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RF ENERGY HARVESTING BASED CHARGING THE LOW POWER DEVICES

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Abstract— **Energy Harvesting is the process of electronically capturing and accumulating energy from a variety of energy sources deemed wasted or otherwise said to be unusable for any practical purpose. More often than not, these residual energies are released into the environment as wasted potential energy sources. Wireless sensors and the potential of energy harvesting to provide power for the life of these devices. The greatest potential, however, lies in a new class of devices that will be battery-free and thus enable applications that would have been prohibitively expensive due to the maintenance cost of eventual and repeated battery replacement. This project deals with the harvesting of energy based on the rf source here the power is transfer from the antenna, there by using the impedence matching is done so that to gain more power from tower and the rectifier circuit convert an incoming rf signal to dc signal that is fed into battery an efficient rectification improves the output power.**

***Index Terms*— RF to DC, matching network, energy harvesting.**
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I. INTRODUCTION

I N RECENT years, the decrease of electronic components consumption has led to the development of wireless devices. An interesting application concerns wireless sensor networks (WSNs). The wireless sensors communicate with each other and gather different data such as temperature, pressure, humidity, etc. They are used in various scenarios such as intelligent monitoring systems for office, domotic, medical, or military applications. Most applications require small low-power sensors for autonomy, environmental, and electromagnetic (EM) pollutions. Developing efficient methods for extracting DC power from RF signals has become an important necessity for a number of applications involving self-powered devices and sensor nodes. In recent years, development of technology is rapidly growing allowing the decrease of certain characteristics of a system or device like size and power consumption. However, these devices are powered by bulky batteries that need to be recharge or replace every so often. Extracting energy from the environment particularly RF signal is not only an eco-friendly way of generating free energy but can be a solution to minimize the consumption and usage of battery in most wireless devices. Wireless power transfer will be possible for low-power applications only since the expected received power will be low at about 1mW. However, converting RF energy from RF signals at different frequencies is relatively difficult issue particularly when RF signals have relatively low power levels. The operating range of such self powered devices has been severely limited by the failure of existing power extraction techniques to successfully extract power from radio frequency signals having relatively low power levels. This is mainly because of the problems of extracting DC power from electromagnetic radiation which consist of two main parts: collecting the incident radiated power, and converting the collected power to DC signals enough to power self-powered devices.

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II.SYSTEM DESIGN

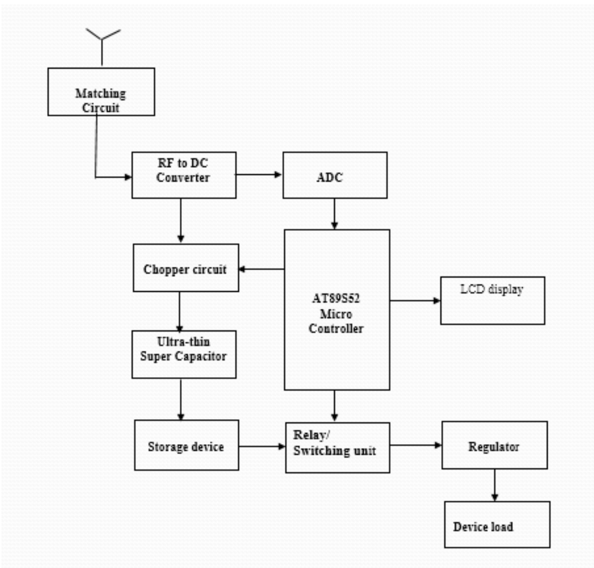

Figure 1. Block diagram of the working system

III.EXPERIMENTS

A. AT89S52MICROCONTROLLER:

The AT89S52 is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory. The device is manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the Indus-try-standard 80C51 instruction set and pin out.

Features:

- Compatible with MCS®-51 Products.
- 8K Bytes of In-System Programmable (ISP) Flash Memory – Endurance: 1000 Write/Erase Cycles.
- 4.0V to 5.5V Operating Range.
- Fully Static Operation: 0 Hz to 33 MHz.
- Three-level Program Memory Lock.
- 256 x 8-bit Internal RAM.
- 32 Programmable I/O Lines.
- Three 16-bit Timer/Counters.
- Eight Interrupt Sources.
- Full Duplex UART Serial Channel.
- Low-power Idle and Power-down Modes.
- Interrupt Recovery from Power-down Mode.
- Watchdog Timer.
- Dual Data Pointer.

Figure. AT89S52 microcontroller

B.MATCHING CIRCUIT:

Impedance Matching was originally developed for electrical power, but can be applied to any other field where a form of energy (not necessarily electrical) is

C.RF TO DC MODULE

A general overview of the proposed RF/DC module is shown in Fig. 4. The RF signal from the power divider comes in through a 50W coaxial cable. A "backup" termination resistor is connected to the input through a circulator. It ensures that the modules do not reflect RF power – under any circumstances – back to the cavity. This approach guarantees a failsafe system, which degrades gracefully in case of component failures. When a rectifier defect occurs (open or short), the overall recovery efficiency of the RF/DC array will be degraded but the operation of the particle accelerator will not be restricted in any way.

