Laser Audio and Video Transmitter and Receiver

Degree Project Report

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Dated:

CERTIFICATE

We accept the work contained in the degree project report titled (**Laser Audio and Video Transmitter and Receiver**) as a confirmation to the required standard for the partial fulfillment the degree of BS (ETM).

Project Coordinator

Supervisor **Internal Examiner** **External Examiner**

Head of Department

Acknowledgement

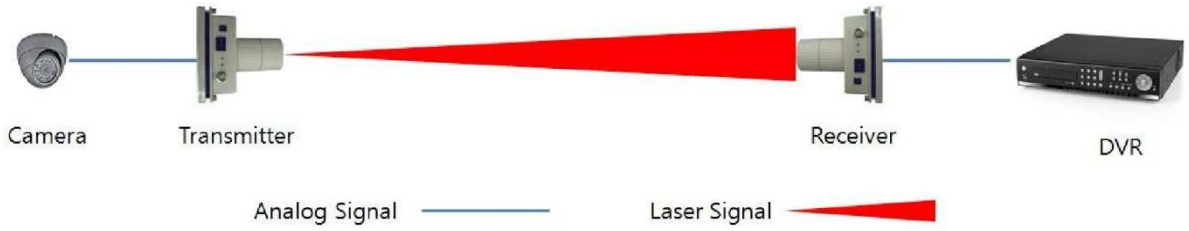
First of all we are very thankful to Almighty Allah that we have successfully completed our project. In all stages of our project there was a grace of Allah. On the other hand we are very grateful to our teachers. They helped us a lot. Especially our supervisor Ms.Madeeha Basharat. And secondly we are very thankful to our project coordinator Sir Junaid Imtiaz. At this stage of life we cannot miss our parents who have sacrificed and made lot of efforts for us to reach this position in our life. Last but not the least we shall thank all those who have helped us in completing our thesis directly or indirectly.

Dedication

This project is dedicated to our parents, teachers, brothers and friends.

Abstract

The objective of this research is to design audio and video transmitter and receiver. The motive is to provide a fast and secure communication between transmitter and a receiver. The medium of communication is laser. The laser carries audio and video and is received with the help phototransistor. LM386 audio amplifier IC is used to filter the audio signal and an error free audio is available. The video is received and an LCD is used to show video. To minimize cost laser was used to transmit signals via line of sight instead of fiber optic. This project is cost effective while achieving the goals and an estimate of the cost is also made.



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CHAPTER#1 INTRODUCTION

1.1 Block diagram

Fig 1.1

Transmitter

Receiver

1.2 Project motivation

In this project approach our teachers motivated us. We consulted different people to either start this project or not. We also read a lot of material on the internet about this topic. This project is based on the communication between transmitter and a receiver and the mode of communication is laser. We were motivated to start this project because we thought that now days the wired systems are a big problems for us and distortions and error signals are present because of wires. On the other hand the wireless systems also include distortions that are due to atmospheric conditions like rain, attenuation of a signal. So we selected the laser for this project. Because the laser is the technology that can transmit data at a high speed without WEP (Wired Equivalent Privacy) which is the internet protocol used for the wireless network security purpose. This project is made for both transmissions of data, audio as well as video.

1.3 Project Objectives

In this project we have to make a communication system that is based on laser technology. The laser is a fast and reliable technology. It has high data rates as compared to the wireless technology. There is less attenuation in a laser than wireless technology. We have to transmit both audio and video data in our project for the audio the laser has a disadvantage that it has line of sight without the line of sight the signal will not be received properly and it will result in a distortion. So the both ends transmitter and the receiver should be in line of sight with each other to eliminate errors in the communication. There are few steps that are involved in our project that are important to discuss these steps are as follows:

Steps:

1. Battery voltage of 12 volts is applied to the circuitry. There is a transmitter that transmits the laser beam and a receiver that receives audio and video signals.
2. There is an audio amplifier at the receiving side that is used to amplify the signal and getting high gain signal.
3. Filters are used to remove the distortion.
4. The 5V regulator is also used because to save the laser from 12V the laser can only hold 5V so it is used to save the laser from high voltages.
5. At the receiver side there is a photo diode used to absorb the laser light and with the help of speakers the audio is heard at the receiving side.
6. At the transmitting side there is a microphone that is used for audio.
7. For the transmission of video a video modulator is used.

1.4 Project aims

The aim of this project is to make a fast laser communication system. The components that are used in this project are interrelated to each other. The purpose of performing these steps is to make a communication system that has a less distortion and high data rate and signal quality. But the flaw is that the line of sight should be equal between the transmitter and the receiver. Now our aim is to just maintain the problem of line of sight because if line of sight will not be equal then our system will result in distortion or noise. So what we have done is that we have put both the transmitter and receiver aligned in a fixed position with each other. The wavelength of the laser is 680nm and we have used red laser. The aim of using red laser is that it improves the range and it has more power and it faces fewer distortions. Another extension in this project is that at the receiver side there are speakers to listen the audio but we have also introduced the A/v jack and this A/V jack can also be tuned into a mobile. When any song is selected from source on transmitter side it can be heard with the help of laser at the receiver side. The laser will be aligned with the photo transistor.

