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Carrier Communication through Power Lines

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Abstract—*Power Line Carrier Communication Means Audio Power Transmission via Power Line and Reception of The Amplified Audio Power at the Receiver as in the form of Speaker Output Signal using Power Line as the Channel Medium. The Main Objective of this Suggested Work is to transmit our Message Signal after Frequency Modulation by the help of FM Modulator IC LM565 Which Gives Output Proportional to the Input Voltage of the Input Message Signal. And this Audio Power is received from the Power Line by the help of Isolation Circuit and Demodulated from IC LM565 Which uses the Concept of The PLL and Produces FM Demodulated Signal to the Listener. Message Signal will be transmittedover the Carrier Signal That will Generated from the FM Modulator IC LM565*

1. INTRODUCTION

This power line communication system contains two main blocks; one is the transmitter and next is receiver and both Blocks will be connected to the power line which is acting as the communication channel. The transmitter is responsible for sending the signal to the power line using isolation circuit. It includes the following stages: the signal modulation stage, the signal amplification stage, and the power line interfacing. The receiver is responsible for receiving the FM modulated signal from the power line using isolation circuit and recovering it to the original message signal.

1.1 Block Diagram

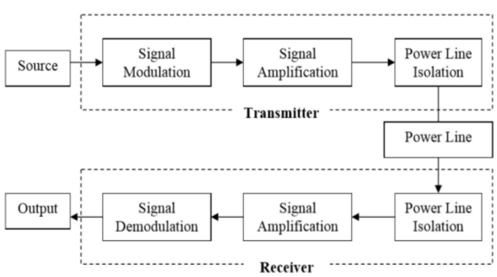

Fig. 1: Block diagram power line communication system

2. POWER LINE INTERFACE

One of the most important parts of our power line transmitter and receiver is the Power Line Interface. Because we have to connect our circuit has to the 230V, 50 Hz power line, and without careful isolation, the rest of the circuit will be burnt definitely. The ideal isolation circuit should completely stop the 50Hz signal, and only pass the message signal. The message signal in our case is the frequency modulated signal. In our circuit, the carrier frequency was kept to be 70KHZbecause the input signal has frequency ranging from 500 Hz to 5 kHz and our isolation should be able to pass the signal frequency ranging from 70 kHz to 80 kHz. The solution for transmitting the modulated signal is to couple a 10nf capacitor with an audio transformer. Fig. 2 shows the simulation circuit created in MULTISIM This circuit completely blocks the 50 Hz signal and passes the signal with frequency ranging from 60 kHz to 70 kHz. By placing this isolation circuit between the power line and the rest of the circuit, we ensure that the 230V power signal will not affect the transmitter and receiver circuit, and also, the information signal can be sent and received from the power line.

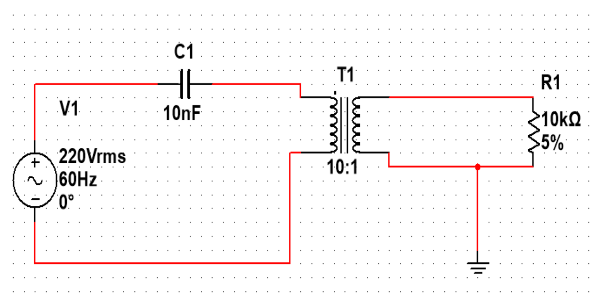

Fig. 2: Power line isolation circuit

3. TRANSMITTER

The transmitter system includes the signal modulation circuit and the signal amplification circuit.

3.1 Signal Modulation

The LM565CN Voltage Controlled Oscillator was used to modulate the input signal. The LM565CN is a general purpose voltage controlled oscillator which may be used to generate square and triangular waves, the frequency of which is a very linear function of a control voltage. The frequency is also a function of an external resistor and capacitor. The LM565is very commonly used to build frequency modulation circuitry.

Fig. 3 shows the completed frequency modulation circuit in our system. Pin 6 is connected to a timing resistor and potentiometer, which works with the timing capacitor connected with Pin 7 to control the modulation frequency. The potentiometer allows us to fine tune the carrier frequency to produce the best modulated signal. Pin 3 was used as the output which gives us the frequency modulated square wave. We chose the value of the timing capacitor and timing resistor so that a carrier signal would have a frequency around 60 kHz. This ensures that the modulated signal can be sent through the isolation circuit to the power line.

