

# RF Energy Harvester for Wireless Applications

M.Reji, I.SaiChakresh

**Abstract**—RF vitality is presently being communicated from the radio transmitter billions around the globe, including PDAs, handheld radios, portable base stations and communicate stations TV/radio. The capacity to reap RF vitality from surrounding or committed sources, empowering remote charging of low-control gadgets and have created benefits for item plan, ease of use, and unwavering quality. Remote power transmission was conceptualized right around a century prior. explicit accomplishments made to date makes power collecting actuality, ready to give an elective wellspring of vitality. This audit gives an outline of radio recurrence (RF) control innovation gather so as to fill in as a guide for the structure of RF vitality collecting unit. Since the vitality gathering circuit is intended to work with a generally little voltages and flows, they depend on cutting edge electrical innovation to acquire high effectiveness. Accordingly, the examination and exchange of their different structures and a far reaching exchange off is incorporated. At last, the most recent utilization of RF power gathering depicted

**KEYWORD**:-RF detector, impedance matching circuit, RF to DC convertor, micro processor, load.

## I. INTRODUCTION

RF vitality is right now being communicated from the radio transmitter billions around the globe, including PDAs, handheld radios, portable base stations and communicate stations TV/radio. The capacity to collect RF vitality from surrounding or devoted sources, empowering remote charging of low-control gadgets and have created benefits for item structure, ease of use, and unwavering quality. remote power transmission was conceptualized just about a century prior. explicit accomplishments made to date makes power reaping actuality, ready to give an elective wellspring of vitality. This audit gives a rundown of radio recurrence (RF) control innovation collect so as to fill in as a guide for the structure of RF vitality gathering unit. Since the vitality reaping circuit is intended to work with a generally little voltages and flows, they depend on cutting edge electrical innovation to get high proficiency. In this way, the investigation and discourse of their different plans and a thorough exchange off is notwithstanding At the outset RF power harvesting are outlined for recent applications