1.5 Project requirements

The project requirements are as follows:

Audio Transmitter:

Resistors	10kohm , 150 ohm
Diode	IN-4007
Variable resistors	470ohm, 10kohm
Transistors	NPN-945
Regulator	7805
Laser diode	
Capacitors	10uF (2), 220uF
Battery	12V

Audio Receiver:

Resistors	10kohm , 90ohm
Capacitors	220uF, 104pF, 10uF (2)
Operational amplifier	LM-386
Phototransistor	NPN (L14G3)
Battery	12V

To transmit an audio signal with the help of a laser we were required these components which are mentioned above. At the transmitting side we used battery to provide voltage to the circuit then we used a regulator that converts these 12V into 5V because our laser works at 5V. Then we used variable resistor that is used to control the intensity of sound shrill or grave. At the input we connected the microphone, mobile or MP3 player. At the input of the transistor NPN-945 the laser diode is connected as the laser diode is exactly aligned with the phototransistor so that the audio is heard without any signal distortion. At the receiving side we have placed a speaker in which we can hear the voice that is transmitted from the transmitter. Now the laser beam that is transmitted from the transmitter hits the phototransistor in the receiving end. The receiving circuit is connected to a 12V battery supply. After hitting the phototransistor there is an operational amplifier that we have used for filtering the audio signals. The audio signals coming from the transmitter are not so clear so the use of this operational amplifier is used to filter the distorted signals and produce a pure audio signal.

Video Transmitter:

Regulator	7805
Battery	12V
Laser diode	
Resistors	47k, 10k,1k, 150ohm
capacitors	470uF, 103pF(2), 102pf,335pf
Transistor	NPN-945
Inductor	200 ur

Video Receiver:

Photo transistor	NPN (L14G3)
Video modulator	
OP- AMP	LM-741
Resistors	10k(2), 270k
Capacitor	10uF

Like the audio signal the video signal is also transmitted from the transmitter. The battery voltage of 12V is applied to the circuit. When this 12V pass through the 7805 regulator IC it is converted into 5V. At the transmitting end we can place a camera which records live transmission of video and we can see that video at the LCD without any time delay. The red laser is used for both audio and video. Its wavelength is 680nm. And it has a very good data rates and high speed data transfer. It has less attenuation. The attenuation of signal is increased when the alignment of transmitter and the receiver is out of order. At the receiver side there is a photo transistor that absorbs the signals that is coming from the transmitter. This signal is then fed into the video modulator. The video modulator function is that its converts a optical signal into a video signal. The frequency of the camera can be matched by adjusting the variable resistor. After passing through the video modulator this signal is amplified with the help of an amplifier so that distortion and signal attenuation can be eliminated and at the end a pure video signal is received at the receiver side with the help of laser technology.

Chapter#2 Literature Review

2.1 Background

The concept of communication has been started when the world was made. In the olden days the communication network was very slow. People used to communicate with the help of letter, telegrams, and pigeons. But gradually the time started to change and after sometime the analog telephone was invented by Graham Bell in the year 1870. At that time the people thought that all the problems are solved and they have got the phone. But this was also a problem because in those days there was huge bundle of wires that was used to communicate between the transmitter and a receiver. So in this way the line costs were increased and the load between transmitter and receiver was increased a lot. Most of the time it happened that the number that was dialled from one place to another it would get a busy tone. So this was also a big issue. After this issue the communication experts thought that there should be a system that can decrease the number of wires and can decrease the line cost and more users are accommodated. So FDM technology came into being in this technology many calls were transmitted at the same time and multiplexed. And they were transmitted at one line. This line was fiber optic cable that has a huge capacity of transmitting data and voice etc. After this technology the wireless was introduced but our concern is about the laser technology. The laser is abbreviated as (light amplification through stimulated emission of radiation). The laser uses light source to transmit data. This light source is very thin. The laser uses the concept of stimulated emission to produce a light source. Another advantage of a laser is that it uses a pump. The pump is actually the source or energy for the laser. Another thing is the active medium that is used to convert the stored energy into the laser through the process of stimulated emission. Another thing is the optical cavity that is made up with mirrors. We are using laser technology due to its fast communication and also for long range communication. Our main aim of using laser is to provide safer communication because laser light can't be hacked. like wifi communication it is easily hacked by matching the frequency .Laser is the most secure communication ever.

2.2 Readings list

To create more beauty in this project we studied different articles books etc to achieve our goals. We also took help from the internet which is a very valuable source of getting knowledge. We also took internet lectures on the free space laser communication. The websites that we consulted to achieve knowledge includes www.geek.com/articles/tagged/laser-communication-relay/.
courses.cit.cornell.edu/ee476/FinalProjects/s2003/kmc29/index.htm
www.howstuffworks.com › Science › Physical Science › Optics

2.2.1 Books reviewed:

In our project we studied different books about the laser communications. The books areenlisted below:
Lasers by Anthony.E. Seigman
Principles of Laser by Orazio Svelto

2.2.2Articles reviewed:

The articles were present at IEEE explore. We studied those articles also to get some help about our project.