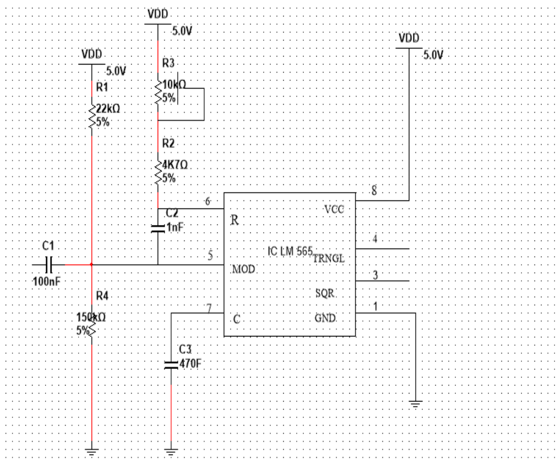

Fig. 3: modulation circuit

3.2 Amplification Circuitofthe Transmitter

The signal from the source is usually very small. Even after modulation, it is not strong enough for the receiver to receive because of the high inference of the power line noise. So, the modulated signal needs to be amplified before being sent through the power line. Fig. 4 shows our amplification circuit for the transmitter.

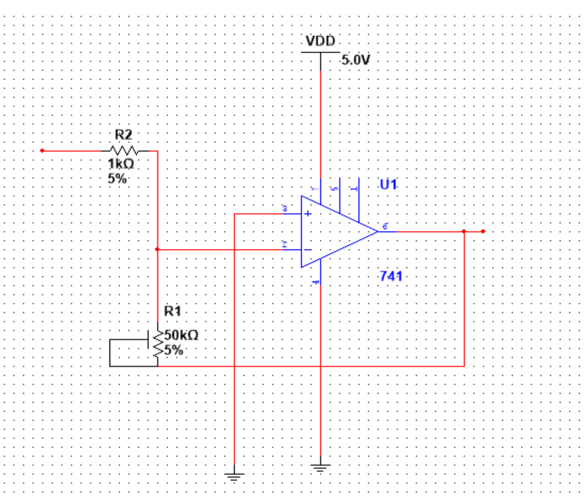

Fig. 4: Amplification circuit of transmitter

The 50k potentiometer connected to Pin 2 allows us to adjust the amplification factor. Within the operational amplifier's operating limit, the output amplitude and the input amplitude have the following relationship:

Vout = - RPotentiometer/R7 * Vin

Fig. 5 and Fig. 6 show the simulation circuit and simulation result of the amplification circuit in Multisim. A ratio of 5 was chosen for the resistance of the potentiometer and resistor R7. The correct waveform was obtained from the simulation.

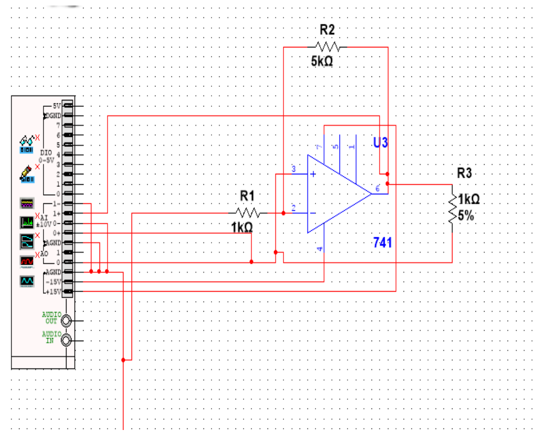

Fig. 5: Amplification circuit in multisim

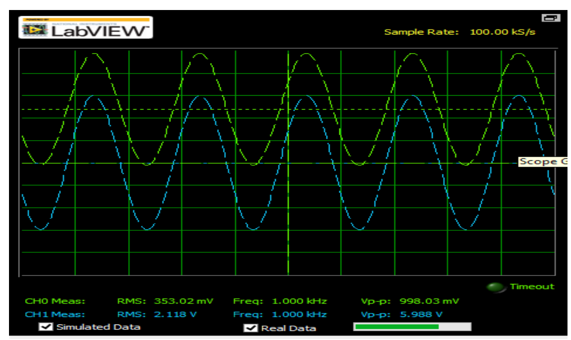

Fig. 6: Simulation results of amplification circuit

4. RECEIVER STRUCTURE

The receiver system includes the signal amplification circuit, the signal demodulation circuit, and filters.

