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# Wireless Power Harvesting and Time Setting In Metallic Environment

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## ABSTRACT

**This project emphasizes on transfer of data & power harvesting wirelessly in metallic environment. Data /power transmission from transmitter to receiver is a mature technology, but transmission of signal from transmitter to receiver in metallic environment is challenging. Microchip PIC microcontroller is used on the transmitter side as well receiver side, data transmitted will be in the form of ASK (Amplitude Shift Keying) and is transmitted by using inductor. The signal generated by transmitter should pass through the metal which is difficult due to reflection of transmitted signal by metal.On the receiver side Power is harvested by using an electrolytic capacitor and transmitted signal is detected, corresponding acknowledgement is sent by receiver to the transmitter side which is further compared by comparator. Wireless transmission of data /power can be used in military application.**

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## I. INTRODUCTION

Concept of wireless power existed since the inception of electricity. Nicola Tesla (physicist) was the first person to pursue the idea of wireless transmission. A true wireless device ,is able to transmit signals without actual connection of wires. It thus helps in reducing size, increasing mobility of device and enables device to be more compact by removing necessities of large batteries. With advancement in technology this concept can be further improved to transfer and harvest power. Data can also be transferred wirelessly which would be of great use hence reducing hardware.

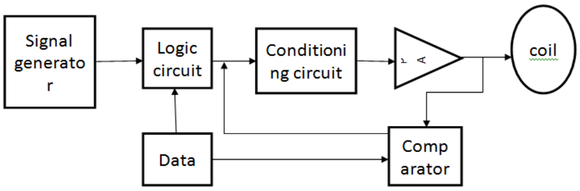
## II. LITERATURE SURVEY

The emissions from the RFID transponder considered as intentional radio transmission signals despite their very low emission levels. As such they have to be published in the national air interfaces, which according to the RTTE Article 4 must be notified to the Commission. The compatibility with radio communication systems and services below 30 MHz is a precondition to accept listing of RFID Transponder frequencies in the ERC SRD Rec 70-03, Annex 9 or in the relevant national frequency tables. This report defines the technical characteristics, the justification of the various RFID systems with regard to the transponder frequencies and the sharing of primary and secondary services.Radio Frequency Identification (RFID) systems consists of an electronic data and carrier device and reader that communicate information using radio technology.The contact less transfer of data has numerous application in commerce and industry.RFID is more flexible than optical, magnetic and contact smart card technology.[2]In the earlier days the time data (in hours/days) had been set in the sub-munitions at the time of manufacturing itself and have no flexibility to change it into the field by the users. This technique forced the users to maintain different inventories of sub-munitions for different days setting. Remote time data setting concept will not only help the user to eliminate the need to maintain the inventories of munitions for different days but at the same time also give flexibility to set the time (according to the war scenario) in individual munitions before its deployment.[3]

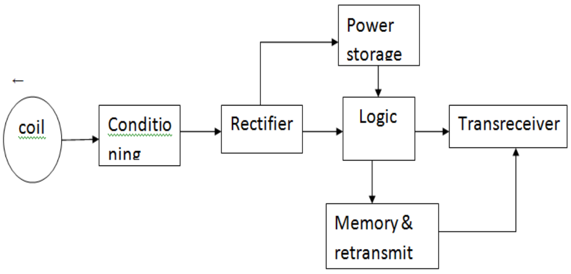
 

## III.BLOCK DIAGRAM

A) Transmitter




B) Receiver




System Modelling:

Figure 1 shows the system level diagram of transmitter and receiver. The data is generated in the microcontroller which is serially taken out and is modulated with a carrier frequency of 125 kHz. The modulator isput is ASK(Amplitude Shift Keying). This signal is given to transmitter coil via power amplifier to increase the power level.

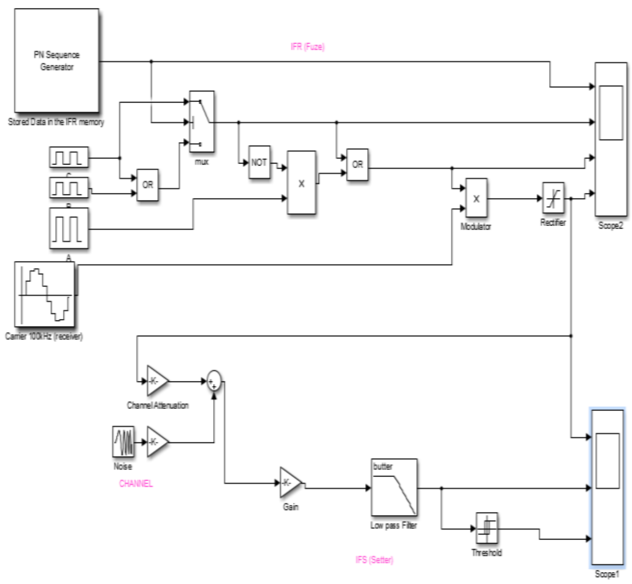



Figure 1 System model of transmitter and receiver

## IV.WORKING

Signals are generated with the help of signal generator with frequency 125 kHz . PIC18fXXmicrocontroller is used on the transmitter side to generate data, data transmitted will be in the form of ASK (Amplitude Shift Keying) and is transmitted by using inductor. Conditioning circuit filters and amplifies in order to get desired output .Power amplifier as its name suggests amplifies the signal. The signal generated by transmitter should pass through the metal which is difficult due to reflection of transmitted signal by metal. The comparator compares the transmitted signal with the received signal and determines whether it is correct if not it retransmits the data.

On the receiver side Power is harvested by using an super capacitor and the transmitted signal is detected, corresponding acknowledgement is sent by receiver to the transmitter side. The Receiver works on the same frequency as that of the transmitter.