Chapter#3 Project Methodology

3.1 Tools and description of steps involved:

3.1.1 Lm-386 audio amplifier:

Fig 1.2

3.1.2 Features:

1. It is generally used for battery operation.
2. Its voltage ranges from 4V-12V or 5V-18V.
3. Its current drain is 4mA.

3.1.3 Description:

It's a low voltage amplifier that is used for the low voltage purposes. It gain is 20 to keep the external parts count low. The use of resistor and capacitor between the pin 1 and 8 can increase the gain up to 200.

3.1.4 Applications:

This audio amplifier has several applications such as radio amplifier, tape player amplifiers, and sound systems of TV, power converters, line drivers, and small servo drivers.

3.1.5 7805 Regulator

Fig 1.3

3.1.6 General description:

It is a three terminal device that is used for current limiting purposes. They are safe from any damage from output overloads. They can deliver approximately 0.5A output current. It can eliminate noise and degraded performance that is associated with single point regulation.

3.1.7 Features:

Some features of 7805 regulator is given below

1: the output current of 7805 regulator is 0.5A.
2: there are no external components.
3: it provides internal thermal overload protection.
4: it has output voltages of 5V, 12V and 15V.

3.1.8 Laser diode:

Fig 1.4

3.1.9 Description:

Laser diode is a device that emits stimulated emissions of radiation. It is a semiconductor device that produces radiations that are coherent. When the current is passed through the laser diode it produces same frequencies and phases. The laser diodes have small size and less weight they have fewer requirements for power voltage and current. They have low intensity the people are actually confused about laser they think that the laser is used to make thick hole in a metal, they are used to put the aircraft pilot blind. Or it is used to destroy the satellites but this is not the truth actually the laser is used for control applications and communications between a transmitter and a receiver.

3.1.10Transistor NPN-945:

Fig 1.5

3.1.11 Description:

A transistor is a device that can be used as a switch or it's used for switching purposes. There are three legs in a transistor they are as follows

3.1.12 Base: The base in a transistor is defined as a leg that is used to activate the transistor. The base is a P region of a transistor that lies between two N doped regions.

3.1.13 Emitter: In the NPN transistors the emitter is made up of N type material. Its base is a P type region and at last the collector is an N type region. NPN transistor operated when the emitter is connected to the negative side the base and collector is connected to the positive side.

3.1.14 Collector: A collector in a transistor is a leg where the output is collected. It is also an N doped region of a transistor. When the current comes from the emitter it goes into the base for some time and after passing through the base it is received at the collector.

3.1.15 Video modulator

Fig 1.6

3.1.16 Description

The video modulator or an RF modulator is a device that is used to distribute video signals. They are used to convert a yellow video and the red green audio signals from VCR, DVD player to a UHF, VHF signals etc.

3.1.17 Diode IN-4007

Fig1.7

3.1.18 Description

A diode is a device that has two terminal one is positive and another one is negative terminal. The diode helps the current to pass in only one direction. In this state the diode is forward biased diode. In this state the diode blocks the reverse current. The diodes are made up of silicon and germanium.

3.1.19 Forward biased diode

The forward biased diode is a diode in which the P region is connected to the positive terminal of a battery and the negative terminal is connected to the negative terminal of the battery. In this case the electrons the P carriers and the holes N carriers are combined at the junction.

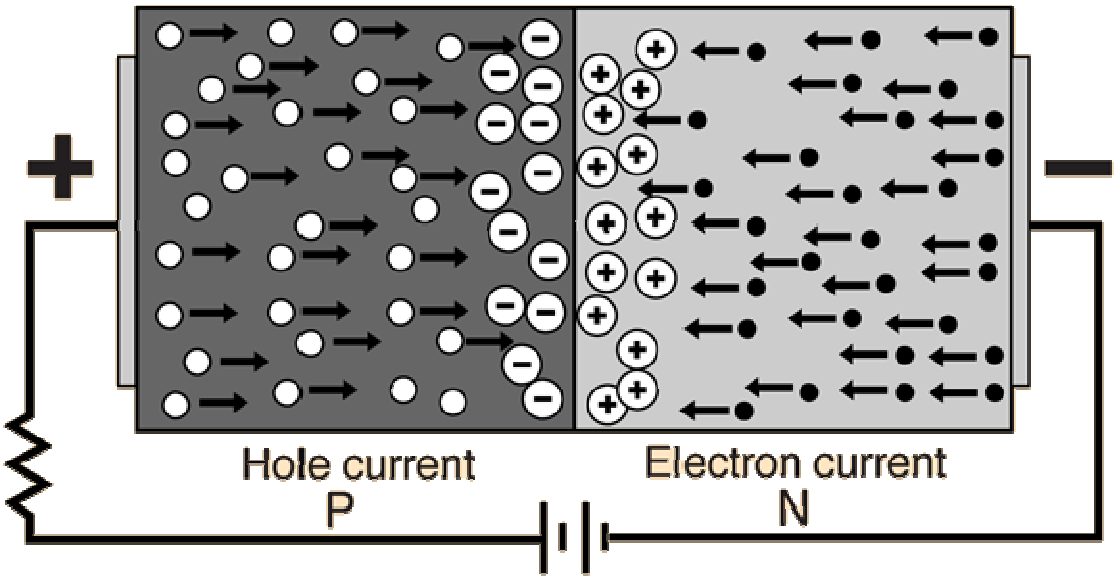


Fig 1.8

3.1.20 Reverse biased diode

The reverse biased diode is a diode in which the P region is connected to the negative terminal of a battery and the N region is connected to the positive terminal of the battery. In this case the electrons the P carrier and hole N carriers are repelled from the junction.

