DESIGN,CONSTRUCTION AND TESTING OF A WIRELESS T.V SENDER (500MHZ)

BY

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A PROJECT REPORT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF ENGINEERING (B. ENG.) DEGREE.

IN THE

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING, SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGERIA.

MARCH 2000.

DECLARATION

With solemn declaration I hereby declare whole heartedly that this project work was sincerely carried out by me under the supervision of Mr. Paul Attah. Department of Electrical/Computer Engineering, Federal University of Technology Minna. During 1998/1999 academic session.

YUSUF SALAWU

NAME

17/4/2000

Sign and Date

CERTIFICATION

This is to certify that this project titled "wireless T.V sender" was carried out be MR. SALAWU YUSUF under the supervision of Mr. Paul Attah and submitted to Electrical and Computer Engineering department, Federal University of Technology, Minna in partial fulfillment of the requirements for the award of Barchelor of Engineering (B.Eng.) degree in Electrical and Computer Engineering.

Mr. Paul Attah
Project supervisor

24/03/2000
Sign and Date

Eng. (Dr) Y.A. Adediran
Head of department

6/4/2000
Sign and Date

Dr. J.O. Oni
External Examiner.

15/4/2000
Sign and Date

DEDICATION

This project work is dedicated to Almighty Allah for providing and guiding me throughout my course of study.

It is also dedicated to my loving. Brother Mr. Y.A. Adeiza, my father Mallam Yusuf Anagbe and my other brothers and sisters who are all my supporters in the struggle for survival.

Finally, it is dedicated to the memory of my late mother Hajia Rekiya Yusuf.

ACKNOWLEDGEMENT

My gratitude goes to Almighty Allah for his divine protection, provision and guidance throughout my course of study.

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TABLE OF CONTENT

ABSTRACT

This project report is on the design and construction of a Wireless TV Sender within the frequency range of UHF that can transmit a quality audio and video to any UHF TV channel. The task of the Sender is to produce at the receiving end an image which is a replica of the scene being televised.

The Sender is crystal – controlled, its first stage is crystal controlled Oscillator with a frequency which is 1/8 the final output frequency.

The signal produce by the oscillator drives three stages of frequency doublers and the combined actions of those doublers multiplies the input frequency by eight for a final output frequency of (nominally) 500MHZ. Double tune circuits are used between each stage to help reduce spurious outputs that might cause unwanted interference. The method of modulation is similar to the way a conventional A.M transmitter is modulated. In this project work, a study of all the components and stages of operation with their specific system constructed are discussed. Suggestions and recommendations for improvement of the project are highlighted. Any other recommendations or suggestion that can improve this work are highly welcome

CHAPTER ONE

1.1 GENERAL INTRODUCTION

Once television became practical, people could sit in their living rooms and see as well as hear a play or a news broadcast. As far back as 1927 radio Engineers had known that pictures, as well as sounds, could be sent by radio waves. But technical problems slowed their progress. TV transmitting did not begin on a large scale until the late 1940's. Then, it quickly became one of the world's most popular forms of communications and entertainment.

Television reaches millions of people. By a flick of the switch, viewers can enjoy a concert, a lecture, a play or comedy. News events can be seen as they happen. Since television has become one of athe most important mass communication tools, then the need for a wireless TV sender becomes relevant.

A TV sender is a device capable of generating radio frequency (RF) energy which is controlled by the information to be send .

A TV sender consists of two basic sections irrespective of the kind of information they are designed to send. These sections are:

(i) The radio frequency (RF) section which consists of an oscillator stage and a network of R.F. amplifiers.

(ii) The audio or video frequency section which is purely a network of amplifiers.

The aim of this wireless TV sender is to transmit a quality audio and video signal to any UHF TV channel and is of low power requirement. By so doing, people would then be able to capture an event by turning their TV to any UHF TV channel. Also, its small size and light weight makes it natural for wireless video camera recording. This wireless TV sender would also make us to be free of the cumbersome cable that connects your video camera to your video cassette recorder (VCR). The block diagram of the wireless TV sender is shown in fig 1.1 below.

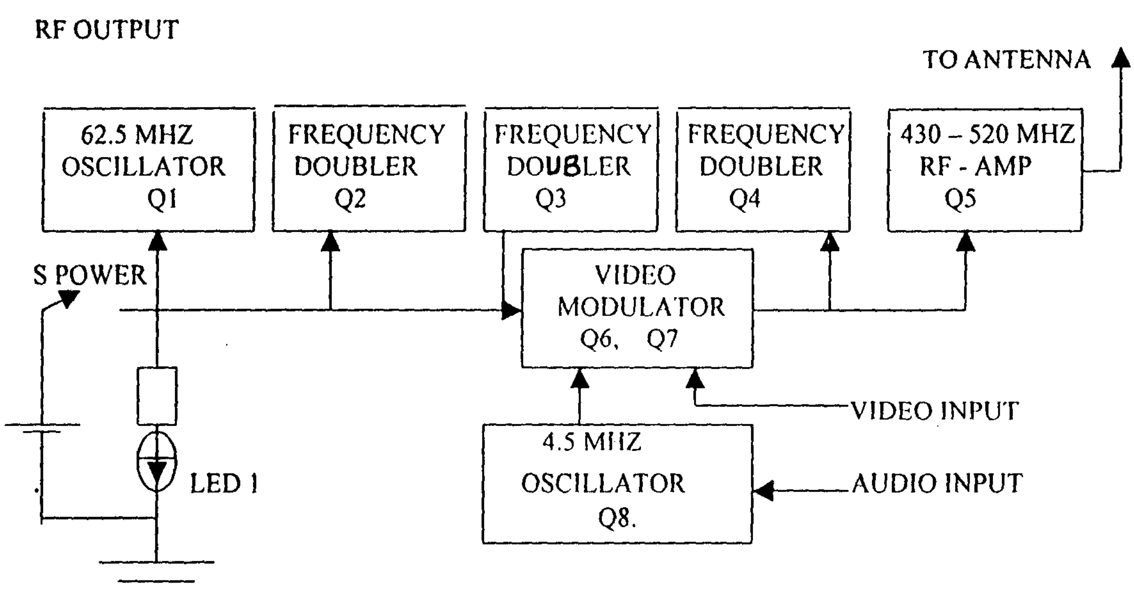


FIG 1.2 BLOCK DIAGRAM OF A WIRELESS TV SENDER

The first chain is the RF chain. Its first stage is crystal controlled oscillator (Q_1) with a frequency of 60 to 65 MHZ. But my design used a crystal frequency of 60.406MHZ, which gives a final output frequency of 483.25MHZ.

The oscillator produces a signal that drives three stages of frequency doublers. The combined action of those doublers multiplies the input frequency by eight (8) for a final output frequency of normally 500MHZ.

Double tuned circuit are used between each stage to help reduce spurious outputs that might cause unwanted interference.

The video input signal drives a video modulator (Q_6 and Q_7) that adds the video signal to the + 12 – Volt line supplying power to the final doubler Q_4 and the output amplifier Q_5. That method of modulation is similar to the way a conventional AM-radio transmitter is modulated.

Audio input is applied to Q_8, which operates as VCO (voltage controlled oscillator) running at a nominal frequency of 4.5MHZ to produce the modulated sound carrier.

1.2 AIMS AND OBJECTIVE

The aims of this project, is to design and construct a wireless TV sender.

Its objectives are:-

(i) To transmit high quality audio and video to any UHF TV channel.

(ii) To be free of the cumbersome cable that connects your video camera to your video cassette recorder (VCR).

(iii) To design a wireless TV sender that is of low power requirement and of light weight.

(iv) To design a wireless TV sender that is crystal controlled.

1.3 METHODOLOGY

The circuitry of this project work is made up of building blocks or units and each unit building block is made up of components. The building of the circuitry involve stages and it consists of different unit build and tested in a bread board before finally transferred into veroboard for soldering. Such stages are named below.

Power unit section

RF crystal oscillator/frequency doubler section.

Audio and video input section

Each of the above named stages or section are made up of components of building block. However, in this work, passive and polarised components are used throughout, such as resistors, capacitors, transistors and inductors.

The method of modulation used is similar to the way a conventional A.M transmitter is modulated.

IMPORTANCE OF MODULATION

(i) To increase the power of the intelligence frequency signal.

