

# Piezoelectric Sensor Based Wireless Charging Platform

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**Abstract:** Wireless charging may one day replace plugs and wires similar to how Wi-Fi and Bluetooth have modernized personal communication. Wireless charging with inductively coupling uses an electromagnetic field that transfers energy from the transmitter to the receiver. Consumers are wild about the gadget of simply placing a portable device on a charging mat. Wireless charging works easily with mobile phones, digital cameras, music players, gaming controllers and Bluetooth headsets. Other charging applications are power tools, medical devices, e-bikes and battery cars (EVs).

**Keywords:** Rectifier, wireless charging, power inverter, transformer, dc regulator, pic controller, piezoelectric sensor, sound sensor.

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## I. INTRODUCTION

In the existing system mobile phones are charged and operated normally on the wireless charging pad under most circumstances without using repeaters. For safety reasons, planar wireless charging pads tend to have an electromagnetic (EM) shield underneath the pad. It is used to prevent the ac magnetic field generated by the planar winding structure from entering any metal object underneath the charging mat. Without such EM shield, the ac magnetic flux could induce eddy current and heat up a metallic table on which the charging pad may be placed. In this system, for charging the mobile we are using piezo plate and sound sensor. Piezo plate will detect the pressure and sound sensor will detect the sound produced in that place. DC Power generated will be stored in the battery. From the battery direct current is converted into alternative current and send to the transformer which has 12V 40 kHz AC supply. By transformer through the primary side of WPT (wireless power transmission) it is transmitted to secondary side of WPT and from there it is filtered through filter and sends to dc regulator, after that the mobile can charged. We will see the voltage value in LCD. This paper reports new results of an emerging field that combines radio-frequency (RF) repeater design and wireless power technologies for charging applications. Power electronics based contact less charging pads have recently been developed for charging portable electronic devices such as mobile phones. If, the electromagnetic shield underneath the pad could reduce transmission and reception signals. In this paper, a fresh passive Radio frequency repeater for a wireless charging platform is proposed and investigated for mitigating the signal blocking problem. Since the effective shielding construction for the low-frequency charging signal is not Radio frequency friendly and the received RF signal of a wireless mobile device can be reduced when the phone is placed on a wireless charging platform. A dual-polarization free-emplacement passive RF signal repeater has been successfully designed and implemented. It will improve the Radio Frequency reception signal strength by at least minimum 3.6 dB without noticeable reduction in energy efficiency in the charging process.

## II. PIEZO PLATE AND SOUND SENSOR BASED WIRELESS CHARGING ANALYSIS

### A. Piezo Plate:

#### *Description*

A piezoelectric sensor is a device which uses the piezoelectric effect to measure pressure, acceleration, strainer force by converting them to an electrical charge

The rise of piezoelectric technology is directly related to a set of inherent advantages. The high modulus of elasticity of many piezoelectric materials is comparable to that of many metals and goes up to  $10^6$  N/m<sup>2</sup><sup>[citation needed]</sup>. Even though piezoelectric sensors are electromechanical systems that react to compression, the sensing elements show almost zero deflection. This is the reason why piezoelectric sensors are so rugged, have an extremely high natural frequency and an excellent linearity over a wide amplitude range. Additionally, piezoelectric technology is insensitive to electromagnetic fields and radiation, enabling measurements under harsh conditions. Some materials used (especially gallium phosphate [2] or tourmaline) have an extreme stability even at high temperature, enabling sensors to have a working range of up to 1000 °C. Tourmaline shows pyroelectricity in addition to the piezoelectric effect; this is the ability to generate an electrical signal when the temperature of the crystal changes. This effect is also common to piezo ceramic materials

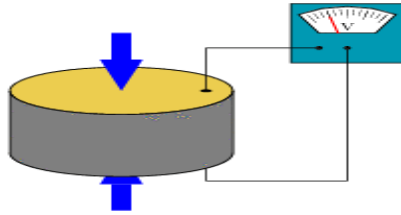


Figure.1 A piezoelectric disk generates a voltage when deformed (change in shape is greatly exaggerated)

### III. BASIC STRUCTURE OF RECTIFIER

#### 1. Rectifier:

A rectifier is an electrical device that converts alternating current (AC), which periodically reverse direction, to direct current (DC), which flows in only one direction. The process is known as rectification. Physically, rectifiers take a number of forms, including vacuum tube diodes, mercury-arc valves, copper and selenium oxide rectifiers, semiconductor diodes, rectifiers and other silicon-based semiconductor switches. Historically, even synchronous electromechanical switches and motors have been used. Early radio receivers, called crystal radios, used a "cat's whisker" of fine wire pressing on a crystal of galena (lead sulfide) to serve as a point-contact rectifier or "crystal detector".