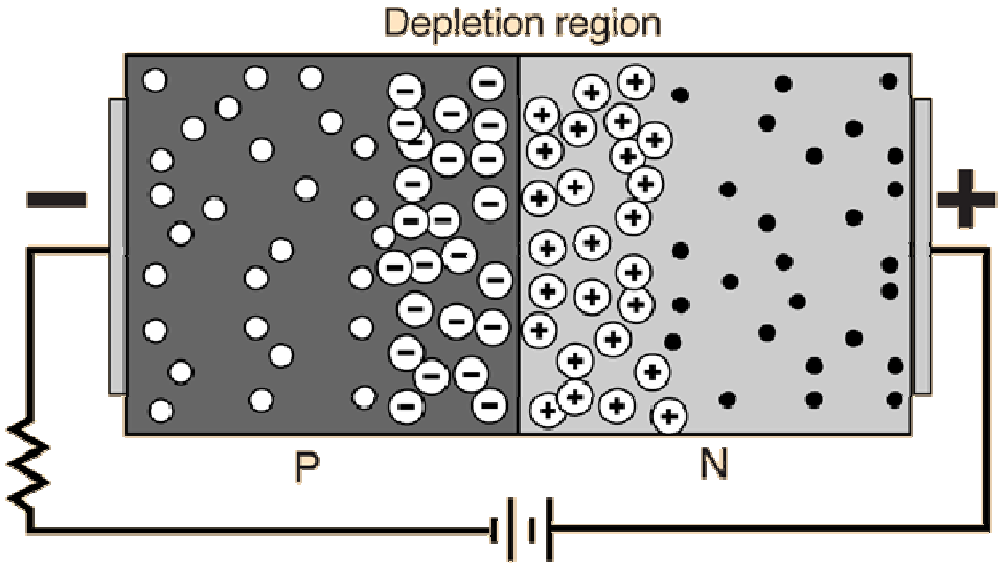


Fig 1.9

3.1.21 Phototransistor NPN (L14G3)

Fig 1.10

3.122 Description

The phototransistor is a device that is used to convert a light energy into voltages and currents. In our experiment we have to produce audio and video signals. So when the laser light hits the photo transistor. The phototransistor converts that light into the current. It is a light sensitive device. If a fraction of light also hits a phototransistor it produces current or voltage.

3.123 Applications

The photo transistors have lot of applications in daily life. They are used in the circuits that can sense light around them. It has lot of applications in smoke detectors, night vision etc.

3.1.24 Variable capacitor (470uF)

Fig 1.11

3.1.25 Description

It is a type of capacitor which is used to tune the radios. It is used for increasing and decreasing the electrical charge from one value to another. A normal capacitor is used for storing the charge its also used for storing the charge but in this capacitor we can adjust the charge according to our requirements.

3.1.26.Resistor

Fig1.12

3.1.27 Description

The resistor is a device that is used in an electronics circuit to resist the flow of current. We see that when the resistance in any electronic circuit is increased then the amount of current is decreased. This is due to ohms law which states that resistance and current are inversely proportional to each other

Chapter#4 Project Specification

4.1 Technology used

The technology that we are using between the transmitter and receiver is laser technology. We have used a red laser whose wavelength is 680nm. It has a high intensity and it has a long range.