A) Frequency selection

The ground-breaking part of this project is to transmit the signals from metallic sheet. Various factors are responsible to accomplish the transmission through a metallic sheet. As discussed above, the main problems of this project is finding the correct frequency to transmit data through the metal, as the metal sheet reflects the signal back to the transmitter .To find the right frequency we can imply two approaches. The first is to select a low frequency, secondly ,we have to calculate the skin depth of the metal sheet which will be used.

A low frequency signal of around **125khz -128khz** is preferred due to following reason-

i) It can penetrate through a metal sheet. (explanation given in part B)

ii) Low distortion, hence maximum probability of successful transmission.

iii) Reduced chances of back reflection.

| Frequency band | Common frequency | Coupling | Data Rate | Maturity | Communication Range Max. |
|---|---|---|---|---|---|
| LF | 125 to 135 kHz | Inductive | low | Very Matured | 20cm 100cm |

B) Skin depth

Another important parameter that should be considered frequency that would pass through a metal sheet.

As the frequencies increase, the electric current flows mainly at the "skin" of the conductor, between the outer surface and a level called the skin depth. The skin effect causes the effective resistance of the conductor to increase at higher frequencies where the skin depth is smaller, thus reducing the effective cross-section of the conductor.

$$\delta_s = \sqrt{\frac{2}{\omega * \mu * \sigma}} = \sqrt{\frac{\rho}{\pi * f * \mu}}$$

μ = permeability (4π* 10-7 H/m), note: H = henries = Ω*s

π = pi

δs = skin depth (m)

ρ = resistivity (Ω*m)

ω = radian frequency = 2π*f (Hz)

σ = conductivity (mho/m),

note: mho [Electrical 'mho' symbol - RF Cafe] = Siemen [S]

The Calculations for the effective skin depth (1/ε) for common conducting materials using the formula and data given below :-

Select the Conductor Material: Copper

Resistivity (ρ): 1.678 x 10-8 Ω.m
Enter the required Frequency: 0.125 MHz
Relative Permeability (μr): 0.999991
Skin Effect Depth: 184.4009μm
Results:
Transmitter side:

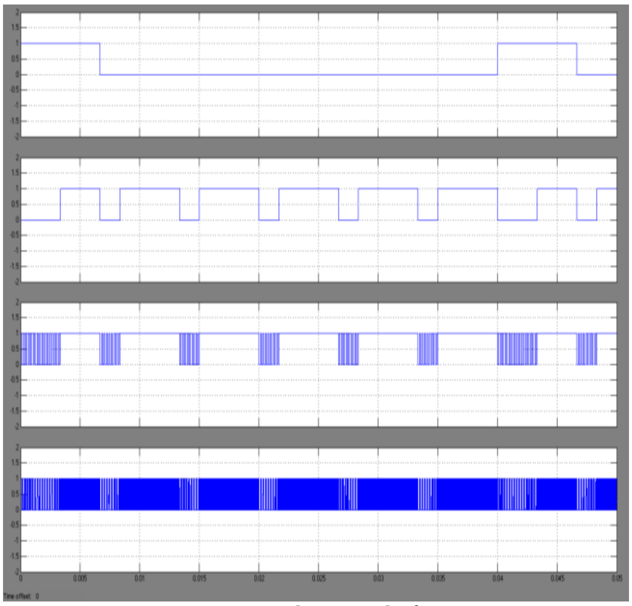


Figure 2: Simulation results for transmitter

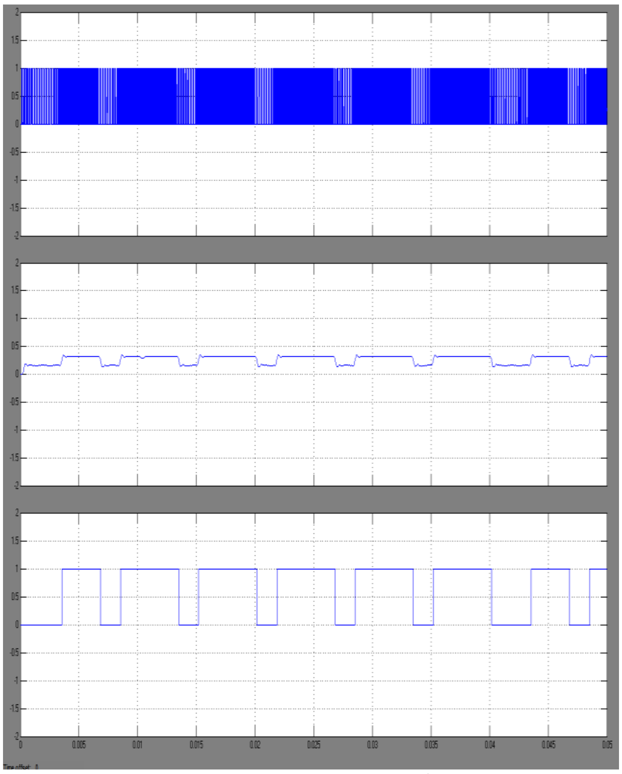


Figure 2: Simulation results for receiver

## V. APPLICATIONS

Secure wireless communication, Wireless charging for battery operated devices, Power transfer to vehicles (hybrid cars, buses, etc.), Tracking & identification and Defence applications.

## VI. CONCLUSION

The data is transmitted wirelessly at a low frequency of 125 kHz. The Data is transmitted in metallic environment which is theoretically feasible but practically difficult due to the reflection of the part of data by metal sheet. To avoid this inductive coils are used at both transmitting and receiving ends instead of antenna.

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