#### 2. Rectifier Circuit:

Rectifier circuits may be single-phase or multi-phase (three being the most common number of phases). Most low power rectifiers for domestic equipment are single-phase, but three-phase rectification is very important for industrial applications and for the transmission of energy as DC (HVDC).

##### A. Single-phase rectifiers

##### 1. Half-wave rectification

In half wave rectification of a single-phase supply only, either the positive or negative half of the AC wave is passed, other the other half is blocked. Because their only one half of the input waveform reaches the output, while voltage is lower. Half-wave rectification requires a single diode in a single-phase supply and three in a three-phase supply.

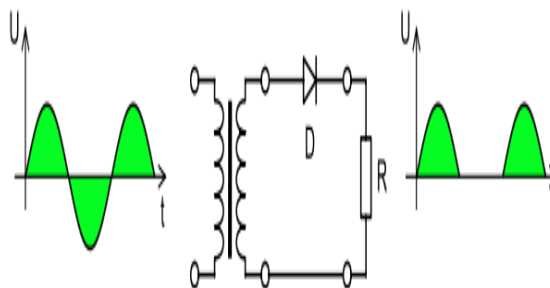


Figure.2 Half-wave rectifier

The no-load output DC voltage of an ideal half wave rectifier for a sinusoidal input voltage is

$$V_{rms} = \frac{V_{peak}}{2}$$

$$V_{dc} = \frac{V_{peak}}{\pi}$$

Where:

$V_{ic}$ ,  $V_{av}$  - the DC or average output voltage,

$V_{peak}$ , the peak value of the phase input voltages,

$V_{rms}$ , the root-mean-square value of output voltage.

##### 2. Full-wave rectification

A full-wave rectifier converts the input waveform to its full positive or full negative waveform at its output but generally full wave rectification provides the conversion of input signals to pulsating DC (direct current), and gives more average output voltage. In full wave rectifier either two diodes including a center tapped transformer or four diodes in a bridge rectifier configuration and any AC sources are needed.<sup>[3]</sup> Manufacturization of a single components semiconductor diodes, double diode along with common cathode or common anode, and four-diode bridges is needed to implement

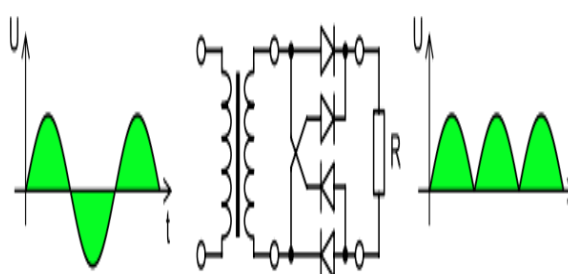


Figure.3 Graetz bridge rectifier: a full-wave rectifier using 4 diodes.

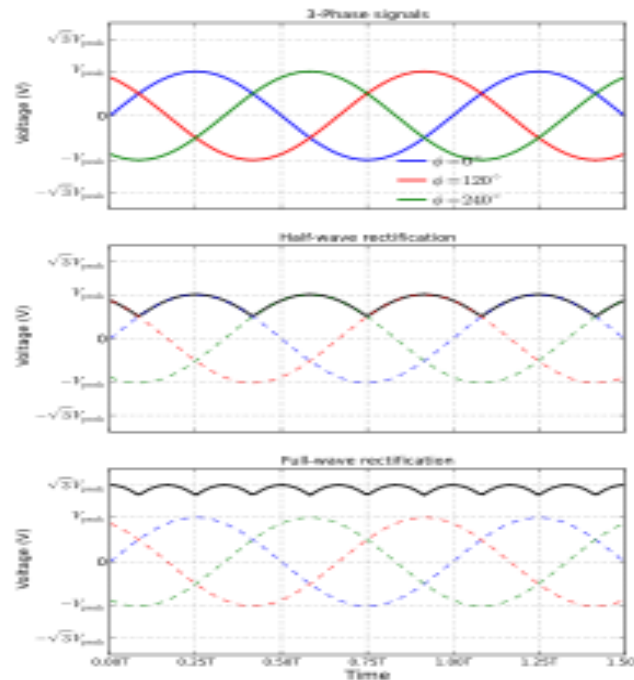
The average and root-mean-square no-load output voltages of an ideal single-phase full-wave rectifier are:

$$V_{dc} = V_{av} = \frac{2V_{peak}}{\pi}$$

$$V_{rms} = \frac{V_{peak}}{\sqrt{2}}$$

**B. Three-phase rectifiers**

Mainly the usage of single wave rectifier for domestic equipment as a power supply. However for industrial as well as power applications, three phase rectifiers are used. On comparison of single and three phase rectifiers three phase can take the form of a half-wave circuit, a full-wave circuit with a center-tapped transformer.



Figur.4 Phase AC input, half and full-wave rectified DC output waveforms

**IV. POWER INVERTER**

A power inverter, or inverter, is an electronic device or circuitry that changes direct current (DC) to alternating current (AC).

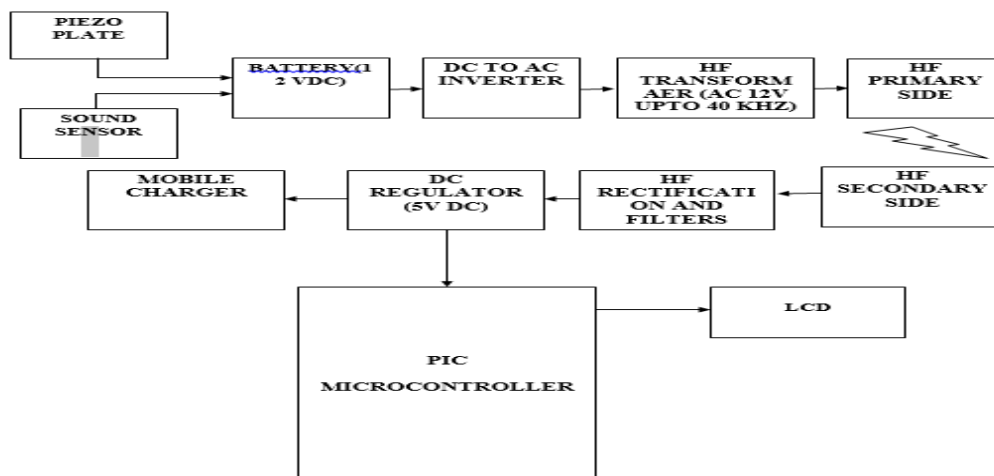
The input voltage, frequency output voltage and overall power handling depend on the design of the specific device. The inverter does not supply any power; the power is provided by the DC source .A power inverter can be entirely electronic or may be a combination of mechanical effects (such as a rotary apparatus) and electronic circuitry. Static inverters does not use moving parts in the conversion process.

**V. TRANSFORMER**

A transformer is an electrical device that can transfers energy between two or more circuits through electromagnetic induction.

A varying current in the transformer's primary winding creates a varying magnetic flux in the core and a varying magnetic field impinging on the secondary winding coil. This varying magnetic field at the secondary induces a varying electromotive force (elf) or voltage in the secondary winding coil. Making use of Faraday's Law in conjunction with high magnetic core properties, transformers can thus be designed as efficiently change AC voltages from one voltage level to another within power networks

**VI. CIRCUIT DIAGRAM**



## VII. ACKNOWLEDGEMENT

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## VIII. CONCLUSION

In this paper, a study on the use of piezo plate and sound sensor in a wireless charging environment has been presented. The effect of the EM shield on signal reception and transmission under the worst case scenario has been identified. *WPT can* enhance signal reception and transmission without adversely sacrificing energy efficiency. Proposed dual – polarization passive array repeaters can be fabricated in flexible printed circuit sheets and placed on the top of the charging pad. Contactless energy transfer is higher system availability because the system is essentially maintenance free

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