Circuit diagram

4.2 Audio transmitter

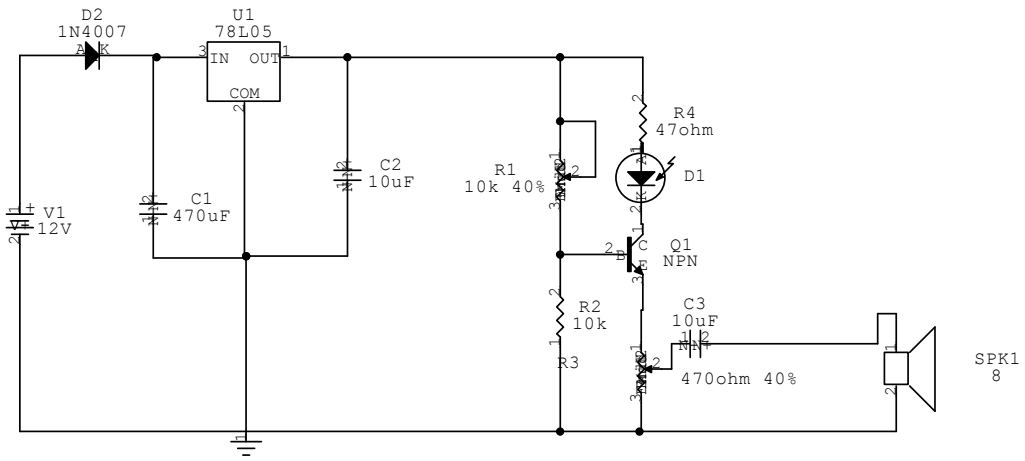


Fig 1.13

4.2.1Simulation steps

We have done simulation on circuit maker

1. There is a 12V battery connected to this circuit.
2. When the 12V are reached at the diode IN4007 the diode saves this whole circuit from damage or short circuiting due to different poles. The voltage at the diode is 11.35V.
3. After passing through the diode the voltage through 7805 regulator is 5.038V.
4. Then the voltage through variable resistor R1 is 2.494V.
5. The voltage calculated at the laser diode is 1.765V.
6. The voltage at the transistor NPN is 1.747V.
7. At last the voltage at capacitor C3 is -1.400pV.

4.2.2 Assembly of equipment

For an Audio Transmitter the equipment that is used is enlisted below:

Resistors	10kohm,150 ohm
Variable resistors	470ohm, 10kohı
Transistors	NPN-945
Regulator 7805	5V
Laser diode	
Capacitors	10uF (2), 220uF
Diode	IN4007
Battery	12V

For a Audio Receiver the equipment that we used is enlisted below:

Resistors	10kohm , 90ohm
Capacitors	220uF, 104pF, 10uF (2)
Operational amplifier	LM-386
Phototransistor	NPN (L14G3)
Battery	12V

For a Video Transmitter the equipment that we used is enlisted below

Regulator	7805
Battery	12V
Laser diode	
Resistors	47k, 10k,1k,
capacitors	470uF, 103pF(2), 102pf,335pf
Transistor	NPN-945
Inductor	335 pF

For the video receiver the equipment that we used is enlisted below

Photo transistor	NPN (L14G3)
video modulato	
Audio amplifier	LM-386
Resistors	10k(2), 270k
Capacitor	10uF

Circuit diagram

4.2.3 Audio receiver

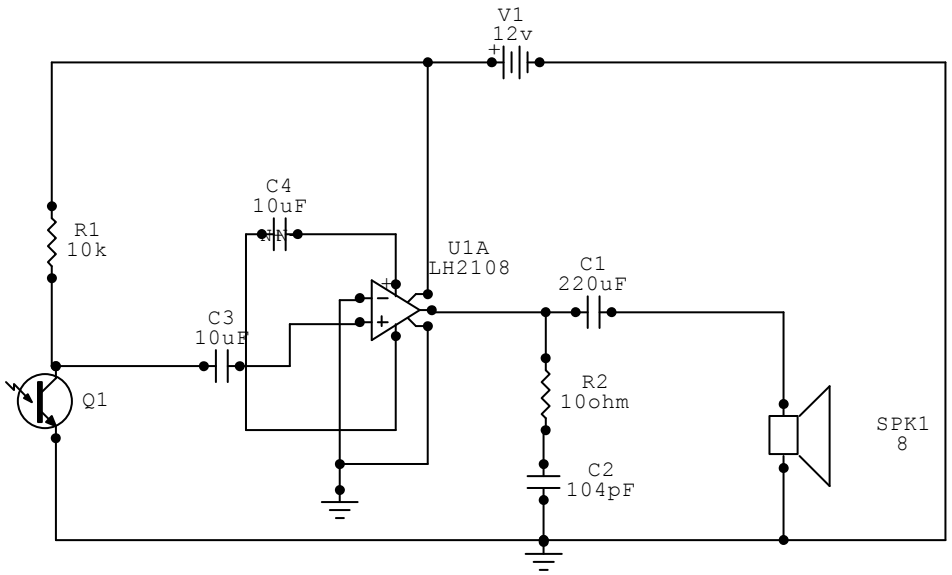


Fig 1.14

4.2.4 Simulation steps

1. At the receiving side the laser light is absorbed by the phototransistor and then it produces voltages and currents in the receiving circuitry.
2. Then an LM386 audio amplifier amplifies the audio and removes distortion from it.
3. A 12V battery is used to provide the power to receiving circuit.

4.2.5 Video Transmitter

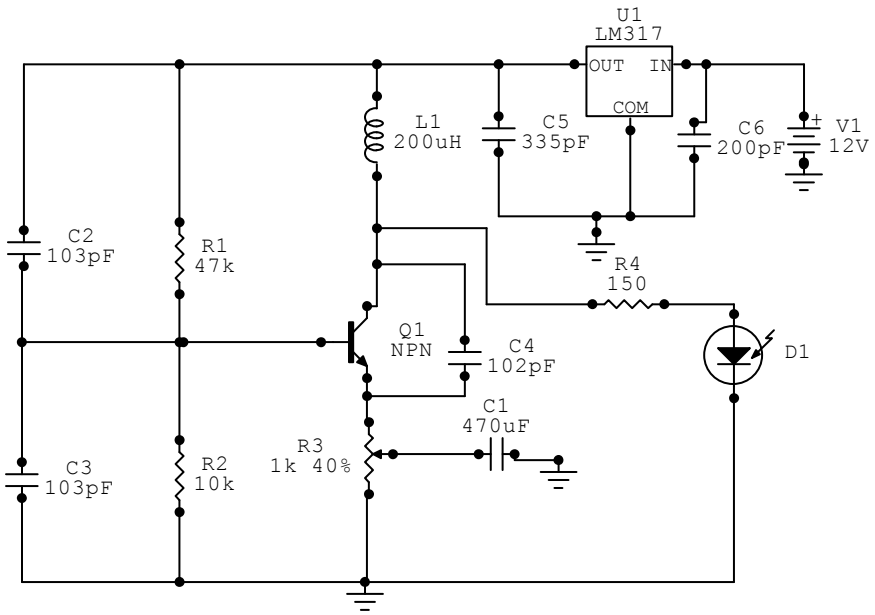


Fig 1.15(A)