### 1.1 BLOCK DIAGRAM:-

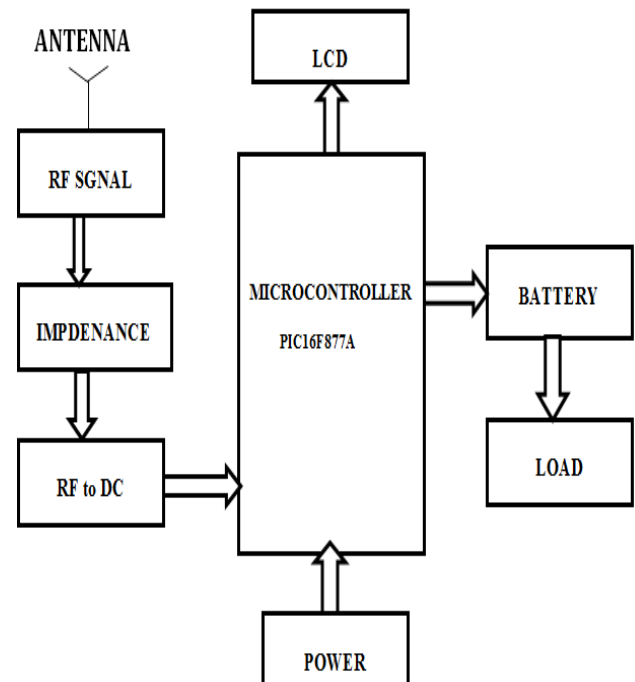


Fig.1.1 Block diagram

### 1.2 Block description:

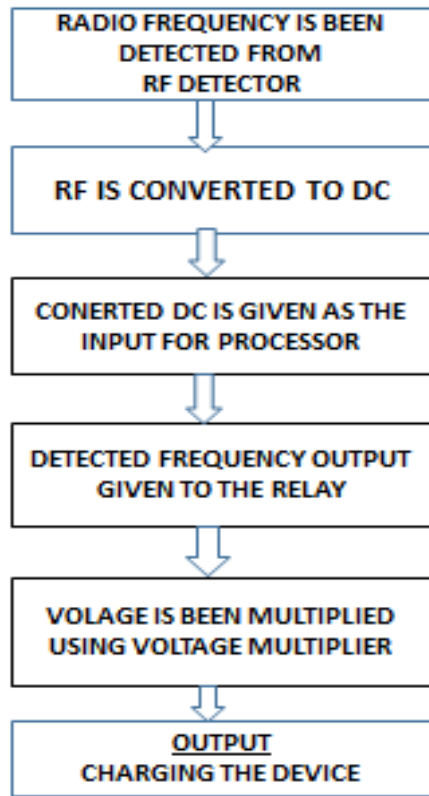
The block outlines the parts and work stream of the undertaking. The procedure starts with a receiving wire gets the RF signal, it is identified by RF finder that is utilized to follow the nearness of RF sign and electromagnetic commotion in neighborhoods, office or store. This can be a helpful device when testing or planning RF circuits, trailed by RF-DC converter fit for changing over the RF wave to a DC signal and accomplish higher proficiency by detached components. Dc converter at that point gave as contribution to a microcontroller. PIC16F877 PIC (programmable interface controller) the littlest controllers on the planet who can play out an enormous number of errands and are additionally found in numerous electronic gadgets. At that point the got sign is recognized outwardly through the LCD screen LCD display.16X2 been utilized in circuits for low power utilization to the utilization of power. Power has been pushed through by a 12v battery which is given as information capacity to the circuit. Costs are 12 v transfer which is utilized to isolate the low intensity of the sign

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M.Reji, Department Of ECE, Saveetha School of Engineering, SIMATS, Chennai, Tamilnadu, India.

I.SaiChakresh, Department Of ECE, Saveetha School of Engineering, SIMATS, Chennai, Tamilnadu, India.

## II. MODULE1



**Fig.2. Projected methodology**

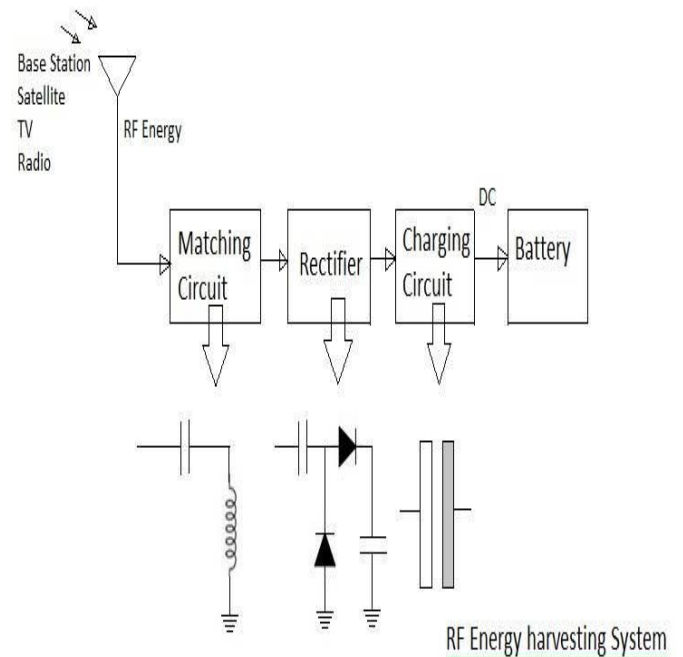
There are three main methods for achieving a successful harvest energy. Energy Sources: There are various sources of energy. Anyone can be used for energy harvesting systems. Sources such as solar energy, wind energy, thermal energy, electromagnetic waves etc. Energy Harvesting IC: This IC converts the energy of ambient to some of the energy can be stored in the energy storage device Energy storage: There are various ways energy can be stored that includes a rechargeable battery, traditional capacitors, super capacitors etc. The super capacitor has characteristics that is, smaller size, higher efficiency, higher capacity etc. The other component is a communication interfaces, memory, sensors, actuators, processing and control devices such as microcontrollers, etc.