(ii) To translate the frequency of the intelligence bearing signal (message) to a frequency that is more suited for transmission over the desired medium

THEORY OF THE DESIGN

OSCILLATOR:-An oscillator is any device or circuit that produce an output which varies its amplitude with time, the output may be sinusoidal, square, pluse, triangular or saw tooth. Oscillators can be constructed using components that exhibit a negative resistance characteristics such as the unijunction transistor and the tunnel diode. The block diagram of a typical oscillator is shown below.

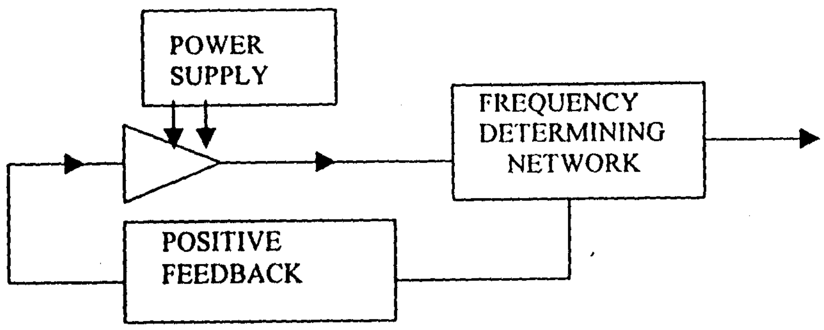


Fig 1.3 Block diagram of typical oscillator.

The requirements for a circuit to produce oscillations are:

(i) Amplification

(ii) A positive feed back loop

(iii) Some network to control the frequency

(iv) A source of power supply.

The oscillators used in this design are:

(i) Crystal oscillator

(ii) Voltage controlled

CRYSTAL OSCILLATOR

Crystal oscillator is used because only one fixed frequency is to be used and power output is not the most important consideration. The crystal oscillator is a highly satisfactory circuit for this, because it overcomes one defect which all other oscillators suffered from i. e. its frequency is not affected by changes of load.

The operating frequency of the crystal oscillator f_o is given by the

formular $f_o = \dfrac{1}{2\pi\sqrt{LC}}$

FIELD EFFECT TRANSISTOR (FET)

The field effect transistor (FET), like the bipolar transistor is a semiconductor device. The principle of operation of the FET, however, differ substantially from those of the bipolar transistors. One of the major functional differences is that , in the FET, the current through the device is controlled by a voltage (which sets up an electric field) rather than by a current as in the bipolar transistor.

The control terminal of the FET, called the gate, requites no current. Any current that might flow in the gate circuit is a result of leakage, and does not affect the controlled (output) current through the device. But in this design, JFET was used.

ADVANTAGES OF JFET OVER OTHER TRANSISTORS.

(I) It has wide tuning range.

(II) It has spectral purity with sinusoidal output .

(III) It has low phase noise and drift with temperature.

(IV) It is less expensive.

1.4 LITERATURE – REVIEW

Television is a division of Telecommunications which has to do with the transmission and reception of still and moving images by electric communication facilities in real time.

The task of Wireless TV Sender is to produce at the receiving end an image which is a [illegible] replica of the scene being televised. This task is tackled by an assemblage of apparatus intended to transmit, encode, decode, convert and present visual in formation.

The scientific foundation for TV has been laid by the remarkable discoveries made in many countries. The advent of the first motion picture projectors followed the invention of the incandescent lamp by A.N ladyguin of Russia in 1873 and accidental discovery of the properties of selenium by W. Smith and L. may in the same year. These two discoveries enable electric energy to be converted to light and back.

Basing himself on these two discoveries, J. Kerry of the United States came up in 1875 with a system for the transmission of moving images. He was the first to propose that the image should be analyzed into elements. In Kerry's system, all of the picture elements were to be transmitted in parallel and this called for a great no of communication channels as many as there would be picture elements. The idea was obviously impractical Its limitation were avoided in what are known as sequential television systems using only one communication channel over which the picture elements are transmitted in turn. Systems based on this principle of transmission were proposed in a variety of designs by A. de Paiva (1878) of Portugal, the Russian physiologist P.I Bakhmetyev (1880), S. Bidwell of Britain (1881), and Seneca of France (1881).

The details and techniques have of course changed since then, but the basic principle of sequential transmission has survived.

In 1984, N. Nipkow, a polish scientist working in Germany, invented his mechanical analyzer now known as the Nipkow disc, which ushered in the era of mechanical TV systems. Mechanical TV was able to show something for the effort put into it in 1925 when J.L. Baird in Britain and C. Jen Kins in the United States first demonstrated the transmission of moving silhouettes over a distance. The first transmitting TV system used the Nipkow disc.

Television transmission has come of age with every state in the Federal Republic of Nigeria having its own T.V station.

1.5 PROJECT OUTLINE

Chapter one of this project basically introduces the project topic, the aims and objectives, Methodology, Literature Review and project outline.

Chapter two give an indepth description of the entire system design, the various sections of the design are outline here and the stages are equally described.

In chapter three, the various steps taken in construction and testing were discussed and the result was also discussed.

CHAPTER TWO

DESIGN ANALYSIS

2.0. DETAILED SYSTEM DESCRIPTION.

The complete schematic diagram of the TV Sender is shown in fig 2.1 Transistor Q_1 is a common base (or colpitts). Oscillator biased by resistor R_1, R_2 and R_3. Inductors L_4 and capacitors C_3, C_4, C_5 and C_8 form a circuit that is tuned to the frequency of the crystal.

The crystal is series – resonant at some frequency between 60 and 65MHZ, so, it appears as a low impedance (50oohm or less) at that frequency. Therefor Q_1 will have sufficient gain as a common – base amplifier only at the resonant frequency of the crystal. Hence the signal developed at the junction of C_4 and C_5 will be amplified by Q_1 only if that signal is at the same frequency as the crystal. At that frequency, Q_1, has sufficient gain to oscillate. Capacitor C_3 and C_8 complete the tuned circuit, they also form a voltage divider that feeds the base of Q_2.

Transistor Q_2 functions as an overdriven amplifier that distorts its input signal and thereby produces harmonics of the input frequency. L_2 and C_{10} are tuned to that harmonic i.e. the second harmonic (120MHZ) which is the frequency we're interested in. C_8 is also series – resonant at that frequency Q_2's efficiency of oscillation is improve by the additional base current supplied by C_8. C_{11}, C_{12}, C_{13} and L_3 provide a doubled – tuned circuit. Those components filter harmonics higher than the second.

Q_3 provides another stage of frequency doubling, it operates very much like Q_2, except that the tuned circuits at its input resonate at approximately 125MHZ and its output circuits resonate at about 250MHZ.

Again, Q_4 operates like Q_3, taking account of the values of the components in the tuned circuits. However, note that no emitter – Bypass capacitor or resistor is used. It is difficult to get good bypassing in the 430 – 500MHZ range with ordinary components, and it takes only a very small impedance in the emitter to kill the power gain of that stage therefore, the emitter is directly grounded.

Q_5 provides power amplification, L_7, L_8, C_{22},C_{24}.amd C_{25} constitutes the double – tuned circuit.

Both Q_4 and Q_5 receive their supply voltage from the emitter of Q_7, which supply 4.5V that voltage has positive sync – tip video supper imposed on it.

Negative – sync input video from a camera VCR, e. t. c is DC – coupled to the junction of R_{21} and R_{22}. Video by pass is provided by C_{31}. Gain and Q – point are set by R_{24}. Potentiometer R_{31} acts as a video gain control and R_{29} keeps the input impedance around 75Ohms.

FET Q_8 functions as a Harley – type VCO with a free – running frequency of 4.5 MHZ. C_{36} is used to fine – tuned that frequency. Feedback is provided by C_{35} and C_{34}. D_2 is a Varactor (Variable – capacitance) diode. It is biased by R_{25}, R_{26} and zener diode D_1 which also biases Q_8.

The varactor D_2 provides frequency modulation (FM). This it does by changing capacitance at the audio rate and that would cause the oscillator's frequency to vary. Audio is fed to D_2 via R_{27} and C_{38}, C_{37} provides RF by-passing at 4.5 MHZ

. Audio pre-amplification is provided by Q_9. R_{32} is the audio gain control. The 4.5 MHZ FM signal from Q_8 is summed with the video signal through R_{23}.