4.1 Amplification Circuitofthe Receiver

The amplification circuit of the receiver is very similar to that of the transmitter. The only difference is that a regular 220k resister was used to replace the potentiometer. The schematic is shown in Fig. 7

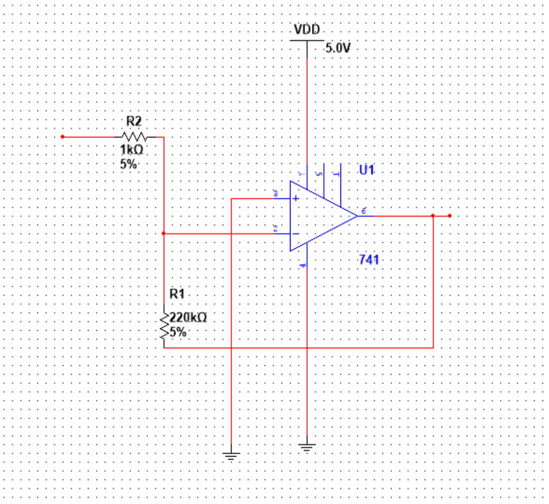

Fig. 7: Amplification circuit of receiver

4.2 Demodulation Circuit

Frequency modulation was used in our transmitter to modulate the input signal. In our receiver, this frequency modulated signal is recovered using a phase locked loop chip - the LM565. The LM565 is a general purpose phase locked loop containing a stable, highly linear voltage controlled oscillator for low distortion FM demodulation. Fig. 8 shows the demodulation circuit of the receiver.

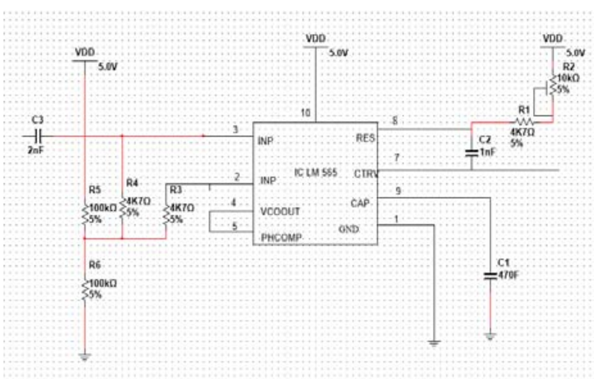

Fig. 8: demodulation circuit of the receiver

The timing capacitor (Pin9) value and the timing resistor (Pin8) values were set the same as the values in the modulation circuit so that the modulated signal can be recovered.

4.3 Filter Circuits

Two filters were implemented for the demodulation circuit. The first filter was designed to band pass the modulated signal which has a frequency range from 65 kHz to 75 kHz as discussed before. It is used to filter out any low or super high frequency noises from the power line. The schematic and simulation result are shown in Fig. 9 and Fig. 10 respectively. From the AC simulation result, we can see that signals with frequency from 65 kHz to 75 kHz can pass the filter and the power signal with frequency 50 Hz will be filtered out.

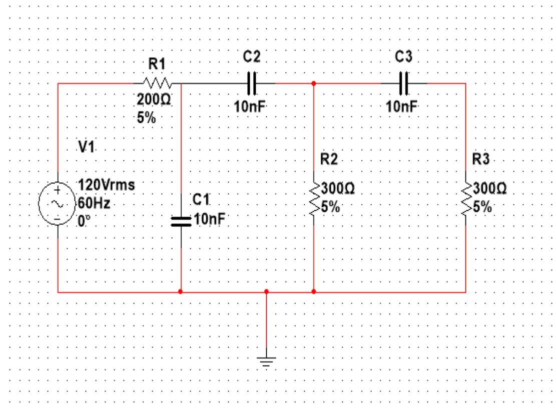

Fig. 9: Circuit diagram of band pass filter

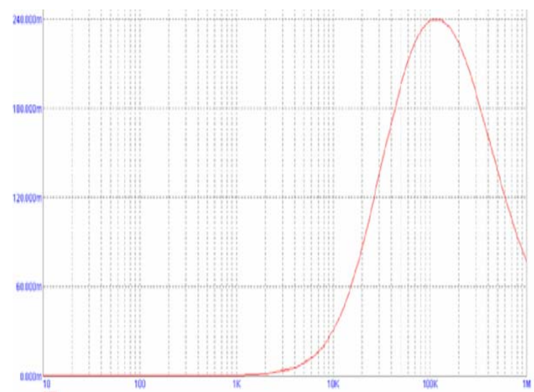

Fig. 10: Simulation Results of bandpass filter

The second filter is a low pass filter which is implemented to filter out the high frequency noise generated by the demodulation circuit. So the message signal, which has a frequency ranging from 500 Hz to 5 kHz, can be produced. The schematic and simulation results are shown in Fig. s 11 and 12 respectively.

