board.
- ii. The trainer is Computer Based Trainer (CBT) which it is interface between hardware part and PC through Visual Basic software.
- iii. The trainer have speaker at the output part. Student can observed the output waveform by oscilloscope and also listen the AM frequency through the speaker.

1.8 Scope of the Project

For this project, new AM radio board panels as a Computer Based Trainer (CBT) will be developed. The trainer will be implementing by student for labwork of BENG 2413. The AM radio board used a basic an AM radio circuit which is consists of 5 stage; tuner, RF amplifier, detector, audio amplifier and speaker. It uses Visual Basic 6.0 software to control the AM frequency on the AM radio board. The AM radio board will be interface to PC using RS-232 cable. The data from PC will be transmitting to the controller MAX 232 using RS 232 cable. The AM radio board consists of speaker to listen the AM radio frequency and the output can be observed by using oscilloscope.

The project final result;

At the end of this project, an AM radio board panel as a Computer Based Trainer (CBT) had been designed. For this purpose, the AM radio board is able to interface to PC and control the AM radio frequency using by PC with Visual Basic 6.0 software. As an AM radio circuit on AM radio board panel, it needs to be function and the output frequency will be observe using by oscilloscope to make student easier to study and understand the AM radio topic.

The scope of this project:

- i. For this project, a new AM radio board panel as a Computer Based Trainer (CBT).
- ii. It uses Visual Basic 6.0 software to design Graphical User Interface (GUI).
- iii. The AM radio board will be interfaces to PC using serial port RS-232 cable and the data will be transmitting to the controller MAX 232 through it.
- iv. The speaker is adding at the output part. The output waveform can observed by oscilloscope and listen the AM frequency by speaker.

1.9 Organization of the Report

This thesis is divided into 5 chapters. Each of the following paragraphs generally described the contents of each chapter.

Chapter 1 explained the objectives and problem statements of this project. It also consists of explanation the scope of this project.

Chapter 2 gives general description and overview of the theory of AM radio operation, software development and interface device. Some of literature review on AM radio trainer such as application, and advantages is also discussed in this chapter.

Chapter 3 discussed the process development of this project. The description of work plan, software and hardware used and also interface circuit. Part by part of hardware development is also briefly discussed in this chapter.

Chapter 4 shows the result, analysis and discussion of this project. Simulated and measurements result are analyzed before the analytical comparison take places.

Chapter 5 gives a summarized work and conclusion for overall of this project. Suggestion for future improvements and advancements of this project also discussed.

1.10 Summary

In this chapter objective, problem statement and scope of this chapter is discussed so that readers could have a better understand the general idea about this project. The theory and literature review will be discussed in the next chapter 2.

CHAPTER 2

THEORY AND LITERATURE REVIEW

2.0 Introduction

An AM radio trainer is device that is developed to studying process through practical work section. Combination of the fundamental theory and practical work is more efficiency in give student easier understands about the AM radio topic. In order to develop this project, it is necessary to have strong background knowledge and fundamental concepts and theory about the communication system. This chapter introduced some of these fundamental concepts and an idea about the AM radio trainer from previous design.

2.1 AM Radio Operation

A communication link consists of three components: the transmitter, the channel, and the receiver. The transmitter element processes an information signal in order to produce a signal most likely to pass reliably and efficiently through the channel. This usually involves coding of the information signal to help correct for transmission errors, filtering of the signal to constrain the occupied bandwidth, modulation of a carrier signal by the information signal, and power amplification to overcome channel losses.

The transmission channel is loosely defined as the propagating medium or electromagnetic path between source and destination, for example cable, optical fiber, or atmosphere. The channel, in wireless communication, is the atmosphere which may add attenuation, delay, distortion, interference, and noise to the transmitted signal.

The receiver function is principally to reverse the modulation processing of the transmitter in order to recover the transmitted information signal, and attempts to compensate for any signal degradation introduced by the channel. This will normally involve amplification, filtering, demodulation, and decoding and in general is a more complex task than the transmit process.

2.1.1 Principle of Amplitude Modulation

Amplitude modulation is one of the earliest methods for transmitting a signal over a distance. Audio frequencies range from 0 to 20KHz but these frequencies do not radiate off metal antennas as well as radio frequencies (RF) in the high KHz range. So a RF oscillator is used to create the carrier frequency that is subsequently amplitude modulated with the audio, hence the name AM. The receiver is responsible for tuning in a station then demodulating the signal simply by extracting the audio from the carrier.

The amplitude of the signal is basically the vertical lengths of a sinusoidal and the amplitude can be changed by modulating the audio onto the carrier over time. The figure 2.1 below show demonstrates this concept. A signal can be understood in time domain or frequency domain. The figure 2.1 below is in the time domain because it shows a sinusoidal over time and the modulated signal has changing amplitudes over time.

