

# IMPLEMENTATION OF USB FM RADIO RECEIVER FOR PC

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**ABSTRACT :** An aim of a work is to develop an FM radio using computer peripheral known as the USB Radio, worked as a plug and play device for a computer .The radio is capable of receiving FM signals in a standard FM band of 88 to 108 MHz. It is designed to take an advantage of the popular communication protocol Universal Serial Bus (USB) by connecting an FM radio to a personal computer. A required power for a hardware module is provided by a computer via USB. In the hardware module, major components are the FM radio receiver IC and the microcontroller. A software programming can be done in keil , java or c++.

**KEYWORDS:** Frequency Modulation, Universal Serial Bus, Serial Peripheral Interface Bus, Microcontroller, Radio frequency.

## 1. INTRODUCTION

Following the increasing number of FM stations in the country the rate of interference between stations is in the increase as a result of this the sound quality of a simple FM receiver is very bad. And today, most of the people is having a personal computer and they are interested to listen a FM radio on personal computer while they are working on it. An aim of this work is to make an USB based FM radio to be connected as a radio receiver device supporting Microsoft Windows operating system. The device will make it possible to listen to FM radio stations on computer without use of an internet..An audio signal can be received through FM IC. Major components are FM radio receiver, microcontroller peripheral, a host PC. A PC plays the audio using the PC speakers. So sound quality of FM radio signal is better to make it audible via computer speakers.

This work is divided in two parts. In first part simple FM radio is made in which FM audio signal is received by FM tuner and it is given to a computer. Using a program of computer it can be run. In this work FM tuner is controlled manually. It is a limitation of this design. As a second part, USB FM radio will be designed based on microcontroller IC. Through microcontroller IC, FM IC will be tuned by GUI of computer. Thus all control of FM radio can be done by computer using microcontroller. So FM signal now will be tuned by computer and song will be played on computer speakers.

## 2. DETAILED ARCHITECTURE

Figure 1 Detailed architecture is shown. In which three major parts are shown. From antenna FM signal is received by FM IC.FM IC is interfaced with microcontroller IC, such that FM IC is controlled by microcontroller IC. Though USB, computer system and microcontroller IC are interfaced, using speaker of computer system an audio signal is heard.FM IC can be scanned by computer using GUI.

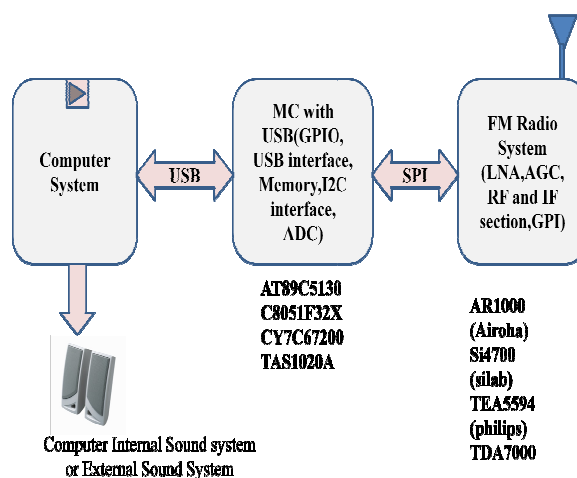


Fig.1 Detailed Architecture of USB FM radio.

**3. SYSTEM DESIGN**

This project aims designing an USB FM receiver using CXA1619 integrated circuit (IC) for demodulation; this is inbuilt in the IC to eliminate the complications involved in the use of RF transformers which require impedance matching process. An output of FM receiver will be given to computer and using software of computer an audio signal will be played on speakers of computer. A required power for a circuit will be given by USB port.

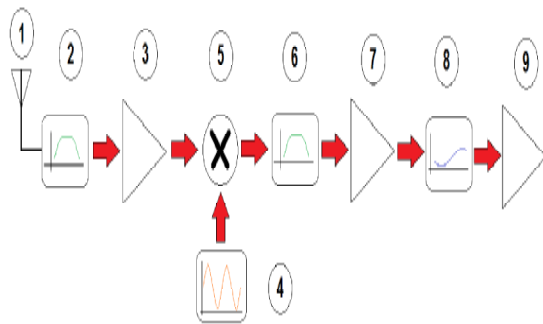


Fig.2 Block Diagram of an FM receiver [4].  
Block Functions: 1 Antenna; 2. RF Filter; 3. Low Noise Amplifier; 4. Local Oscillator; 5. Mixer; 6. IF Filter; 7. IF Amplifier; 8. Demodulator; 9. Audio Amplifier