NOTE:

The sound – level carrier may be varied by changing R_{23} as necessary.

POWER SUPPLY.

External power is coupled in through Jack J_3. The power-on condition is indicated by LED1, which is current-limited by R_{28}.

2.1 DESIGN ANALYSIS

2.1.1 THE POWER SUPPLY UNIT.

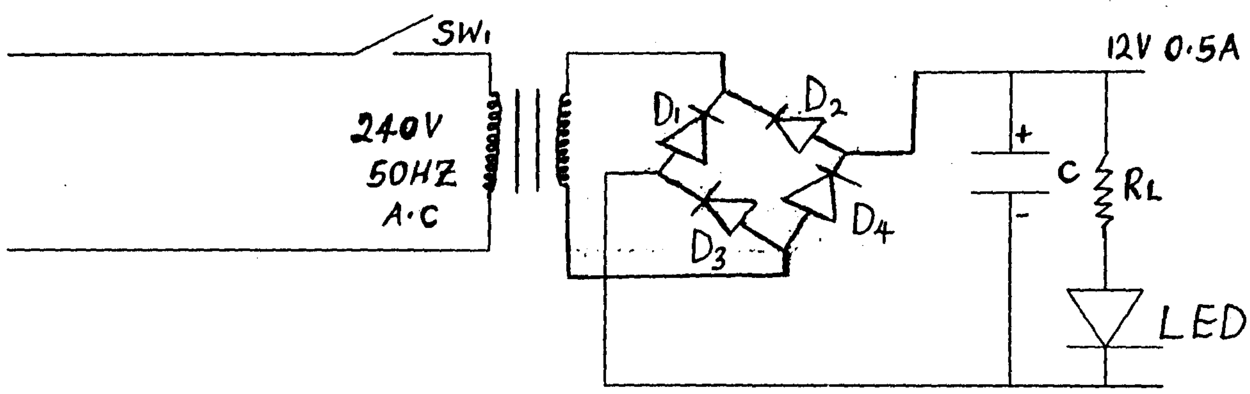


Fig 2.2 POWER SUPPLY UNIT

The power is obtained from a unit that converts the normal single phase a. c main supply (240V at 50HZ) to 12V a. c, the function of the power supply is to provide the necessary d. c voltage and current, with low levels of a .c ripple (main hum) and with good regulation and stability.

Components:

(i) 12V; 500mA transformer

(ii) Four silicon diodes for bridge rectification

(iii) 1000UF 35V reservoir electrolytic capacitor.

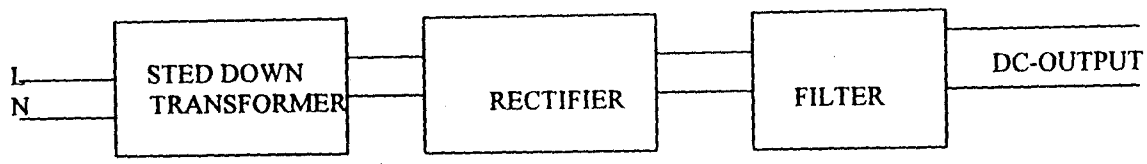


Fig 2.3 BLOCK DIAGRAM OF THE POWER SUPPLY UNIT.

The bridge rectifier produce full – wave rectification, consideration is given to this because it does not use expensive centre – tapped transformer and the transformer is used to alter the level of the a. c input to the rectifier.

The four diodes used for rectification must be able to withstand the 12V a. c voltage from the transformer, so has a peak inverse voltage.

(PIV) of > 2Vp

Since $Vp = \sqrt{2}\ Va.c$

$Va.c = 12V$

Therefore $Vp = 16.97V$

Therefore PIV of each of the diode = 2 x 16.97

=33.94V.

Therefore a diode of PIV > 33. 94V was chosen

1N4001 with PIV of 50V is chosen.

In order to reduce a. c variation of the rectified waveform, a reservoir capacitor C was connected across the output of the bridge rectified diodes.

The reservoir capacitor is expected to discharge at a shorter time (t) i. e to give a smaller a. c ripple.

Let the time t = 0.1sec

Load Resistance RL = 100ohm

To calculate the value of the reservoir capacitor,

t_1 = ($C.R_L$ (secs).

But t_1 = 0.1 sec.

R_L = 100ohm

$$\text{Therefore } C = \frac{t}{R_L} = \frac{0.1}{100}$$

C = 1000uF

Since the voltage is 12V d. C, then a capacitor with voltage rating > 12V is chosen.

i. e

C = 1000uF, 35V was chosen.

2.1.2 RF CRYSTAL CONTROL COLPITTS OSCILLATOR/ FREQUENCY DOUBLER SECTION.

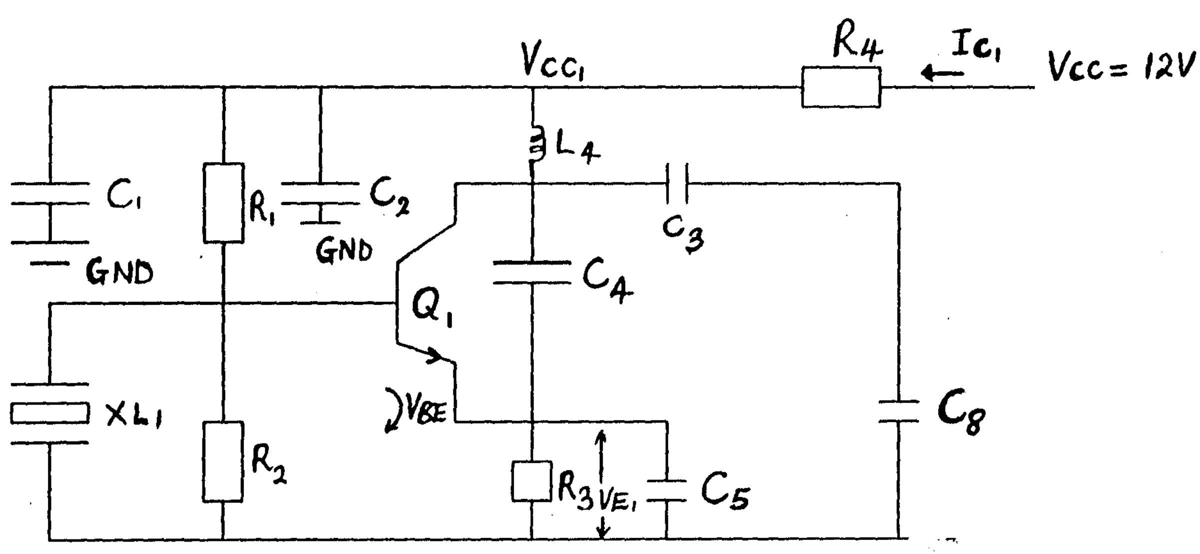


Fig 2.4 CRYSTAL – CONTROLLED OSXILLATOR STAGE.
Choice of transistor

The transistor 2N 3563 was chosen for Q_1 and from the data book for Electronic component guide (ECG), the parameters of transistor Q_2 was given as stated below.

$Ic\ max = 50mA$.
$V_{CE} = 15V$
$P_D = 0.600W$ (dissipation power) at 25^0C.
$hFE = 20min$.
$F_T = 800MHz$
$V_{BE} = 0.7V$ (silicon transistor).

Since a U.H.F Video frequency is needed, then our design was based on a tunable U.H.F channel.

A .video frequency S/W 483.25MHz.

A three stage of frequency doubler was used to generate this frequency.

Since an LC Oscillator was used in conjunction with the crystal Oscillation, then the value of crystal Oscillator is given by

$$XL_1 = \frac{U.H.F}{8} = \frac{483.25MHz}{8}$$

$$XL_1 = 60.40625MHz.$$

C_1 and C_2 are grounded to remove voltage spark of VHF or Electromagnetic interference (EMI) that might appear on the screen.

Chosen values for C_1 and C_2

$C_1 = 0.01UF$ (Ceramic disk).