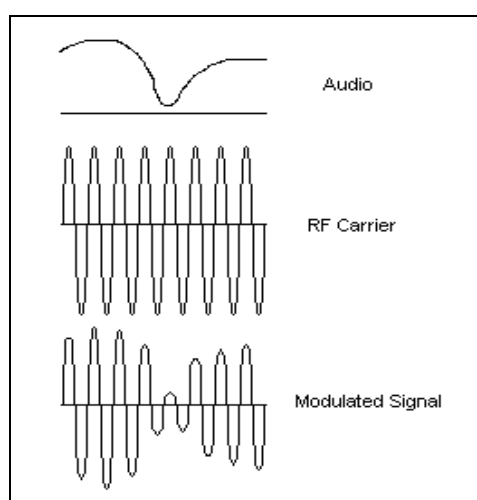


Figure 2.1: AM Generation

Amplitude modulation is a relatively inexpensive, low-quality form of modulation that is used for commercial broadcasting of both audio and video signal. Amplitude modulation is also used for two-way mobile radio communications such as citizens band (CB) radio.

2.1.2 Tuned Radio-Frequency Receiver

The Tuned Radio Frequency (TRF) radio receiver is one of the oldest receiver designs that was popular in the 1910s to 20s. The basic idea was to simply use a LC tuner to select a station, but there are many problems with this approach. At the time, triodes did not have very good amplification gain so several amplification stages were needed. Second, as mentioned earlier the LC circuit in practice is generally a broad bandpass filter and will pass through a few adjacent stations as demonstrated in the animation show in figure 2.2 below:

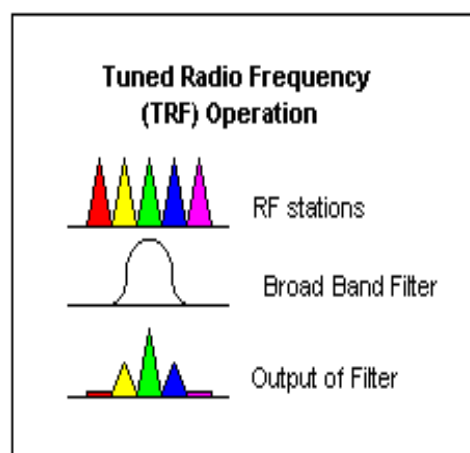


Figure 2.2: Tuned Radio Frequency (TRF) Operation

TRF receivers are probably the simplest designed radio receiver available today. Figure 2.3 shows the block diagram of three stage of TRF receiver that includes RF stage, a detector stage, and an audio stage. RF amplifier required to filter and amplify a receiver signal to a level sufficient to drive the detector stage. The detector converts RF signals directly to information signal. Audio stage amplifies the information signals to a usable level.

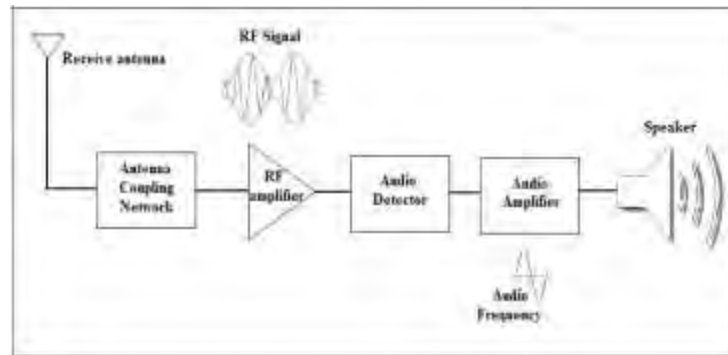


Figure 2.3: Radio frequency receiver block diagram

2.1.3 Demodulator

The earliest radio receiver was simply made with an antenna, a detector and earphones. The detector serves the purpose of extracting the audio from the modulated carrier and often does so by allowing current only in one direction. The diode is the simplest device that allows current in one direction. However, only allowing the positive edges of the modulated signal to pass through to the audio stage will produce high frequency noises and can be visualized in the following figure.

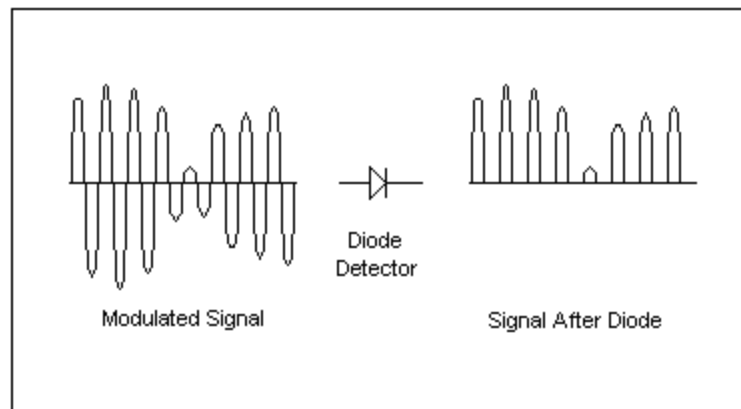


Figure 2.4: AM Demodulation

The most primitive crystal radios could function with just an antenna, a crystal, and the earphones because the construction of the earphone itself was a crude form of low pass filtering with capacitance between the windings of wire. But for improved quality, a low pass filter is used to suppress the high frequency noise. A capacitor and resistor is use on the