**Internal Block Of IC CXA1619**

The FM is based on superheterodyne principle. This chapter is about to discuss FM receiver design using CXA1619 IC. CXA1619BM/BS is a one chip FM/AM radio IC designed for radio-cassette tape recorders and headphone tape recorders,

**FM Section**

- RF amplifier, Mixer and OSC
- IF amplifier
- Quadrature detection

**AM Section**

- RF amplifier, Mixer and OSC
- IF amplifier
- Detector

**RF Amplifier**

The input amplifier with RF selection (88-108 MHz) should have low noise, high gain and frequency selection.[5] The signal from the antenna is tuned and may be amplified in a RF amplifier. One or more tuned circuits at this stage block frequencies which are far removed from the intended reception frequency. For a tuning of the receiver to a particular station, the frequency of the local oscillator is controlled by the tuning. Tuning of the local oscillator and the RF stage may use a variable

capacitor. RF stage tuning must follow tuning of the local oscillator.

**Local Oscillator**

In radio receivers, Local Oscillators shift incoming tuned frequencies to a specified range above or below the incoming tuned frequency. Its usefulness is not fully realized by its frequency-shifting role alone, but also in its ability to change its output frequency as defined by the tuned input frequency. In typical FM receivers, the L.O. has an output of 10.7 MHz above or below the incoming tuned RF, depending on the particular intermediate frequency desired, and the method in which the L.O. frequency is created. Therefore, the output function of a typical FM receiver L.O. is specified as: (RFtuned +/- Desired IF value in Hz.) This output frequency then feeds the Mixer, and plays a critical part in FM Heterodyning.[6]

**Mixer**

A mixer is an active or passive device which converts from one signal frequency to another. It is having two input one from RF circuit and second input from LO. An output of the mixer is different frequency, which is called Intermediate frequency. A mixer takes an RF input signal at a frequency  $f_{RF}$ , mixes it with a LO signal at a frequency  $f_{LO}$ , and produces an IF output signal that consists of the sum and difference frequencies,  $f_{RF} \pm f_{LO}$ . [7] The user provides a bandpass filter that follows the mixer and selects the sum ( $f_{RF} + f_{LO}$ ) or difference ( $f_{RF} - f_{LO}$ ) frequency.

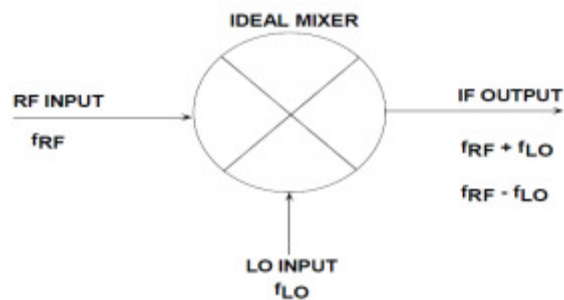


Fig.3 The mixing process.

**IF amplifier**

An IF amplifier is considered same as a RF amplifier. Which is an amplifier for particular frequency. An output of a mixer is intermediate frequency. Which is amplified by IF amplifier.

**Quadrature detection**

The basic principle of a quadrature FM discriminator is given in figure as below.

Frequency modulated signal is

$$v_{FM}(t) = A \cdot \sin\left(\omega_c t + \frac{\Delta f}{f_m} \sin \omega_m t\right)$$

Where  $\omega_c = 2\pi \cdot f_c$  is the carrier angular frequency,  $\omega_m = 2\pi \cdot f_m$  is the baseband modulating angular frequency and  $\Delta f$  is maximum frequency deviation. Maximum frequency deviation is  $\pm 75\text{Khz}$ . Where first is an instantaneous frequency  
The circuit of quadrature FM discriminator is made up by a phase shifter, mixer and lowpass filter. A frequency modulated signal is given in input of a phase shifter circuit. A phase shifter is a circuit which gives 90 degree phase of input signal. A mixer will multiply two quadrature signals. Output of mixer consist of desired demodulated fm signal as well as other parasitic signal component and DC component. This parasitic signal is removed by means of low pass filter.

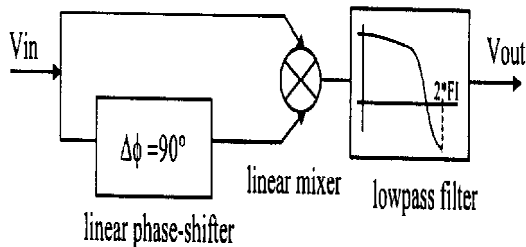


Fig.4 Quadrature Detection.