$C_2 = 470PF$ (Ceramic disk).

$$Vcc - Vcc_1 = Ic_1 R_4$$

But $Vcc = 12V$

Let

$Vcc_1 = 10V$;

$Ic_1 = 20mA$.

$$\text{Therefore} \quad R_4 = \frac{Vcc - Vcc_1}{Ic_1} = \frac{12 - 10}{20 \times 10^{-3}}$$

$$R_4 = 100ohm$$

Therefore R_4 was chosen to be 100ohm

$$\text{Biased voltage } V_{BR2} = \frac{R_2}{R_1 + R_2} \times Vcc_1$$

Let $V_{BR2} = 2V$

But $Vcc_1 = 10V$

Chosen $R_1 = 22K$

$$\text{Therefore } R_2 = \frac{2R_1}{8} = \frac{2 \times 22}{8}$$

Therefore $R_2 = 5.5K$

But for standard resistor value, R_2 was chosen to be 4.7K.

$V_{BR2} = V_{BE} + V_{E1}$

$2 = 0.7 + V_{E1}$

$V_{E1} = V_{BR2} - V_{BE}$

Therefore $V_{E1} = 1.3V$.

But $V_{E1} = IE_1R_3$.

Let $I_{E1} = 6mA$

$$R_3 = \frac{V_{E1}}{I_{E1}} = \frac{1.3}{6 \times 10^{-3}}$$

Therefore $R_3 = 217\text{ohm}$

But for standard resistor value, R_3 was chosen to be 220ohm.

$$R_{B1} = R_1 // R_2$$

$$= \frac{22 \times 4.7}{22 + 4.7}$$

Therefore $R_{B1} = 3.87\text{ohm}$.

$$I_{B1} = \frac{V_{BR2}}{R_{B1}} = \frac{2}{3.87 \times 103}$$

Therefore $I_{B1} = 0.52\text{mA}$.

$$Vcc = Ic_1 R_4 + V_{CE} + V_{E1}$$

$$12 = 20 \times 10^{-3} \times 100 + V_{CE} + 1.3$$

$$V_{CE} = 12 - 3.3$$

Therefore $V_{CE} = 8.7V$

Calculating the value of the decoupling capacitor C_5

$$C_5 = \frac{1}{2\pi \sqrt{f^1 R_3}}$$ where f^1 = minimum frequency to require to decouple R_3.

But $R_3 = 220\text{ohm}$

Therefore $C_5 = \frac{1}{2\pi \times (12.9 \times 10^6 \times 220)}$

$$C_5 = 56PF$$

But $\underline{C_3 * C_8} = 23.53PF$

$C_3 + C_8$

Chosen $C_3 = 33PF$

Therefore $C_8 = \frac{23.53 \quad C_3}{9.47}$

$C_8 = \simeq 82PF$

Chosen value for $C_4 = 15PF$

Therefore $Ceq = C_4 + C_5 + \frac{C_3 * C_8}{C_3 + C_8}$

$Ceq = 94.53PF$

Calculating the operating frequency f_0

$$f_0 = \frac{1}{2\pi\sqrt{L_4Ceq}}$$

chosen L4 = 68 nH

Therefore $f_0 = \frac{1}{2\pi\sqrt{(68 \times 10^{-9} \times (94.53 \times 10^{-12})}}$

$f_0 = 62.7MHz$

To test if the circuit will oscillate.

Condition for testing.

H_{FE} must be $\geq \frac{C_4}{C_5}$ i.e. $H_{FE} \geq \frac{C_4}{C_5}$

Therefore $\frac{C_4}{C_5} = \frac{15PF}{56PF}$

$= 0.2679$

Since $H_{FE} = 20$, and calculated $H_{FE} = 0.2679$ therefore the crystal oscillator would oscillate

2.1.3 FIRST STAGE OF FREQUENCY DOUBLER.

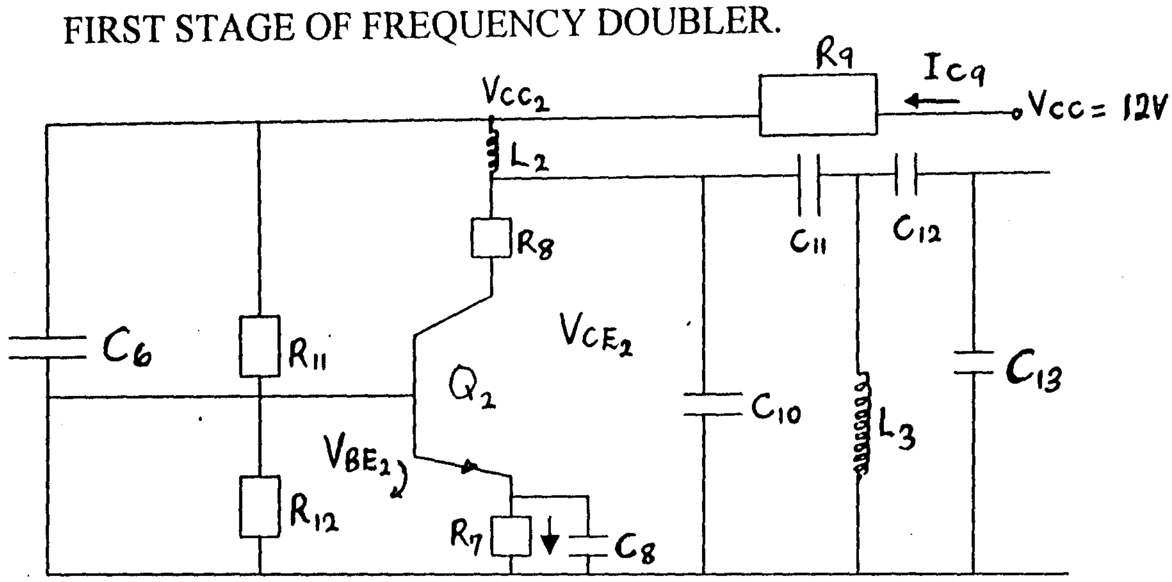


Fig 2.5

Choice of transistor.

Transistor 2N 3563 was chosen for Q_2 with the following parameters

$Icnax = 50mA$

$P_D = 0.6W(\text{at } 25^0C)$

$HFE = 20$

$V_{CE} = 15V.$

$Vcc - Vcc_2 = Icq.\ Rq.$

$Vcc = 12V$

Let $Vcc_2 = 10V$

Chosen $Rq = 100ohm$

Therefore $Icq = \frac{Vcc - Vcc_2}{Rq} = \frac{12 - 10}{100}$

$Icq = 20mA$

$$\text{Biased voltage } V_{B12} = \frac{R_{12}}{R_{11} + R_{12}} \times Vcc_2$$

Chosen

$$R_{11} = 22K, R_{12} = 4.7K$$

$$V_{B12} = \frac{4.7}{22 + 4.7} \times 10$$

$$V_{B12} = 1.76V.$$

$$R_{B2} = R_{11}/R_{12} = \frac{22 \times 4.7}{22 + 4.7}$$

$$R_{B2} = 3.87K.$$

$$\text{Therefore } I_{B2} = \frac{V_{B12}}{R_{B2}} \; 0 = \frac{1.76}{3.87 \times 10_3}$$

$$I_{B2} = 0.455mA.$$

$$Ic_2 \simeq I_{E2} = \beta IB_2$$

$$= 20 \times 0.455$$

$$\text{therefore } I_{E2} = 9.1mA.$$

$$V_{B2} = V_{BE} + V_{E2}$$

$$\text{Therefore } V_{E2} = V_{B12} - V_{BE}$$

$$= 1.06V.$$

$$V_{E2} = I_{E2} \,.\, R_7$$

$$\text{Therefore } R_7 = \frac{V_{E2}}{I_{E2}} = \frac{1.06}{9.1 \times 10_{-3}}$$

$$R_7 = 116ohm$$

But for standard resistor value, R_7 was chosen to be 220ohm.