### 2.1. Problem statement:-

Advances in technology have made it more important to develop a reliable wireless power solutions for low-power devices. Although the development of battery technology has improved reliability, battery limited period resulted in the need for monitoring and replacement. In order to resolve the problems associated with the use of the battery as a power supply, it is necessary to develop a compact, inexpensive system with the ability to recharge the batteries of the wireless sources of energy. A similar system applies to devices with low power requirements that can be directly powered by energy harvesters. radio frequency (RF) energy harvesting is emerging research topics in universities and R & D environment RF energy harvesting circuit is trying to capture the ambient RF energy by means of a receiving antenna, which is then converted into useable DC power. This study aims to develop a processing circuit necessary to

convert the received RF signal from the antenna into useable power capable of charging Lithium-Ion battery. RF signal processing will be achieved by developing the necessary circuitry to filter the incoming RF signal, convert it to DC, and then increase the voltage to the level required for charging Lithium-Ion battery.

## III. HARDWARE BLOCK.



**Fig.3. Hardware block**

It changes over RF vitality to DC vitality consequently it is likewise alluded as RF to DC converter. Figure additionally makes reference to discrete circuit parts utilized in these modules.

- Energy stockpiling circuits
- Matching Network
- Antenna
- Voltage various at least one (for example rectifier circuit)

This gadget grabs RF radiations from different sources accessible in the free space. take the RF vitality and after that guided to the whole module utilizing transmission line or guided structure. Radio wire switch got electromagnetic vitality into electrical sign. Alluding to the sort of radio wire. Coordinating Network: It is utilized for a greatest RF vitality to the circuit. The circuit is made of a capacitor and inductor parts. Voltage multiplier: Image or rectifier voltage multiplier notice is made of a diode and a capacitor. Higher this stage is the voltage at the heap and lower is current. Be that as it may, a higher number of stages the outcomes to an expansion in charging delay before he goes for vitality stockpiling. Alluding half-wave and full-wave rectifier circuit. vitality stockpiling: The DC power acquired from the past module put away either in a capacitor or sent to the battery so as to put something aside for later use.