**4. IMPLEMENTATION**

A developed circuit is shown in figure 5. An IC CXA1619 is integrated circuit, because of that least components are required to design a circuit. Required power is taken from computer through USB port. Pin no 1,11,13,18,20,28 are grounded. Pin no 2 is FM discriminator, filter CF1 is connected to this pin. Pin 3 is connected for negative feedback and 4 pin for is volume control. Pin 5,10,16,22 are not connected in circuit design because these pins are used to receive AM signal using IC. Pin no 6 is AFC pin, capacitor C3 and resistor R1 are connected with this pin. Pin no 7 is FM Oscillator pin, parallel connection of capacitor C4, inductor coil L1 and variable capacitor are connected to this pin to get local oscillator frequency. Pin no 9 is connected to RF tuning coil which is parallel connection of capacitor C5, inductor L2 and variable capacitor. Pin no 12 is RF input which is connected with an antenna. Pin no 14 is output of mixer which is connected to a filter CF2. Pin no 15 is internal band selection switch to select AM or FM band. Pin no 17 is input of FM IF amplifier, connected with filter CF2. Pin no 19 is for tuning indicator pin, but in this design tuning indicator is not used so this pin is grounded. Pin no 23 is detector output, which is connected to mic pin

of computer. In this design power amplifier of internal IC is not used for amplification of detected signal, because detected signal is given to a computer, thus amplification is not required through power amplifier of IC CXA1619. Pin no 24,27 are left opened, which is input and output of power amplifier. Pin no 26 is VCC pin, required voltage for IC is given on this pin from computer through USB port pin V+. Software will read an audio signal from mic and play audio signal on the computer speakers.

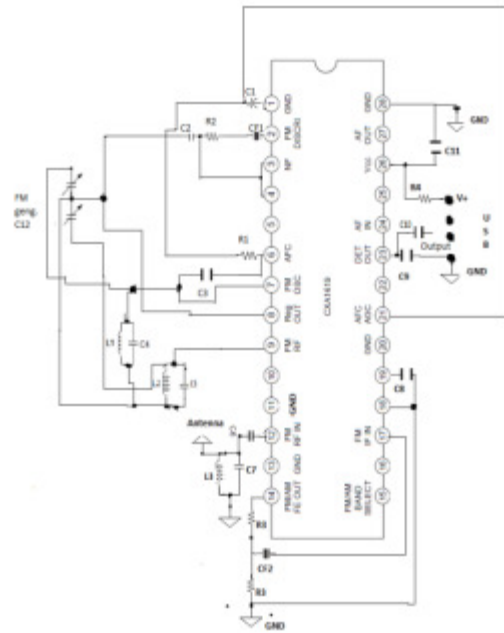


Fig.5 Circuit Design of FM Radio.

In design of FM circuit required power supply is given through USB port from computer[9].

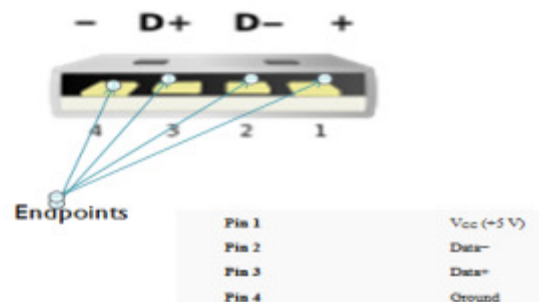


Fig.6 USB Pin.

The transmitted signals, from the transmitter antenna will be received through receiver antenna with reception bandwidth from 88MHz to 108MHz. Through RF coil desired signal is tuned and fed inside the IC. Inside IC RF signal and local oscillator frequency is given to the mixer, where new carrier frequency is generated called the Intermediate

frequency. The IF amplifier then amplify only the signal equal to the intermediate frequency. The FM detector detects an audio signal . The output from the detection stage is from the pin 23 which is fed to the computer.Using software which is written in JAVA, an audio signal is played on computer speakers.

## **5. CONCLUSION**

In this design FM radio signal is tuned manually which is limitation of this design. In future FM radio signal can be scanned from computer through GUI of computer. Design using IC CXA1619 requires minimum external component. In this design USB port is used for power supply ,thus designing of power supply circuit is not required. An output of detector is given to a mic pin of a computer, thus designing of an amplifier circuit is not required.

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