Calculating the value of the decopling capacitor

$$C_8 = \frac{1}{2\pi f_2^1 R_7}$$

Where f_2^1 = Minimum frequency required to decouple R_7

Let $f_2^1 = 8.82MHz$

Therefore

$$C_8 = \frac{1}{2\pi (8.82 \times 10^6) \times 220}$$

$$= 82pF$$

But $C_{12} + C_{13} = 63pF$

Chosen $C_{12} = 24\ pF$

Therefore $C_{13} = 63 - 24$

$C_{13} = 39pF$

Similarly

$C_{10} + C_{11} = 20pF.$

Chosen $C_{10} = 18pF$

Therefore $C_{11} = 20 - C_{10}$

$C_{11} = 2pF$

Inductors L_2 and L_3 was chosen to be

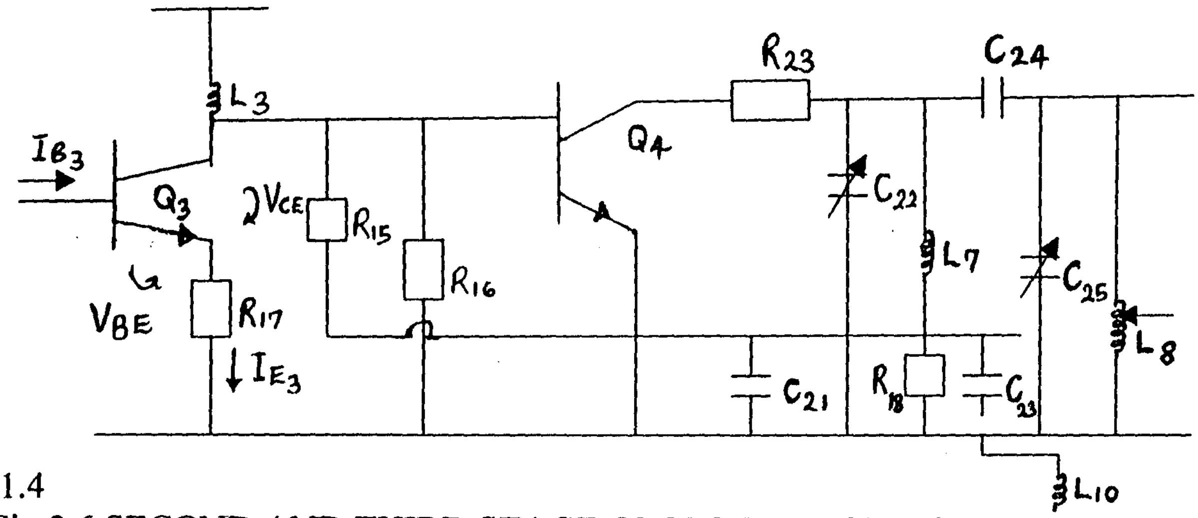
$L_2 = L_3 = 0.074uH.$

Capacitor C_6 was chosen to be 0.01NF 50 volts (Ceramic disc).

Since the function of this stage of amplifier is to double the input frequency by two

Therefore

$$\text{Output frequency } f = 2 \times f_o$$
$$= 2 \times 62.7$$
$$= 125.4\text{MHz}.$$



2.1.4

Fig 2.6 SECOND AND THIRD STAGE OF FREQUENCY DOUBLER.

Choice of transistor.

Transistor 2N3563 was chosen for Q_3 with the following parameters.

$V_{CE} = 15V$

$V_{CB} = 30V$

Icmax = 50mA

$V_{EB} = 2V$

HFE = 20min

$P_D = 0.600.$

Transistor 2N3564 was chosen for Q_4 with the following parameters.

$V_{CE} = 40V$

$V_{EB} = 6V$

Ic (max) = 0.8A

$P_D = 0.5$

HFE = 200

VbE = 0.7 (silicon transistor).

Biasing Transistor Q_3

$$V_{B3} = V_{BE} + V_{E3}$$

But $V_{E3} = I_{E3}R_{17}$

Let $Ic_3 \simeq I_{E3} = 3mA$.

Let $V_{E3} = 6.6V$.

Therefore $R_{17} = \frac{V_{E3}}{I_{E3}} = \frac{6.6}{3 \times 10^{-3}}$

$R_{17} = 2200ohm$

Chosen value for $R_{15} = 100K$

Chosen value for $L_3 = 0.074uH$

$V_{B3} = V_{BE} + V_{E3}$

$= 0.7 + 6.6$

Therefore $V_{B3} = 7.3V$

$Ic_3 \simeq I_{E3} = \beta I_B.$

Therefore $I_{B3} = \frac{IE_3}{\beta} = \frac{3 \times 10^{-3}}{20}$

$I_{B3} = 0.15mA.$

$Vc_E = Vcc - V_{E3}$

Therefore $Vc_E = 12 - 6.6$

$= 5.4V.$

Biasing transistor Q_4.

Since both transistor Q_4 and Q_5 receive their supply voltage from the emitter of Q_7 which supply 4.5V to Both Q_4 and Q_5

Therefore for Q_4

$Vcc = 4.5V.$

$$I_{15} = \frac{Vcc}{R_{15}}$$

Chosen $R_{15} = 100K$

$$I_{15} = \frac{4.5}{100}$$

Therefore $I_{15} = 0.045mA$.

But $$\frac{R_{15} * R_{16}}{R_{15} + R_{16}} = 4.5Kohm$$

Since $R_{15} = 100K$

Therefore $$R_{16} = \frac{4.5}{95.5} \times R_{15}$$

$$= \frac{4.5}{95.5} \times 100$$

$R_{16} = 4.71K$

Therefore R_{16} was chosen to be 4.7K.

Chosen value for $R_{23} = 10K$

Chosen value for $C_{22} = C_{25} = (1 - 8)PF$

Chosen value for $C_{24} = 1PF$

Chosen value for $C_{18} = 100ohm$

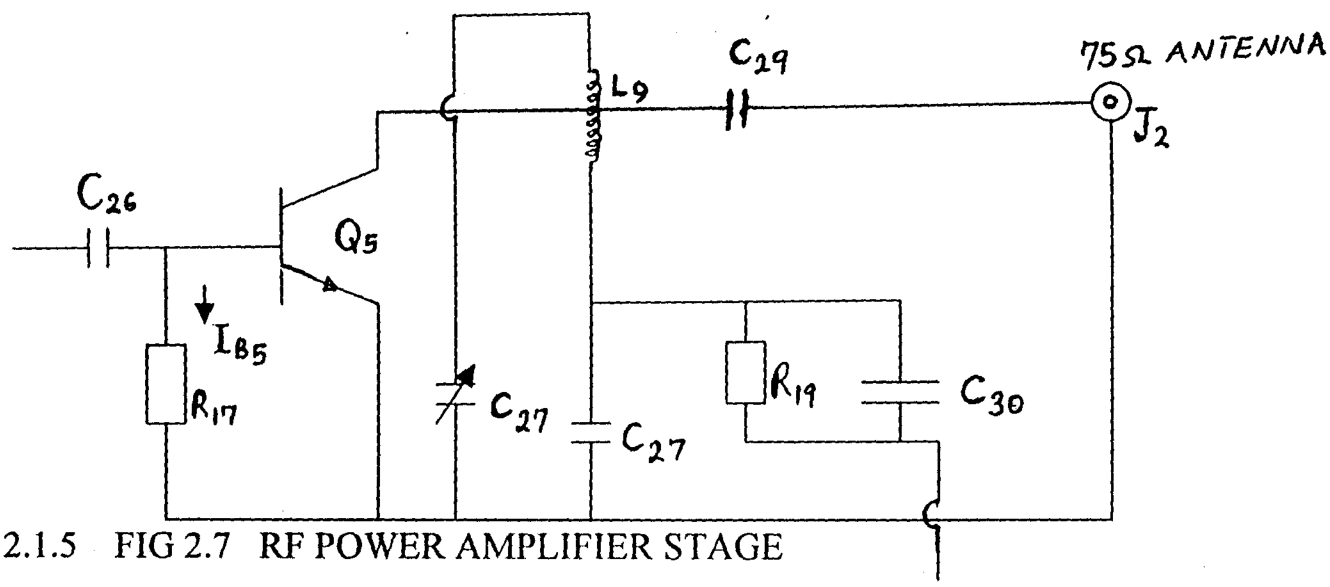
Chosen value for $L_7 = L_8 = L_9 = 0.018uH$.

But $C_{21} + C_{23} = 517PF$

Chosen $C_{21} = 47PF$

Therefore $C_{23} = 517P - C_{21}$

$= 470PF$



2.1.5 FIG 2.7 RF POWER AMPLIFIER STAGE

Choice of Transistor

Transistor Q_5 is chosen to be 2N 3866 with the following parameters.