#### IV. DESING AND EXPERIMENTAL WORK



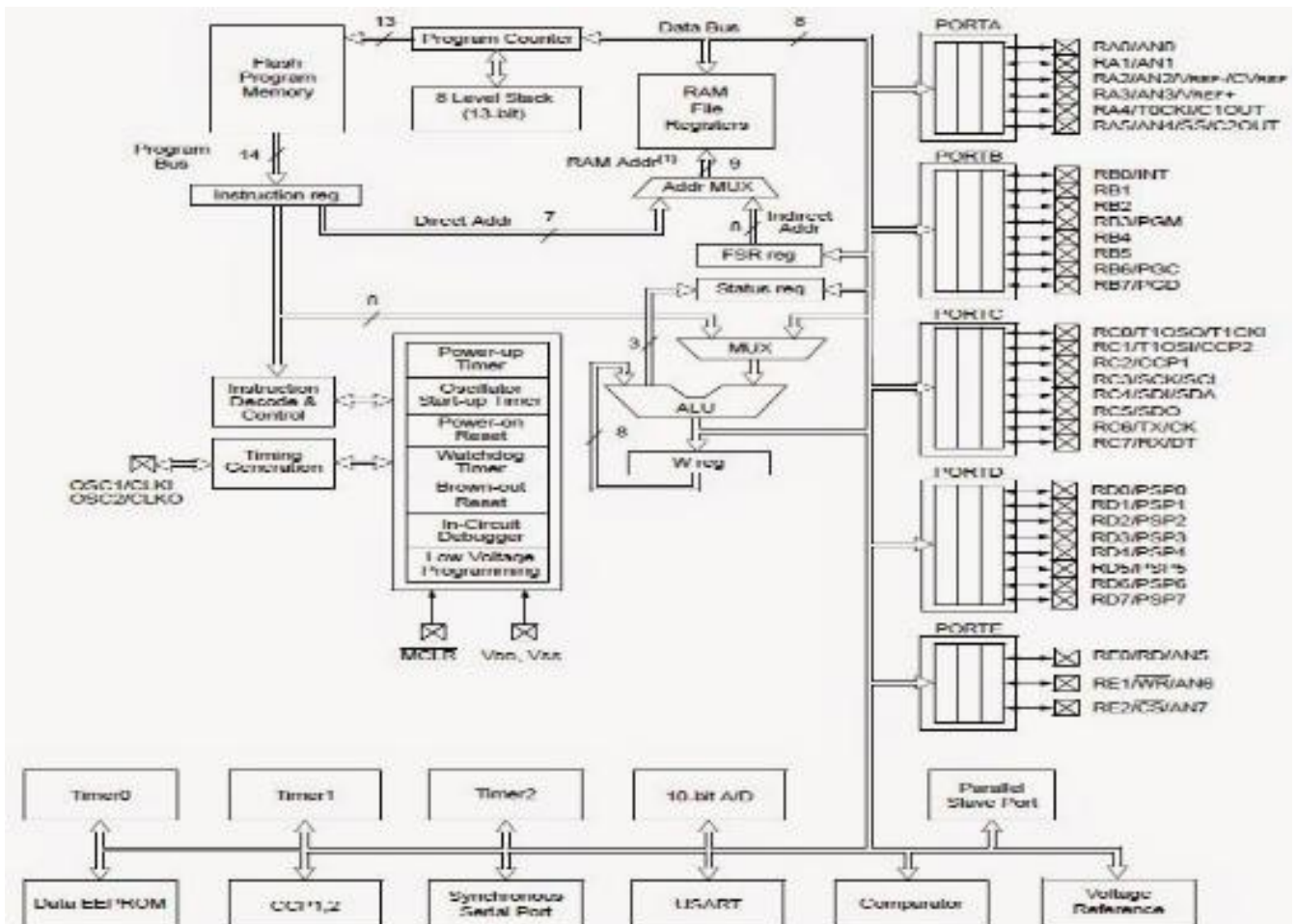
**Fig.4.Pic16F877A**

This amazing (200 nano second guidance execution) yet simple to-program (just 35 word directions) CMOS FLASH-based 8-piece microcontroller packs Microchip incredible PIC® design into 40 bundles and upward good with

PIC16C5X, PIC12CXXX and PIC16C7X gadget. PIC16F877A which has 256 bytes of EEPROM memory the information, the programming themselves, ICD, two comparators, 8 channels of 10-piece Analog-to-Digital (A/D) converter, two catch/look at capacities/PWM, synchronous sequential port can be arranged either as fringe 3-wire sequential interface (SPI™) or the Inter-Integrated Circuit (I<sup>2</sup>C™) 2-wire transport and UART (USART).

PIC microcontroller can be modified with various programming accessible in the market. There are individuals who still use low level computing construct to program the PIC MCUs. Subtleties beneath for most exceptional programming and general and compilers have been created by Microchip themselves.

##### 4.1. Architecture of PIC16F877A MICROCONTROLLER.



**Fig.4.1.Architecture of PIC16F877A**

The memory of a PIC 16F877 chip is divided into 3 sections. They are

- Program memory
- Data memory and
- Data EEPROM

##### 4.2.RADIO FREQUENCY DETECTOR

This basic RF signal locator circuit can be utilized to follow the nearness of RF sign and electromagnetic clamor in your local location, office or shop. It very well may be a valuable apparatus while testing or structuring RF circuits. It can likewise be utilized to identify electrical commotion in your premises. Electromagnetic clamors can be delivered by starting in electrical establishments or different sources.