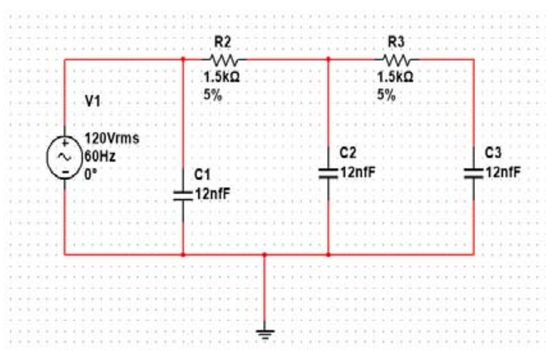

Fig. 11: Circuit diagram of low pass filter in receiver

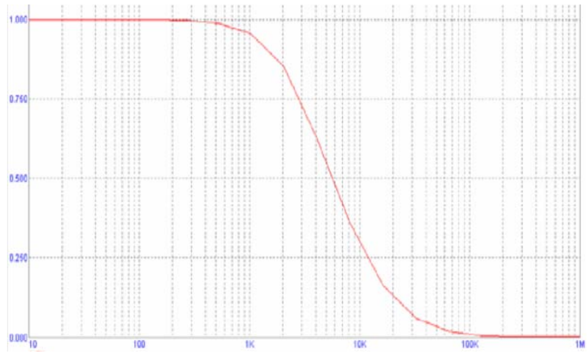

Fig. 12: simulation results of lowpass filter

The completed schematics of the transmitter and receiver are presented in Fig. s 13 and 14 respectively.

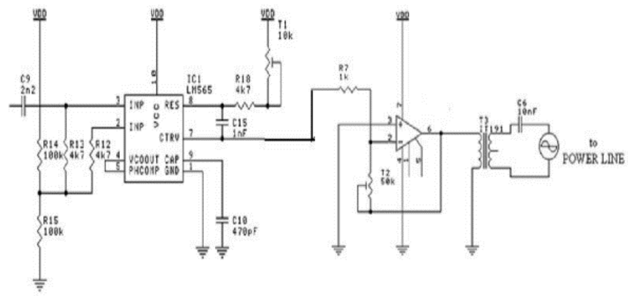

Fig. 13: Schematic diagram of transmitter

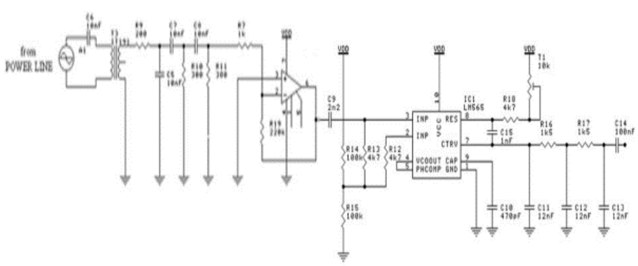

Fig. 14: Schematic diagram of receiver

Fig. 15 show the implemented transmitter and receiver circuits on the breadboard.

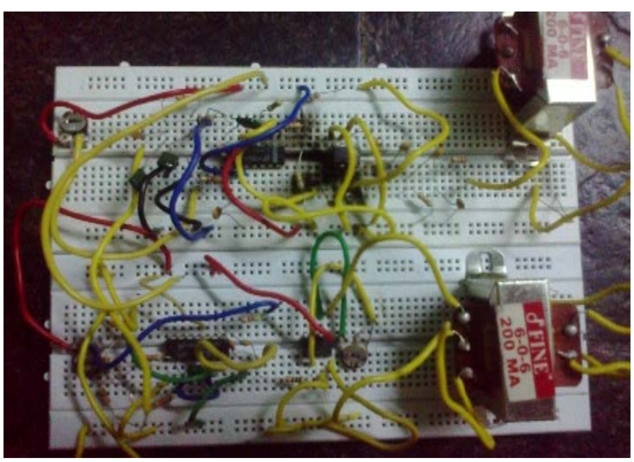

Fig. 15: Transmitter and receiver circuits in bread board

5. IMPLEMENTATION

5.1 Input

A Function Generator was used to generate the input waveform (the message). In our design, waveforms with frequency ranging from 500 Hz to 5 kHz were chosen to be our input signals.