The matching network guarantees an optimum power transfer while not exceeding the maximum voltage or current ratings of the diode. The small bandwidth (¡2%) of the input signal allows the use of standard resonant matching techniques. Care must be taken with the design and simulation procedure, as the rectifier is a nonlinear device and its input impedance is likely to change with different input power levels. The last block is the DC lowpass filter and the actual load. For simulation purposes it is modelled as a simple. In the actual system, multiple module outputs will be combined to reach usable power levels.

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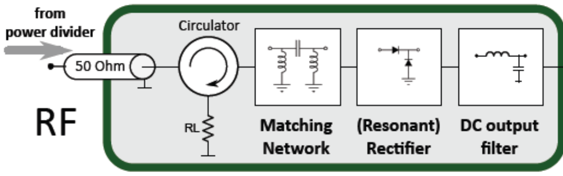
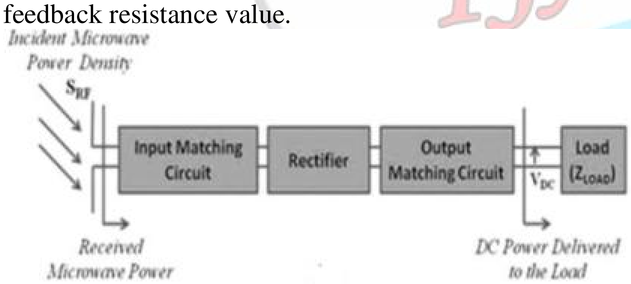


Figure . RF to DC module

RF TO DC CONVERTER:

The block diagram of the conventional RF to DC converter is shown in figure 1. In consists of anantenna, input matching circuit, rectifier, output matching circuit and a load .A method for performing a power extraction includes receiving an electromagnetic radiation signal using antenna, rectifying the signal produce DC voltage and providing the DC voltage to a circuit.

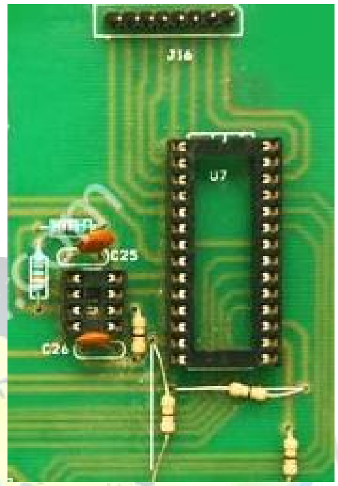
Thus, proper choice and design of antenna and a rectifying circuit is needed to solve this problem. Having an efficient antenna for matching the desired frequency and a high performance rectifying circuit will greatly affect and improve the output power generated. With the challenging issue of improving the generated output power generated in a conventional RF to DC converter, this paper explored the addition of properly designed tank or tuner circuit to improve input matching of the desired radio frequency received before rectification process. Also, different antenna type will be tested to determine the maximum output power generated of the overall system. change the gain by adjusting the value of feedback resistance value.



D. ADC:

Figure. ADC

The ADC0808, ADC0809 data acquisition component is a monolithic CMOS device with an 8-bit analog-to-digital converter, 8-channel multiplexer and microprocessor compatible control logic.



The converter features a high impedance chopper stabilized comparator, a 256R voltage divider with analog switch tree and a successive approximation register. The 8-channel multiplexer can directly access any of 8-single-ended analog signals.

The device eliminates the need for external zero and full-scale adjustments. Easy interfacing to microprocessors is provided by the latched and decoded multiplexer address inputs and latched TTL TRI-STATE® outputs.

E.CHOPPER CIRCUIT:

The basic boost converter is no more complicated than the buck converter, but has the components arranged differently in order to step up the voltage. Again the operation consists of using Q1 as a high speed switch, with output voltage control by varying the switching duty cycle. When Q1 is switched on, current flows from the input source through L and Q1, and energy is stored in the inductors magnetic field. There is no current through D1, and the load current is supplied by the charge in C1. Then when Q1 is turned off, L opposes any drop in current by immediately reversing its EMF . so that the inductor voltage adds to (i.e., .boosts.) the source voltage, and current due to this boosted voltage now flows from the source through L, D1 and the load, recharging C1 as well. The output voltage is therefore

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higher than the input voltage, and it turns out that the voltage step-up ratio is equal to:

Vout/Vin = 1/(1-D)

where 1-D is actually the proportion of the switching cycle
that Q1 is off, rather than on. So the step-up ratio is also equal to:

Vout/Vin = T/Toff

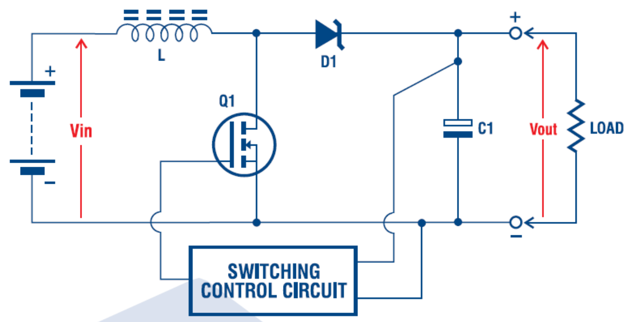

Figure. dc to dc converter

F. ULTRA THIN SUPER CAPACITOR:

Electrochemical Double Layer Capacitors (EDLCs) – also called supercapacitors (SC) - are electrochemical capacitors that have high capacitance and high energy density when compared to common capacitors, and higher power density when compared to batteries. .[5] presented a short overview on widely used microwave and RF applications and the denomination of frequency bands. The chapter start outs with an illustrative case on wave propagation which will introduce fundamental aspects of high frequency technology.

Most EDLC's are constructed from two carbon based electrodes (mostly activated carbon with a very high surface area), an electrolyte (aqueous or organic) and a separator (that allows the transfer of ions, but provides electronic insulation between the electrodes). As voltage is applied, ions in the electrolyte solution diffuse across the separator into the pores of the electrode of opposite charge. Charge accumulates at the interface between the electrodes and the electrolyte (the double layer phenomenon that occurs between a conductive solid and a liquid solution interface), and forms two charged layers with a separation of several angstroms – the distance from the electrode surface to the center of the ion layer. The double layer capacitance is the result of charge separation in the interface. Since capacitance is proportional to the surface area and the reciprocal of the distance between the two layers.

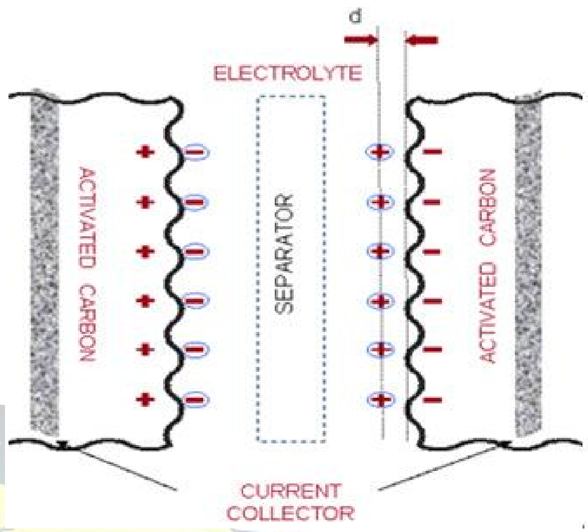

Figure. Super capacitor

G.LCD DISPLAY:

LCD which shows the range of voltage. It is also plays an important role of this application. The output from the micro controller is given to the lcd and it shows the output. Liquid crystal display is a flat panel display or other electronically modulated optical device that uses the light modulating properties of liquid crystals. Liquid crystals do not emit light directly, instead using a backlight or reflector to produce images in color. In this paper it shows the voltage range.

H.RELAY:

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are double throw (changeover) switches. The coil of a relay passes a relatively large current, typically 30mA for a 12V relay, but it can be as much as 100mA for relays designed to operate from lower voltages. Most ICs (chips) cannot provide this current and a transistor is usually used to amplify the small IC current to the larger value required for the relay coil.

The relay's switch connections are usually labeled COM, NC and NO:

- **COM** = Common, always connect to this, it is the moving part of the switch.

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- **NC** = Normally Closed, COM is connected to this when the relay coil is **off**.
- **NO** = Normally Open, COM is connected to this when the relay coil is **on**.

REGULATOR:

A voltage regulator is an electromechanical component used to maintain a steady output of volts in a circuit. It does this by generating a precise output voltage of a precise output of a preset magnitude that stays constant despite changes to its load conditions or input voltage. Electronic components are built to receive a specified amount of volts and can be seriously damaged if the power surges, and low voltages may not be able to power up a component to its full functionality. Regulators ensure the voltage is within a range the electronic components can safely receive and use to optimally function. Depending on its design, a regulator can regulate single or multiple DC or AC voltages.

V. CONCLUSION

RF energy harvesting based charging the low power devices such as mobile phones, iPhone, etc., this is very useful method to charge the device. It is wireless charging. And it is free energy. It harvests the energy from the freely available resources. It can integrated into a small size of chip and placed near the battery of mobile phone. Charging of mobile phone while call is incoming, the RF energy will be available.

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