$Ic\ (max) = 0.4A$

$V_{CE} = 30V$

$P_D = 5Watt$

$H_{FE} = 25min.$

Biasing the transistor

$V_{B5} = I_{B5} . R_{17}$

Let $Ic_5 = 0.15A$.

But $Ic_5 \simeq I_{E5} \simeq \beta I_{B5}$

$$:- I_{B5} = \frac{Ic_5}{\beta} = \frac{0.15}{25}$$

6mA.

$V_{B5} = I_{B5} . R_{17}$

Chosen R_{17} = 2200ohm

Therefore $V_{B5} = 0.006 \times 2200$

$= 13.2V$

$Vcc \simeq Vc_E$

But Vcc = 4.5V

Therefore $Vc_E = 4.5V$.

Chosen value for $L_9 = 0.018uH$.

Chosen value for $C_{29} = 470PF$ (ceramic disc)

Chosen value for $R_{19} = 100ohm$

But $C_{27} + C_{30} = 517pF$

Chosen $C_{27} = 47pF$

Therefore $C_{30} = 517 - C_{27}$

$= 470pF$.

To calculate the value of C_{28}

For a low frequency range of 430MHz.

$$C_{EFF}\ max = \frac{1}{4\pi^2 f^2 L_9}$$

Chosen $L_9 = 0.018\mu H$

$$C_{EFF}\ max = \frac{1}{4\pi^2 \times (430 \times 10^6)^2 \times (0.018 \times 10^{-6})}$$

$= \simeq 8pF$.

For a high frequency range of 520MHz

$$C_{EFF}mm = \frac{1}{4\pi^2 \times (520 \times 10^6)^2 \times (0.018 \times 10^{-6})}$$

$$= \simeq 5PF$$

The effective capacitance range is (5 – 8PF). But, for stand effective capacitance range, (1 – 8PF) was chosen for C_{28}.

To calculate the output power of the R.F Amplifier stage,

Power = IV

But V = IR

Therefore power output = I^2R

$I \simeq Ic_5 = 0.15A$.

R = 2200ohm

Therefore output power (P) = $(0.15)^2 \times 2200$

= 49.5W

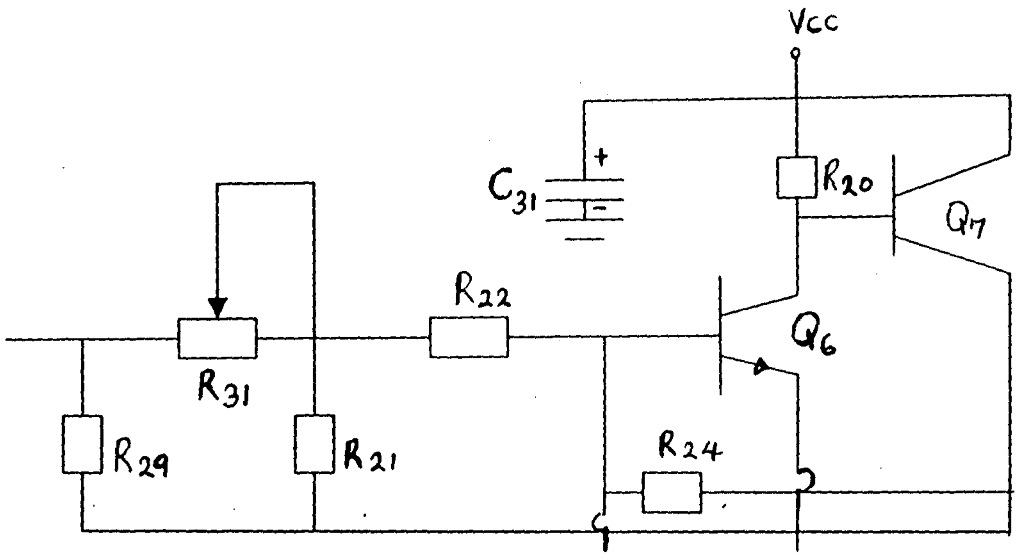
$\simeq$ = 50W.

fmin = 430MHz

fmax = 520MHz

Bandwidth B = Fmax - Fmin

= 90MHz



2.1.6 Fig 2.8 VIDEO INPUT/MODULATOR STAGE.

Choice of transistor

Transistor Q_6 is 2N 3563 with the following parameters

Icmax = 50mA,

V_{EB} = 2V

V_{CE} = 15V

H_{FE} = 20

P_D = 600W, V_{CB} = 30V.

Transistor Q_7 is 2N 3866 with the following parameters

Icmax = 0.4A

P_D(max) = 5

V_{EB} = 3.5V

V_{CE} = 30V

H_{FE} = 25

V_{CB} = 55 V

Biasing the transistor.

$V_{B6} = R_B I_{B6}$.

$R_B = R_{29}//_{31}//R_{21} + R_{22}$

Chosen values for R_{29}, R_{31}, R_{21} and R_{22} are

$R_{31} = 10K$

$R_{29} = 82ohm$

$R_{21} = 100ohm$

$R_{22} = 470ohm$

Therefore $R_B = R_{29}//R_{31}//R_{21} + R_{22}$

$= 515ohm$

Let $Ic_6 = 40mA$.

But $Ic_6 \simeq \beta I_{B6}$

Therefore $I_{B6} = \frac{40 \times 10^{-3}}{20}$

$= 0.002A$

Therefore $V_{B6} = 515 \times 0.02$

$= 1.03V$

$V_{b6} = V_{BE} + V_{E6}$

Therefore $V_{E6} = V_{b6} - V_{BE}$

$= 1.03 - 0.7$

$= 0.33V$

$V_{B7} = V_{BE} + V_{E7}$

Let $V_{B7} = 5.2V$

Therefore $V_{E7} = V_{B7} - V_{BE}$

$= 5.2 - 0.7$

$= 4.5V$

$Vcc = Vc_{E7} + V_{E7}$

But $V_{cc} = 12V$

Therefore $V_{CE7} = V_{cc} - V_{E7}$

$= 12 - 4.5$

$= 7.5V.$

2.1.7

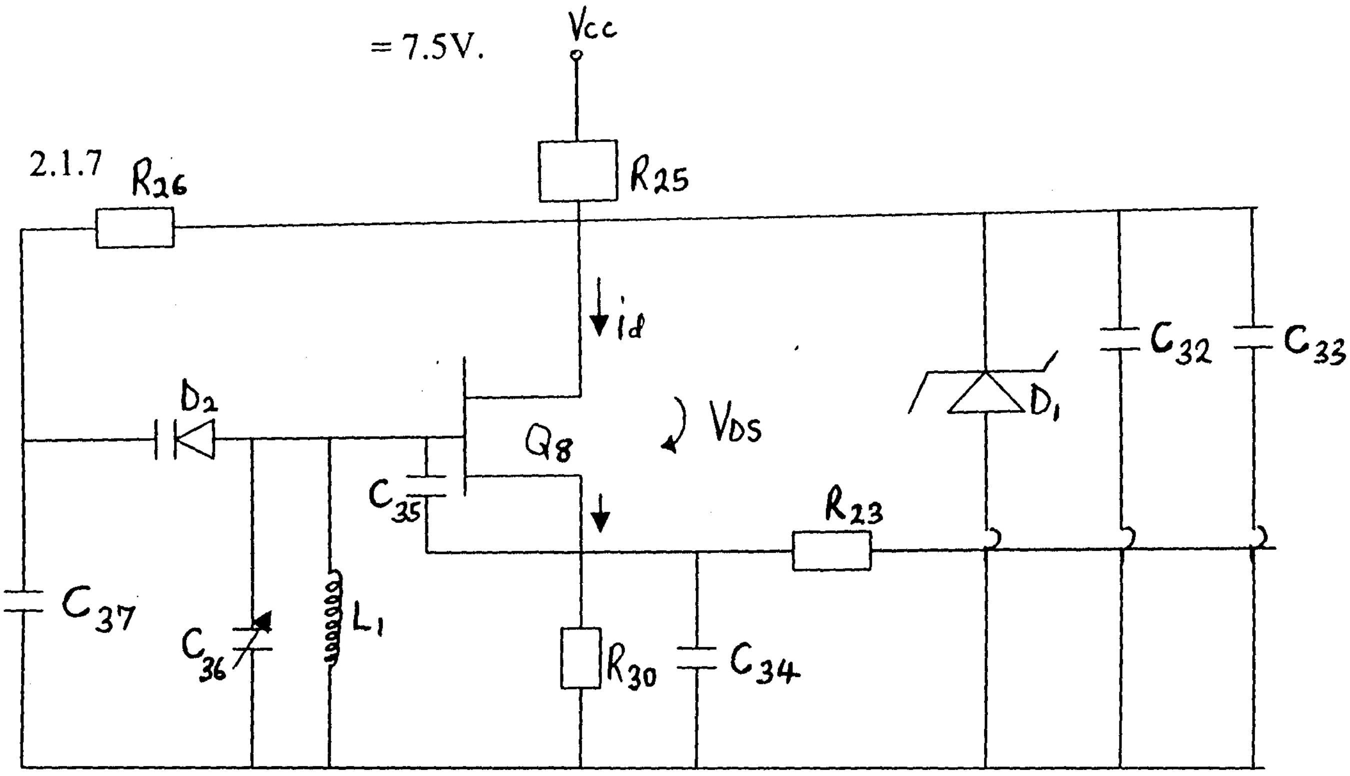


Fig 2.9 AUDIO INPUT/ VOLTAGE CONTROLLED OSCILLATOR STAGE.