4.2.5 Video Receiver

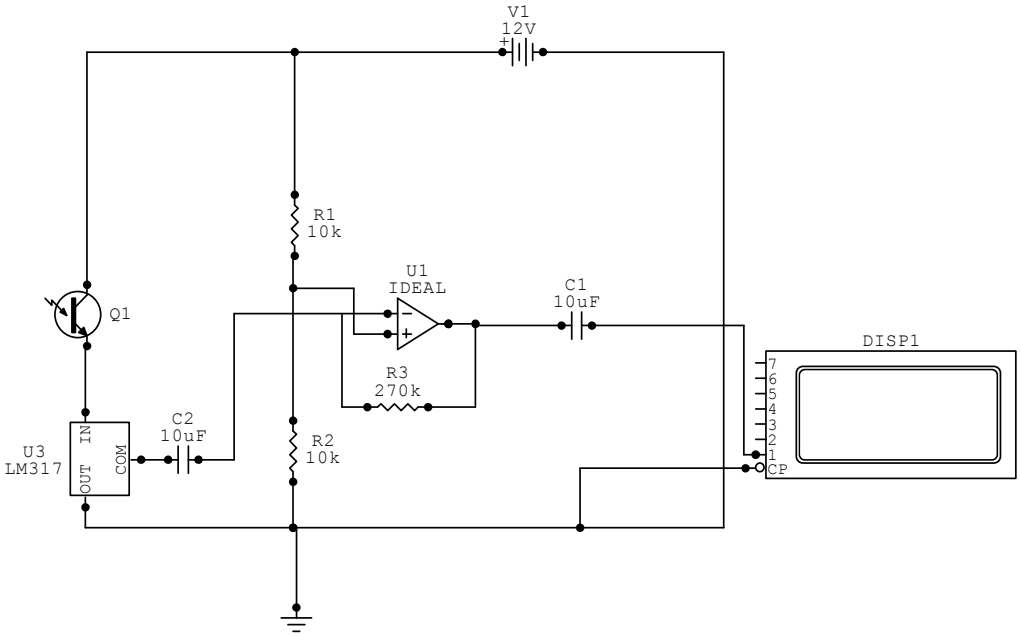


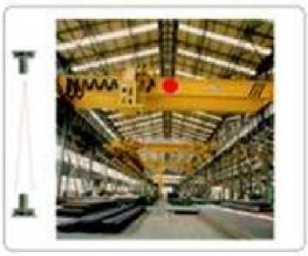
Fig 1.15(B)

4.2.6 Simulation steps

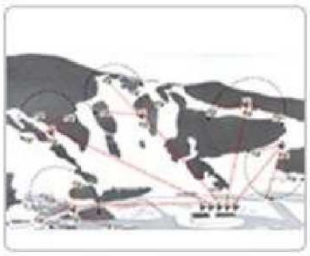
1. The battery voltage of 12V is applied to the circuit. These 12V when pass through the 5V regulator IC then these 12V are converted into 5V.
2. Then there is a variable resistor that is used to control the laser diode. The red laser is used for both audio and video. Its wavelength is 680nm.
3. The attenuation of signal is increased when the alignment of transmitter and the receiver is out of order. At the receiver side there is a photo transistor that absorbs the signals that is coming from the transmitter.
4. This signal is then fed into the video modulator. The video modulator function is that its converts a signal into a video signal. This device is actually a video jack.
5. Signal is amplified with the help of an amplifier so that distortion and signal attenuation can be eliminated at the end we get a pure video at the receiver side with the help of laser technology.

4.2.7 Applications and Implementation

The applications of this project can be in many fields such as:

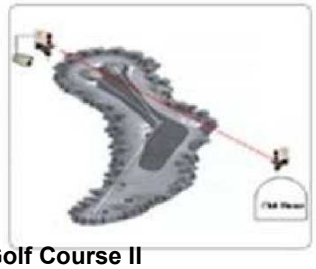

Crane


Fire Monitoring


Sky Slope Monitoring


Wild Fire Surveillance


Golf Course I

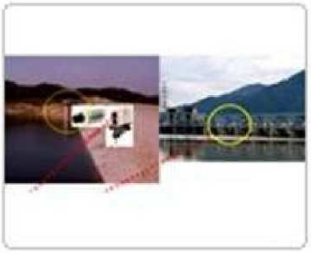

Golf Course II

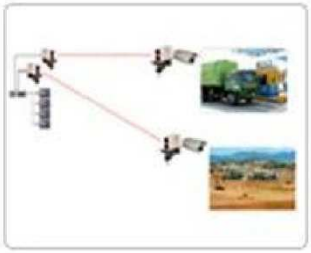

Harbor Monitoring


Water treatment


River Control


Water treatment


River Control


Waste Management


Border

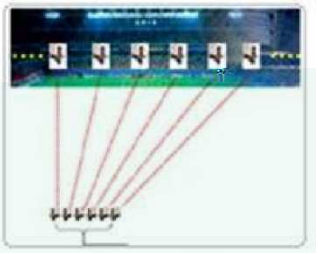

Broadcast

Fig 1.16

Appendix 1

National Semiconductor

August 2000

LM386
Low Voltage Audio Power Amplifier

General Description

The LM386 is a power amplifier designed for use in low voltage consumer applications. The gain is internally set to 20 to keep external part count low, but the addition of an external resistor and capacitor between pins 1 and 8 will increase the gain to any value from 20 to 200.

The inputs are ground referenced while the output automatically biases to one-half the supply voltage. The quiescent power drain is only 24 milliwatts when operating from a 6 volt supply, making the LM386 ideal for battery operation.

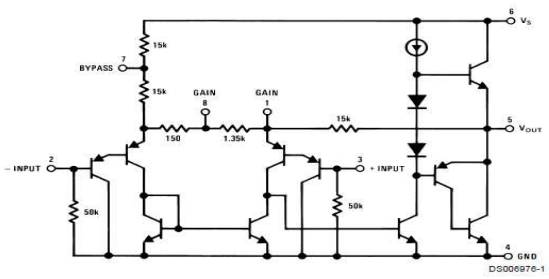
Features

- Battery operation
- Minimum external parts
- Wide supply voltage range: 4V–12V or 5V–18V
- Low quiescent current drain: 4mA
- Voltage gains from 20 to 200
- Ground referenced input
- Self-centering output quiescent voltage
- Low distortion: 0.2% (A_V = 20, V_S = 6V, R_L = 8Ω, P_O = 125mW, f = 1kHz)
- Available in 8 pin MSOP package

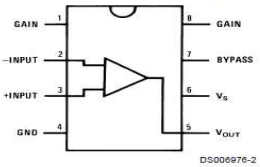
Applications

- AM-FM radio amplifiers
- Portable tape player amplifiers
- Intercoms
- TV sound systems
- Line drivers
- Ultrasonic drivers
- Small servo drivers
- Power converters

Equivalent Schematic and Connection Diagrams



Small Outline, Molded Mini Small Outline, and Dual-In-Line Packages



Top View
Order Number LM386M-1, LM386MM-1, LM386N-1, LM386N-3 or LM386N-4
See NS Package Number M08A, MUA08A or N08E

Fig 1.17

Appendix2

National Semiconductor

August 2005

LM341/LM78MXX Series
3-Terminal Positive Voltage Regulators

General Description

The LM341 and LM78MXX series of three-terminal positive voltage regulators employ built-in current limiting, thermal shutdown, and safe-operating area protection which makes them virtually immune to damage from output overloads.

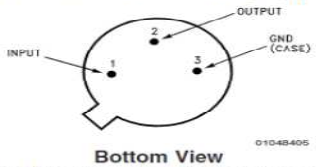
With adequate heatsinking, they can deliver in excess of 0.5A output current. Typical applications would include local (on-card) regulators which can eliminate the noise and degraded performance associated with single-point regulation.

Features

- Output current in excess of 0.5A
- No external components
- Internal thermal overload protection
- Internal short circuit current-limiting
- Output transistor safe-area compensation
- Available in TO-220, TO-39, and TO-252 D-PAK packages
- Output voltages of 5V, 12V, and 15V

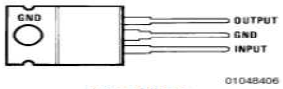
Connection Diagrams

TO-39 Metal Can Package (H)



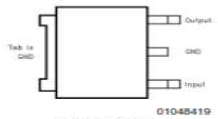
Bottom View
Order Number LM78M05CH, LM78M12CH or LM78M15CH
See NS Package Number H03A

TO-220 Power Package (T)



Top View
Order Number LM341T-5.0, LM341T-12, LM341T-15, LM78M05CT, LM78M12CT or LM78M15CT
See NS Package Number T03B

TO-252



Top View
Order Number LM78M05CDT
See NS Package Number TD03B

LM341/LM78MXX Series 3-Terminal Positive Voltage Regulators

Fig 1.18

Appendix 3

DC COMPONENTS CO., LTD.