## RF Energy Harvester for Wireless Applications

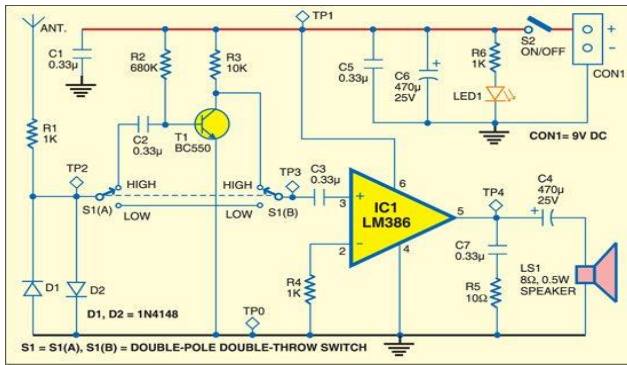


Fig.4.2. Radio frequency detector

It comprises of an adjustable reception apparatus, the insurance of the information resistor (R1), two diodes (D1 and D2), the selector switch (S1), pre-enhancers with low commotion and high-gain transistor (T1), and a sound intensifier IC LM386 (IC1). Switch S1 is utilized to choose among high and low affectability of the circuit. At the point when high affectability is chosen, the increase of the transistor organize T1 was added to get from LM386 IC. At the point when low affectability is chosen, the main preferred position LM386 IC is utilized, which is around 20. So as to keep up a straightforward and reduced circuit, no volume control is incorporated. At the point when there is a solid electromagnetic sign close to the receiving wire, for instance, from mobile phones, phone or electric engine, you can hear the voice from the speaker (LS1). When you bring the locator is nearer to the RF or commotion transmission source, the sound from the speaker ends up stronger. In this way you can follow the careful area of the source. You can utilize a receiving wire of the suitable shape and length to expand the scope of gathering and affectability

### 4.3 Voltage Multiplier:-

Voltage multiplier circuit is simple, made of diodes and capacitors which can increase the input voltage by two, three, or four times and with cascading half together individual or multiplier stages full in series for applying a DC voltage that is desired for a given load without the need for a transformer step up. voltage multiplier circuits are classified as voltage doublers, Tripler, or quadruple, etc., depending on the ratio of the output voltage to the input voltage.

### 4.4. RELAY



Electro-mechanical relay is the output device (actuator) that comes in a whole host of shapes, sizes and designs, and has many uses and applications in electronic circuits. But while the electrical relay can be used to enable low-power electronics or computer types of circuit switching relatively

high currents or voltages either "ON" or "OFF", some form of relay switch circuits needed to control it. Design and type of relay switch circuit is very big, but lots of small electronics project using transistors and MOSFET as a switching device as their primary DC transistor can provide fast switching (ON-OFF) relay coil control of a variety of input sources

### 4.5. RF HARVESTER BLOCK

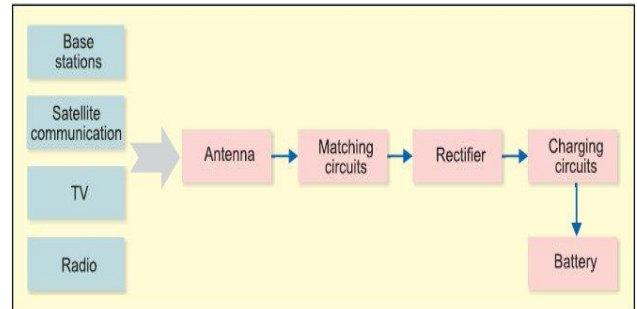


Fig 4.5.1(a) RF harvester block

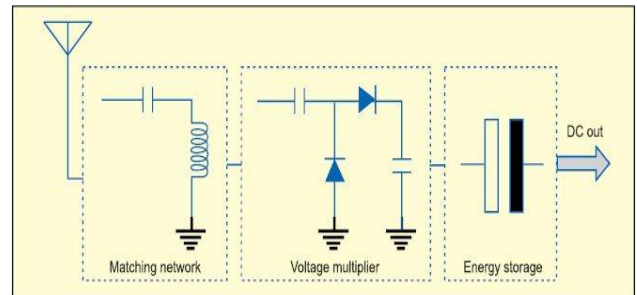


Fig 4.5.2 RF harvester circuit

Coordinating system, comprising of components of inductive and capacitive, ensure most extreme power conveyance from the reception apparatus to the voltage multiplier. Vitality stockpiling guarantees smooth power conveyance to the heap and as a reinforcement for a while when the outside power isn't accessible. for example, the need to painstakingly configuration; expanding the quantity of multiplier stages give a higher voltage on the heap and diminishes the current through the heap branch end. This can bring about unsatisfactory postponements charging for vitality stockpiling power capacitor. RF remote gather (WPH) can possibly supplant the battery or increment their life expectancy. At present, most of low-control battery intensity of remote sensor gadgets and inserted gear. Truth be told, the battery has a restricted life expectancy and require occasional substitution. By applying force reaping advancements, gadgets and hardware can act naturally adequate as for the vitality required for the activity, to get a constrained working life. Along these lines, the interest for electrical support will be disregarded. Hotspots for WPH is accessible in different structures, for example, sun oriented power, wind vitality, warm vitality, electromagnetic vitality, active vitality, and so forth.