Choice of transistor

Transistor Q_8 is an MPF 102 with the following characteristics

$Gf_0 = 4,000\mu$mhos

V_{GS} max = 4V

I_{DSS} (min – max) = 4 – 10mA

BV_{GSS} min = 25V.

Biasing the transistor

$$I_D = I_{DSS} \left[1 - \frac{V_{GS}}{VP}\right]^2$$

$$gfs = \frac{-2}{VP}\sqrt{I_{DSS} \cdot I_D}$$

Let $I_{DSS} = 6mA$

$V_P = 4V$

$$4,000 \times 10^{-6} = \frac{-2}{VP}\sqrt{6 \times 10^{-3} \times I_D}$$

$$(4 \times 10^{-3})^2 = (-2/VP)^2 \times 6 \times 10^{-3} I_D$$

since $V_P = 4V$

Therefore $I_D = \frac{256 \times 10^{-6}}{24 \times 10^{-3}}$

$= 0.0107A$

But $I_D = I_{DSS}\left[1 - \frac{V_{GS}}{4}\right]^2$

Let $V_P = 4V$

$I_D = 0.0107A$

$0.0107 = 6 \times 10^{-3}\left[1 - \frac{V_{GS}}{4}\right]^2$

$$\sqrt{\frac{0.0107}{6 \times 10^{-3}}} = 1 - \frac{V_{GS}}{4}$$

$$1.335 = 1 - \frac{V_{GS}}{4}$$

Therefore $V_{GS} = (1 - 1.335) \times 4$

$= -1.34V$

Calculating the capacitance value.

But $C_{34} + C_{35} = 690PF$

Chosen $C_{34} = 470PF$

Therefore $C_{35} = 690 - 470$

$= 220PF.$

2.1.8

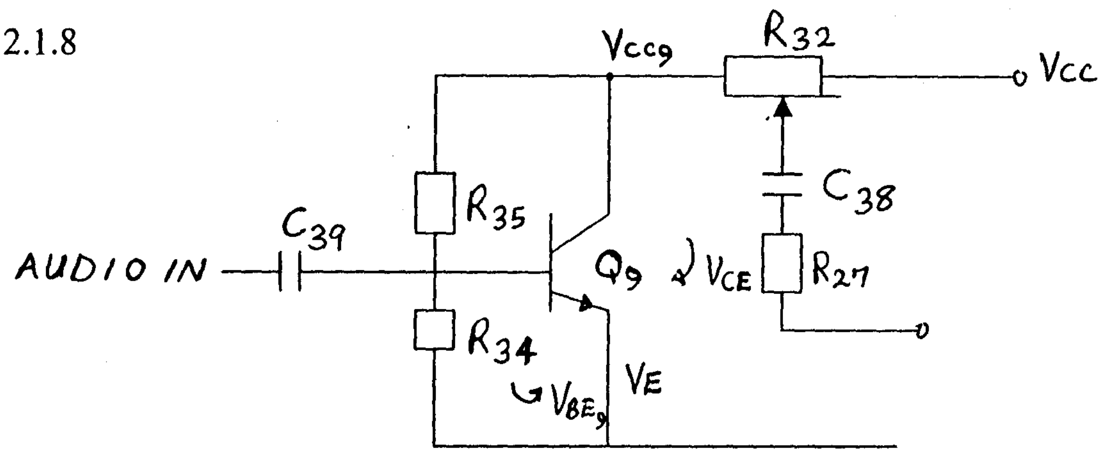


Fig 2.9b AUDIO PRE – AMPLIFIER STAGE.

Choice of Transistor.

Transistor 2N 3565 was chosen for Q_9 with the following parameters

$Icmax = 0.8A$

$$V_{CE} = 40V$$

$$V_{EB} = 6$$

$$H_{FE} = 200$$

Biasing the transistor.

$$Vcc - Vcc_9 = Ic_9 \times R_{32}$$

Let $Vcc_9 = 10V$

$$Ic_9 = 0.2mA$$

$$12 - 10 = 0.2 \times 10^{-3} \times R_{32}$$

therefore $R_{32} = \dfrac{2}{0.2 \times 10^{-3}}$

$$= 10{,}000ohm$$

:- R_{32} was chosen to be 10,000ohm.

$$V_{B9} = \frac{R_{34}}{R_{34} + R_{35}} \times Vcc_9$$

Chosen $R_{34} = 10K$

$R_{35} = 100K$

$$V_{B9} = \frac{10}{10 + 100} \times 10$$

$$= 0.909V$$

$$R_B = R_{34} // R_{35}$$

$$= \frac{100 \times 10}{110}$$

$$= 9.090K$$

But $V_{B9} = I_{B9} R_B$

$$I_{B9} = V_{B9}/R_B$$

$= 0.909/9.090 \times 10^3$

$= 0.1mA$

$I_{c9} \simeq BI_{B9} = 200 \times 0.1$

$= 20mA$

$V_{B9} = V_{BE} + V_E$

Therefore $V_E = V_{B9} - V_{BE}$

$= 0.909 - 0.7$

$= 0.209 V$

CHAPTER THREE

CONSTRUCTION AND TESTING

3.1 CONSTRUCTION

Having gotten the components together, then I started by referring to the circuit diagram. I insert and soldered the components starting with (the resistors and diodes) and working up to the electrolytic and trimmer capacitors. C are was taken not to overheat the semiconductors when soldering them to the project board. The breadboard was extensively used as a testing ground for the construction.

The RF coils was wound and installed, the turns of each coil was spread evenly without spacing perfectly as coils will be compressed and expanded when the transmitter to tune-up.

L1 is a constructed eight turns of 22-gauge wire wound on a Ferro X cube, L_2 and L_3 are seven turns of 22-gauge wire wound on a 26 drill bit and the drill bit was removed after the coil was completed. L_4 is wound around a standard 10-32 screwthread and the screw was removed after the coil was completed, L_7, L_8 and L_9 are 1.5cm loops of wire wound on a 3/8 inch form and soldered to the project board. L10 and L11 are standard 5.6μH. One end of capacitor C_{26} was mounted in the normal fashion, and the other end hangs from the approximate midpoint of L8's loop. Similarly, C_{29} was mounted from the board to the midpoint of L_9; the lead then continues to the pad near the collector of Q_5.

Lastly, the transistors was installed and care was taken to make sure that they are oriented correctly and their lead length was minimized. Finally, before applying power, the work was checked over to make sure no solder bridges exist and to be sure that all polarized Components are correctly Oriented.

CONSTRUCTION OF CASING .

The casing was designed and constructed with respect to the length and width of the Vero boards. The cas ing was made from wood with adequate outlets and provisions was made for the video jack, the antenna, the transformer, the power supply and other components.

The Vero boards were fastened inside the cas ing in a way that allows for ease of access or removal for repairs in the case of any fault.

3.2 TESTING

In testing this project work, necessary precaution was taken such as checking over and over the constructed work to make sure that all components are correctly fixed and to ensure that no solder bridges exist before power was applied.

The following equipment was used to test the Wireless T.V Sender

(i) A video source (video cassette recorder VCR) or camera.