5.2 Implementation Problems

At first 12V was applied to our circuit to power the IC chips. The chips did not function as well as we expected. After referring to the data sheets we decided to use +5v and 0v as our power supply. This greatly improved the output signal.

The capacitor coupled with the transformation in the isolation stage was burnt one time. This occurred because the specifications for our transformers were not clear.

Amplitude of the input signal was first set to be 5 V which is too high for the FM modulation circuit. As the result, the frequency of the carrier waveform was too low to be efficiently passed through the power line. This problem was solved by tuning down the input waveform to 500 mV.

6. TESTING

The system was tested by using the equipment provided in our BE laboratory namely a function generator and an oscilloscope to view the input and output waveforms. Before connecting to the power line, the FSK modulator and demodulator chips were individually tested. First the modulator circuit was connected as in Fig. 3. By applying a sinusoidal waveform to the modulator input, we verified that an FSK waveform was created by the chip and displayed on the oscilloscope. Next, the output of the modulator was directly connected to the demodulation circuit in Fig. 8. Now, we were able to observe the original sinusoidal message on the oscilloscope to affirm that both circuits worked together. After these cases were verified, we proceeded to test the entire system with signal propagation through the power line. Fig. 16 describes the test with connection to the power line

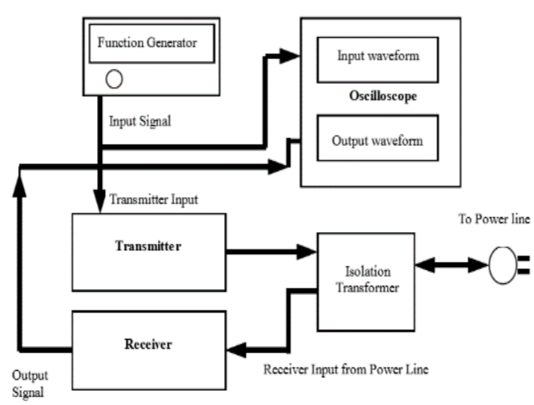

Fig. 16: Tested connections to the power line

From Fig. 16 it can be seen that the input signal is supplied from a function generator to the transmitter circuit. The input signal is also connected to the oscilloscope so it can be viewed and compared with the receiver output signal. The output of the transmitter was connected to an isolation transformer. The isolation transformer is directly plugged into the power line and its sole purpose is to prevent any inadvertent damage to the power line (and any devices connected to it) by the circuit. The isolation transformer is connected to the receiver, which then demodulates the signal

Which now has the added interference from the connection to the power line - and attempts to retrieve the input message. This retrieved message is also connected to the oscilloscope so it can be viewed.

Using the function generator, we supplied sinusoidal waves of various inputs and various amplitudes and observed the output waves on the oscilloscope. As expected we were able to retrieve the message signal and view it on the oscilloscope for frequencies ranging from 500 Hz to 5 kHz. The output observed by any other frequency was noise. Fig. 15 shows a screen shot of the input and output signal at 4 kHz.

Fig. 17: Output wave form

7. CONCLUSION

In conclusion, we accomplished the task that we set forth to do at the beginning of this project which was to send data over the power lines. Through the work we have done we learned about the high interference that must be overcome to make high-speed data transmission over power lines successful

Society's demand for power will continue to grow as new technologies are invented. This is a reality of living in an industrialized age. However, the same technologies that are created to make our lives more comfortable, convenient, and safe can sometimes cause traumatic results. Our power suppliers are given the burden of supplying us with a constant power supply, but this burden cannot always be met.

8. ACKNOWLEDGEMENT

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REFERENCES

[1] Thomas and Rosa, the Analysis and Design of Linear Circuits, New York: John Wiley & Sons, Inc., 2001.

[2] Design Notes, "Home Automation Circuits." (Online article), Available at: http://www.designnotes.com/CIRCUITS/FMintercom.htm

[3] Dallas Semiconductor, "MAXIM Max2900 Data Sheet." Available at: http://www.maximic.com/quick_view2.cfm/qv_pk/3186