## V. RESULTS

The consequences of placing RF collector vitality in the situation by covering the 2.4 GHz GSM flag and allow the capacitor to charge, Testing revealed that immersion in the capacitor reaches approximately 50mV.



- RF vitality can be used to fill in or work varied widely Low-control gadget
- Used for a wide range of gadgets including GPS or following RLTS label, therapy wearable sensors, and hardware shopper, for example, digital books per user and headset.
- electricity can be used for battery-based or without remote battery sensor for HVAC and building control robotization, basic checks, and mechanical controls.
- Change the battery.
- Mobile phones can be used as a convenient electrical hotspot for a variety of remote gadgets without batteries.

## VI. CONCLUSION

ambient radio waves are universally present through an ever-increasing frequency and power level, especially in densely populated urban areas. These radio waves are a unique source and widely available energy if it can effectively and efficiently harvested. The increasing number of wireless transmitters naturally results in improved RF power density and availability. Further dedicated power transmitter enable wireless power solutions engineered and predictable. With the continued decrease in power consumption of electronic components, increased sensitivity to RF passive recipients of harvest, and improve the performance of low energy storage device leakage, applications for wire-free charging by way of RF-based wireless power and energy harvesting will continue to grow.

## VII. REFERENCES

- 1 US Frequency Allocations: The Radio Spectrum(2003.), National Telecom. and Info. Administration Standard,
- 2 Wireless LAN MAC and Physical Layer Specifications(2007), IEEE Standard 802.11
- 3 N. M. Din et. al.,(2012), ‘ Design of RF Energy Harvesting Sys. for Energizing Low Power Devices,’ Electromagnetics Research, vol. - 132, pp- 49-69.
- 4 P Nintanavongsaet. al, (2012), ‘Design Optimization and Implementation for RF Energy Harvesting Circuits,’ IEEE Journal on Emerging & Selected Topics in Circuits and Systems, vol- 2, no.- 1.

- 5 E. Khansalee, et. al, ‘A Dual-Band Rectifier for Radio Frequency Energy Harvesting,’ Engineering Journal, vol.- 19, issue 5.
- 6 [6] J. Record, “RF Energy Harvesting Circuits,” University of Maine, 2011,
- 7 I. Poole, ‘LC band pass filter circuit,’ Radio-Electronics.com
- 8 “Voltage Multiplier,” Electronics Tutorials.
- 9 H. Wheeler,(1965) , ‘Transmission-Line Properties of Parallel Strips Separated by a Dielectric Sheet,’ IEEE Trans. on Microwave Theory and Techniques IEEE Trans. Microwave Theory Techn., vol - 13, no- 2, pp. 172–185
- 10 [10] S.W. Ali, ‘Critical guidelines for RF and microwave PCB Design,’ Embedded,
- 11 H. Zumbahlen, ‘Printed Circuit Board Design Issues,’ in Linear Circuit Design Handbook, Newnes: 2008, ch. 12, <http://www.analog.com/library/analogDialogue/archives/43-09/EDch12pcissues.pdf>
- 12 “Measuring Self Resonant Frequency,” Coilcraft, Document 363-1,
- 13 “Inductor Q, Quality Factor,” Radio-Electronics.com
- 14 F. Ulabyet. al,(2010) Fundamentals of Applied Electromagnetics, 3rd edition . Upper Saddle River, Pearson Education, Inc.,
- 15 W. L. Stutzman and G. A. Thiele, (2013) Antenna Theory and Design, 3rd ed. Hoboken, Wiley.
- 16 <http://www.ti.com/lit/ds/symlink/bq25504.pdf>, 25 June 2015 ‘bq25504 Ultra Low-Power Boost Converter With Battery Management for Energy Harvester Applications,’ Texas Instruments.,
- 17 “How Do RFID Systems Work?” 2016.