(ii) A TV set.

The video source was put to operation by playing a video cassette inserted into it. The video jack corresponding to the Audio (Black jack) and video (Red jack) output of the Sender was plugged to their corresponding Audio and video output of the video source. Then we started tuning the TV to UHF channel to capture the event been played by the video source.

3.3 RESULT

The aim of this project has been achieved as the Sender was found to transmit both audio and video to the used UHF TV channel during the testing.

But it does not actually transmit well to cover a wide range of distance as expected. This problem of transmission, might be attributed to reflections loss, terrain loss, loss from "dead spots" and obstacle shielding.

But however, a distance of about 130 metres was covered.

The above figure was obtained by using measuring tape to measure the distance between the Sender and the receiving T.V

CHAPTER FOUR

CONCLUSION AND RECOMMENDATION

4.1 CONCLUSIONS

Having achieved the aim of this project work, which was successfully constructed, and based on the experience I have acquired during the period of research work which I found useful to my field of study, I therefore, recommend this project topic to any student who might find if interesting to choose as a project work.

However, the problem encountered, such as reflection loss, terrain loss, loss from "dead spots" and obstacle shielding that has affected the range of transmission of this project can still be improved upon by anyone wishing to choose the same as a project topic using the same circuit design.

4.2 RECOMMENDATION

With regards to my extensive research based on his project work, I have been widely exposed to many theoretical analysis of TV and TV Sender in particular and more on analogue electronics as a course as the project is purely analogue.

I hereby recommend this project topic Wireless TV Sender to any student of the department who might find it interesting to choose as a project topic in future not to hesitate.

I equally recommend to any student of the department who might pick it in future as a project topic that with extensive research, an IC may be used to replaced the frequency doubling stage and that would simplify the circuitry.

But due to limited time and unavailability of modern text books on IC electeronic technology to guide us, we are unable to get a specific IC to replace the said stage as our scope of research did not extensively cover that area.

Any further suggestion or correction is highly welcomed by any person after going through this write up.

NOTE:-

The sound-level carrier may be varied by changing R_{23} if necessary.

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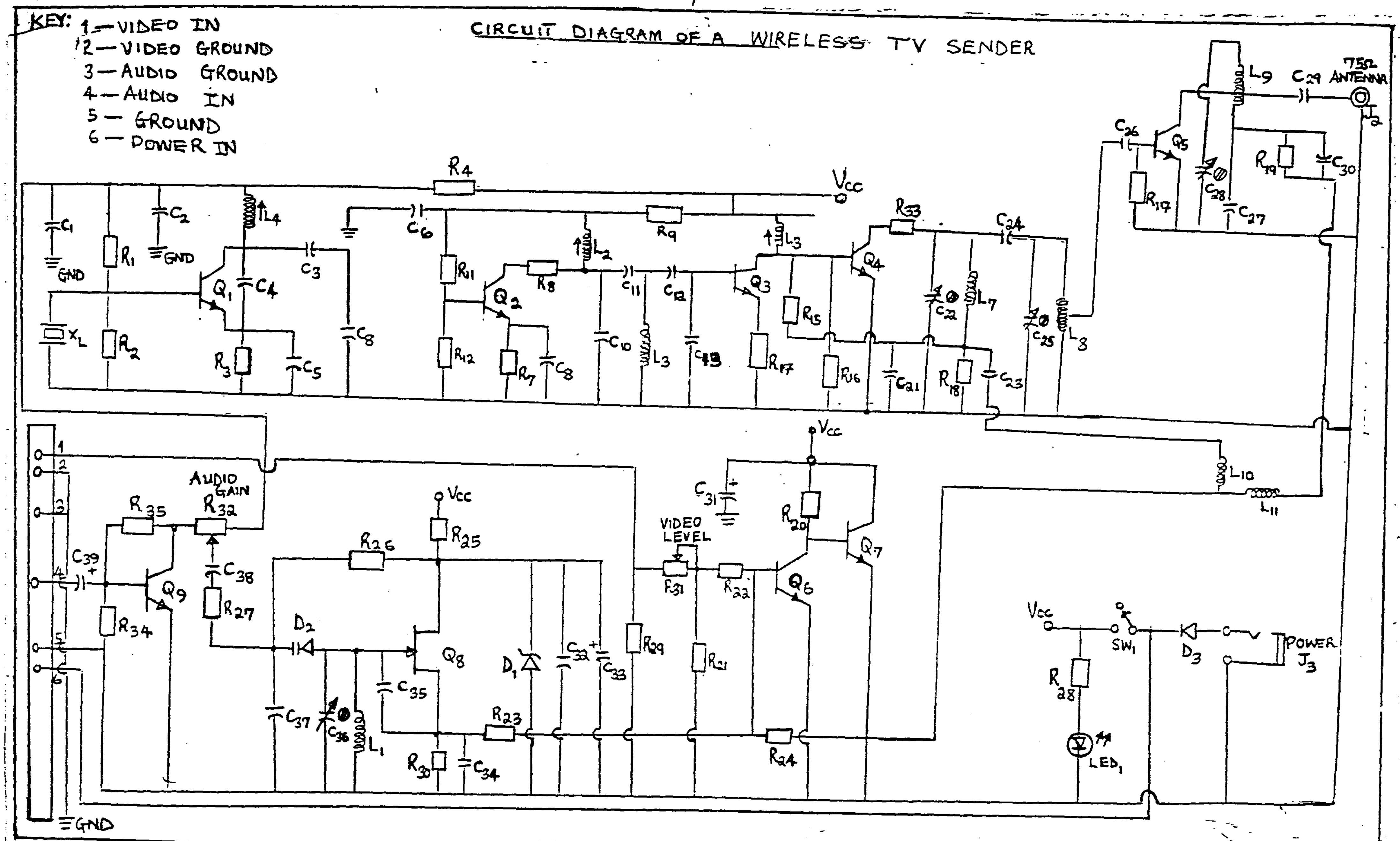
KEY: 1—VIDEO IN
2—VIDEO GROUND
3—AUDIO GROUND
4—AUDIO IN
5—GROUND
6—POWER IN
CIRCUIT DIAGRAM OF A WIRELESS TV SENDER
75Ω ANTENNA
J2
Vcc
GND
AUDIO GAIN
VIDEO LEVEL
POWER
J3
SW1
D3
LED1
R28
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
XL
D1
D2

Fig 2.1

LIST OF COMPONENTS

RESISTORS	INDUCTORS	CAPACITORS
R_1, R_{11} = 22K R_2, R_{12}, R16 = 4.7K R_3, R_7 = 220ohm R_4, R_9, R_{18}, R_{19} R_{21}, R_{25} = 100ohm R_8, R_{33} = 10ohm R_{15}, R_{26}, R_{35}-100K R_{17}, R_{28}, R_{30}=2.2K R_{20}, R_{22} = 470ohm R_{23}, R_{27}, R_{34}=10K R_{24} = 3300ohm R_{29} = 82ohm R_{31} = 1000ohm R_{32} = 10K	L_1 = 6.2uH L_2, L_3=0.074uH L_4 = 68nH L_7, L_8, L_9=0.018uH L_{10}, L_{11} = 5.6uH	C_1, C_6, C_{32}, C_{38} = 0.01uF C_2, C_{23}, C_{26}, C_{29} C_{30}, C_{34} = 470PF C_{33} = 33PF C_4, C19 = 15PF C_5 = 56PF C_8 = 82PF C_{10} = 18PF C_{11} = 2PF C_{12} = 24PF C_{13} = 39PF C_{24} = 1 PF C_{21}, C_{27}=47PF C_{22},C25,C28=1-8PF C_{31},C_{33},C_{39}=8.2uF C_{35} = 220PF C_{36} = 5-60PF C_{37} = 100PF
TRANSISTORS	**DIODES**	**OTHER COMPONENTS**
Q_1 – Q_3, Q_6=2N3563 Q_4 = 2n3564 Q_5, Q_7 = 2n3866 Q_8 = MPF 102 Q_9 = 2N 3565	LED 1 Standard red LED D_1-IN 757 9V Zener D_2-MV 2117 Varactor D_3 – IN 4002	J_1 – Video Camera Jack J_3 – coaxial power Jack. J_2 – BNC Jack.