

DESIGN AND DEVELOP 3-WAY LOUDSPEAKER SYSTEM

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Dedicated to my beloved mother, Hajah Mek Ngah bt Mohamad, my father, Jusoh bin Abas, all my brothers and sisters and my friends whom support me to complete this project.

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ABSTRACT

The typical loudspeaker product is designed to make money and not necessarily to provide accurate sound reproduction. Since customers prefer small, unobtrusive speakers and judge sound quality by the amount of bass that they hear and by high frequencies they had not noticed before. There is a staggering number of essentially identical designs on the market that meet these requirements at different price.

In addition current loudspeaker system technology need a large amount of investment in drivers and enclosures. So the price usually become expensive and a large number of customers could not afford to buy the prestige and high quality loudspeaker system. Furthermore in addition to achieve great and accurate sound reproduction, most manufacturer begin to use high cost material such as Aluminium , Titanium & Diamond for the drivers.

For a 3-way loudspeaker which are designed perfectly, it is enough to cover the range of frequency from 20 Hertz until 20 KHertz. 3-way loudspeaker allows drivers to operate in more narrow, optimized ranges, eliminating the distortion that result from excessive driver excursion. Many advantages can be achieved especially decreasing the cost for research and production to build full range loudspeaker sound reproduction.

In this project the 3-way loudspeaker system was designed and developed successfully.

ABSTRAK

Kebanyakan pembesar suara yang boleh di dapati sekarang di buat hanya semata-mata untuk memperolehi keuntungan dan bukan untuk tujuan asalnya yang sebenar- iaitu menghasilkan bunyi yang mantap. Para pembeli pembesar suara masa kini lebih memilih pembesar suara yang bersaiz kecil, lebih menarik dan menilai kemampuan pembesar suara tersebut melalui kekuatan bunyi berfrekuensi rendah dan bukan pada bunyi berfrekuensi tinggi yang sebelum ini belum pernah mereka dengar, mengakibatkan kekurangan dalam keperluan untuk menghasilkan pembesar suara yang memiliki kelebihan sebegini dengan harga yang berbeza-beza.

Tambahan lagi, teknologi pembuatan pembesar suara masa kini memerlukan sumbangan modal yang agak besar lebih kepada komponen-komponen seperti pemacu dan kotak pembesar suara. Maka sudah tentu harganya semakin mahal hinggan pembeli tidak mampu untuk memiliki pembesar suara yang berprestij dan berteknologi tinggi. Tambahan lagi bagi mencakupi pembesar suara tersebut supaya mencapai keupayaan yang lebih baik, para pengeluar mula menggunakan bahan-bahan yang lebih mahal harganya seperti Aluminium, Titanium dan Berlian.

Bagi pembesar suara 3 arah yang dicipta dengan sempurna, ianya sudah cukup untuk merangkumi sambutan frekuensi antara 20Hertz hingga 20 KHertz. Sistem pembesar suara 3 arah membenarkan pemacu untuk berfungsi dalam julat frekuensi yang lebih kecil, dan lebih baik untuk mengelakkan berlakunya penghasilan bunyi yang tidak baik kerana pemacu tidak mampu untuk menghasilkan bunyi pada sambutan frekuensi yang tertentu. Banyak kelebihan akan di dapati terutamanya mengurangkan

kos pembuatan dan ujikaji tentang bagaimana untuk menghasilkan pembesar suara yang boleh merangkumi sambutan frekuensi sepenuhnya.

Di dalam projek ini direkabentuk dan prototaip pembesar suara 3 arah telah dihasilkan dengan jayanya.

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LIST OF SYMBOLS

V_{as}	Driver's compliance state as equivalent air volume
V_b	Net internal volume of enclosure
R_o	Internal resistance
Z_{max}	Total Driver's impedance
R_e	Driver's DC resistance
Z'	Reduced impedance
F_s	Driver's free air resonance
Q_{ms}	Mechanical value
Q_{es}	Electrical value
$Q_{ts}(Q)$	Total Q factor

LIST OF ABBREVIATIONS

AC	Alternating current
ACVM	Alternating current Voltmeter
DC	Direct current
HP	Hewlett Packard
FKE	Faculty of Engineering
IVAT	Institute of High Voltage and High Current
RM	Ringgit Malaysia
SPL	Sound Pressure Level
SNR	Sound to Noise Ratio
SSR	Steady State Response
THD	Total Harmonic Distortion
TSR	Time Selective Response

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CHAPTER 1

INTRODUCTION

1.1 Project's objective

The objectives of this project is to design and analyze the 3-way loudspeaker system with new enclosure design concept which changing from usual square shape enclosure into trapezoidal shape. There are also including 3-way crossover design to complete the 3-way loudspeaker system and some measurement of the loudspeaker's component by using acoustic laboratory's measurement instrument and anechoic chamber.

Before starting this project, several targets and goals have been set to achieve excellent performance with high fidelity 3-way loudspeaker system. The following are the goals for this project :

- a) To design and develop 3-Way Loudspeaker with nice looks and big size - new concept of design development which is trapezoidal shape
- b) Frequency Response coverage within 20Hz-20KHz range
- c) Low cost construction < RM 500
- d) Good low end bass which result in making a 3-way loudspeaker system

1.2 Project's background

This project mainly to develop and to design a 3-way loudspeaker system in different shape and construction technique with low cost to achieve or at least can be comparable to other same system with very high price and technology.

1.3 Scope of work

Based on the objectives of the project, several scopes have been decided to achieve all the objectives :

- a) Design 3-way loudspeaker to meet the objectives
- b) Construction
- c) Testing of loudspeaker prototype
- d) Analysis of testing result

1.4 Methodology

Below are the methodology to complete this project :

1.4.1 Decide loudspeaker component's parameter and purchasing

Study and set the component's parameters including the drivers to achieve optimum performance with less money.

1.4.2 Driver's parameter measurement

By using acoustic laboratory measurement's instrument, all the drivers will be measured to collect certain data which are important to design the 3-way loudspeaker's system.

1.4.3 System construction

Based on the 3-way loudspeaker component's parameter measurement result, the enclosure and 3-way crossover will be built and these items will be tested to make sure these items are suitable and possible to produce high performance of sound reproduction.

1.4.4 Performance measurement and analysis

Finally after the construction, several testing including the frequency response and audible testing to the finished 3-way loudspeaker system with comparison to another branded and high performance 3-way loudspeaker system.

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