RECTIFIER SPECIALISTS

1N 4001A / RL 101 THRU 1N 4007A / RL 107

TECHNICAL SPECIFICATIONS OF SILICON RECTIFIER

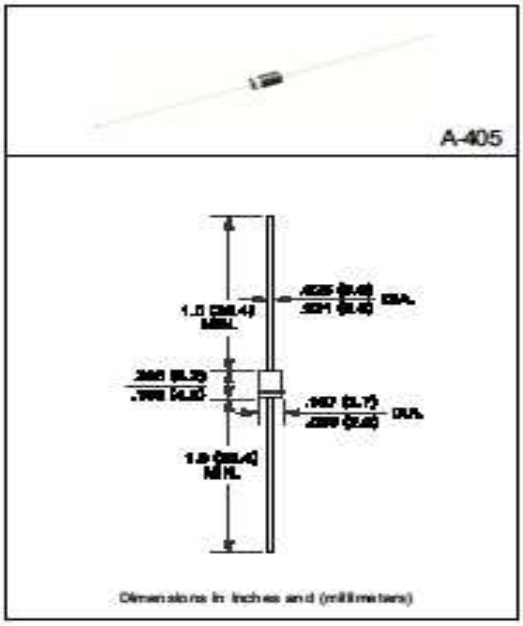
VOLTAGE RANGE - 50 to 1000 Volts CURRENT - 1.0 Ampere

FEATURES

* High reliability
* Low leakage
* Low forward voltage drop
* High current capability

MECHANICAL DATA

* Case: Molded plastic
* Epoxy: UL 94V-0 rate flame retardant
* Lead: MIL-STD-202E, Method 208 guaranteed
* Polarity: Color band denotes cathode end
* Mounting position: Any
* Weight: 0.22 gram



Dimensions in inches and (millimeters)

MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Ratings at 25 °C ambient temperature unless otherwise specified.
Single phase, half wave, 60 Hz, resistive or inductive load.
For capacitive load, derate current by 20%.

		SYMBOL	1N4001A RL101	1N4002A RL102	1N4003A RL103	1N4004A RL104	1N4005A RL105	1N4006A RL106	1N4007A RL107	UNITS
Maximum Recurrent Peak Reverse Voltage		V_{RRM}	50	100	200	400	600	800	1000	Volts
Maximum RMS Voltage		V_{RMS}	35	70	140	280	420	560	700	Volts
Maximum DC Blocking Voltage		V_{DC}	50	100	200	400	600	800	1000	Volts
Maximum Average Forward Rectified Current at TA = 55°C		I_O	1.0							Amps
Peak Forward Surge Current, 8.3 ms single half sine-wave superimposed on rated load (JEDEC Method)		I_{FSM}	30							Amps
Maximum Instantaneous Forward Voltage at 1.0A DC		V_F	1.1							Volts
Maximum DC Reverse Current at Rated DC Blocking Voltage	@TA = 25°C	I_R	5.0							uAmps
	@TA = 100°C		500							
Maximum Full Load Reverse Current Average, Full Cycle .375" (9.5mm) lead length at T_L = 75°C			30							uAmps
Typical Junction Capacitance (Note)		C_J	15							pF
Typical Thermal Resistance		$R_{\theta JA}$	50							°C/W
Operating and Storage Temperature Range		T_J, T_{STG}	-65 to + 175							°C

NOTES : Measured at 1 MHz and applied reverse voltage of 4.0 volts

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Fig 1.19

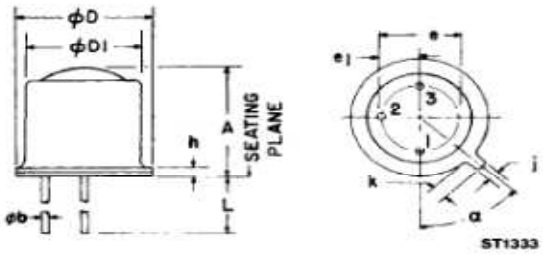
Appendix 4

QT OPTOELECTRONICS

HERMETIC SILICON PHOTOTRANSISTOR

L14G1/2/3

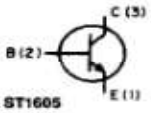
PACKAGE DIMENSIONS



SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	.225	.255	5.71	6.47	
⊕b	.016	.021	.407	533	
⊕D	.209	.230	5.31	5.84	
⊕D1	.178	.195	4.52	4.96	
e	.100 NOM		2.54 NOM		2
e1	.050 NOM		1.27 NOM		2
h	—	.030	—	.76	
j	.036	.046	.92	1.16	
k	.028	.048	.71	1.22	1
L	.500	—	12.7	—	
α	45°	45°	45°	45°	3

PACKAGE OUTLINE

(COLLECTOR CONNECTED TO CASE)



ST1605

NOTES:
1. MEASURED FROM MAXIMUM DIAMETER OF DEVICE.
2. LEADS HAVING MAXIMUM DIAMETER .021" (.533mm) MEASURED IN GAUGING PLANE .054" + .001" – .000 (137 + .025 – .000mm) BELOW THE REFERENCE PLANE OF THE DEVICE SHALL BE WITHIN .007" (.778mm) THEIR TRUE POSITION RELATIVE TO MAXIMUM WIDTH TAB.
3. FROM CENTERLINE TAB.

DESCRIPTION

The L14G series is a silicon phototransister mounted in a narrow angle, TO-18 package.

FEATURES

- Hermetically sealed package
- Narrow reception angle

Fig 1.20

1.2.1 References

1 Resistor
http://www.google.com.pk/search?hl=en&q=resistor&bav

2 Variable capacitor
Wise geek.com

3 Video modulator

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