

EMBEDDED SYSTEMS(EE30004)

Homework 8

Submitted by:

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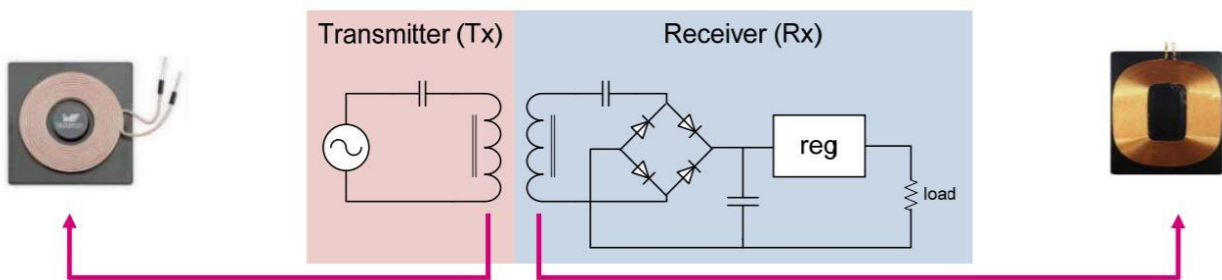
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Q1. With the help of an architecture diagram, explain how wireless chargers work.

Ans:

Power Transfer Principle

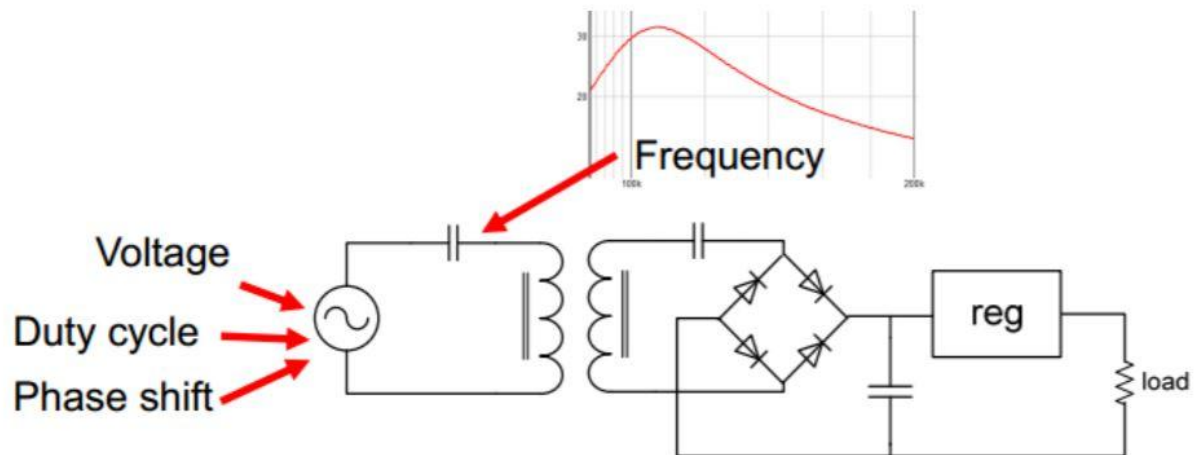
- Tightly coupled wireless charging technology uses magnetic induction to transfer power from a transmitter (Tx) to a receiver (Rx).
- The magnetic field is generated by a **coil on the TX side**. The field is captured by a **coil on the RX side**. The field works through air, no magnetic circuit links the coils.
- The received electrical signal is **rectified, filtered and regulated** before supplying the load.



For adjusting the power to control the magnetic field

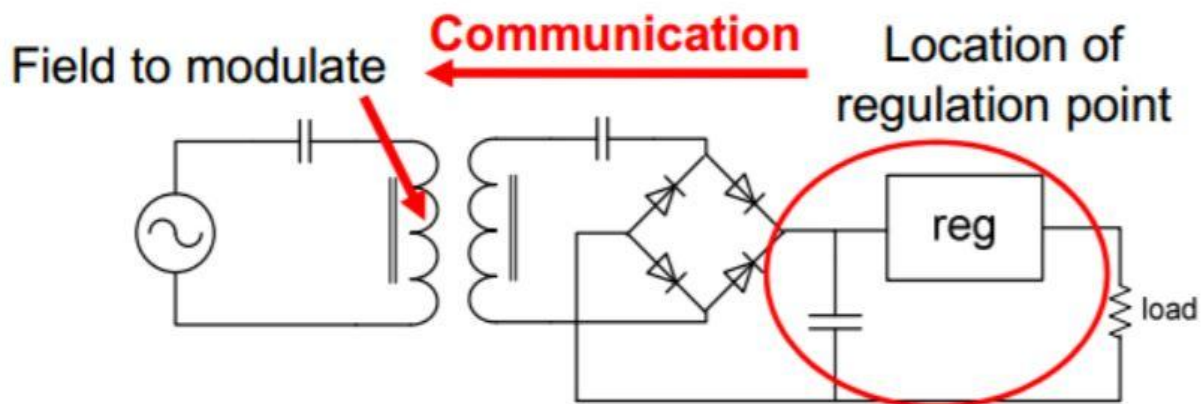
To control the field, various solutions can be used (and combined):

- Use the LC tank properties, changing the oscillator **frequency**.
- Change the oscillator **duty cycle** (using a square wave oscillator)
- Change the oscillator **voltage**.
- Apply **phase shift** to a full bridge oscillator.



RX to TX Communication

- Because there are too many variables (RX/TX coupling, RX & TX coils, load, ...), the TX cannot set the regulation point by itself.
- There is then an absolute need of communication from RX to TX: the RX will have to pass data to the TX about the regulation set point.
- This communication channel can also be used for auxiliary purposes and extended to bidirectional communication



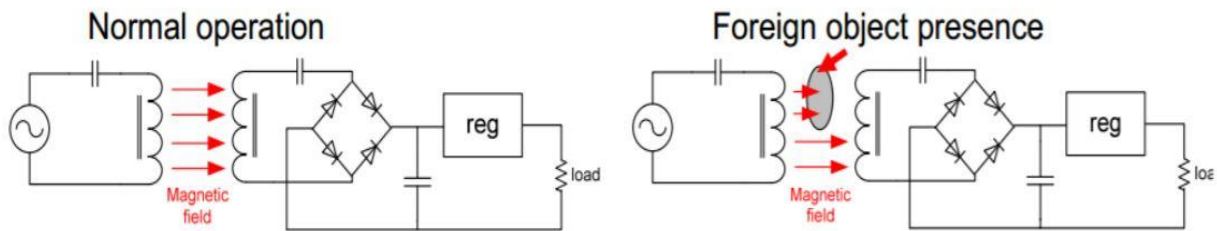
RX Presence Detection and FOD

Receiver Presence Detection

- The transmitter generates a magnetic field at regular intervals and check if a load is present and consumes power.

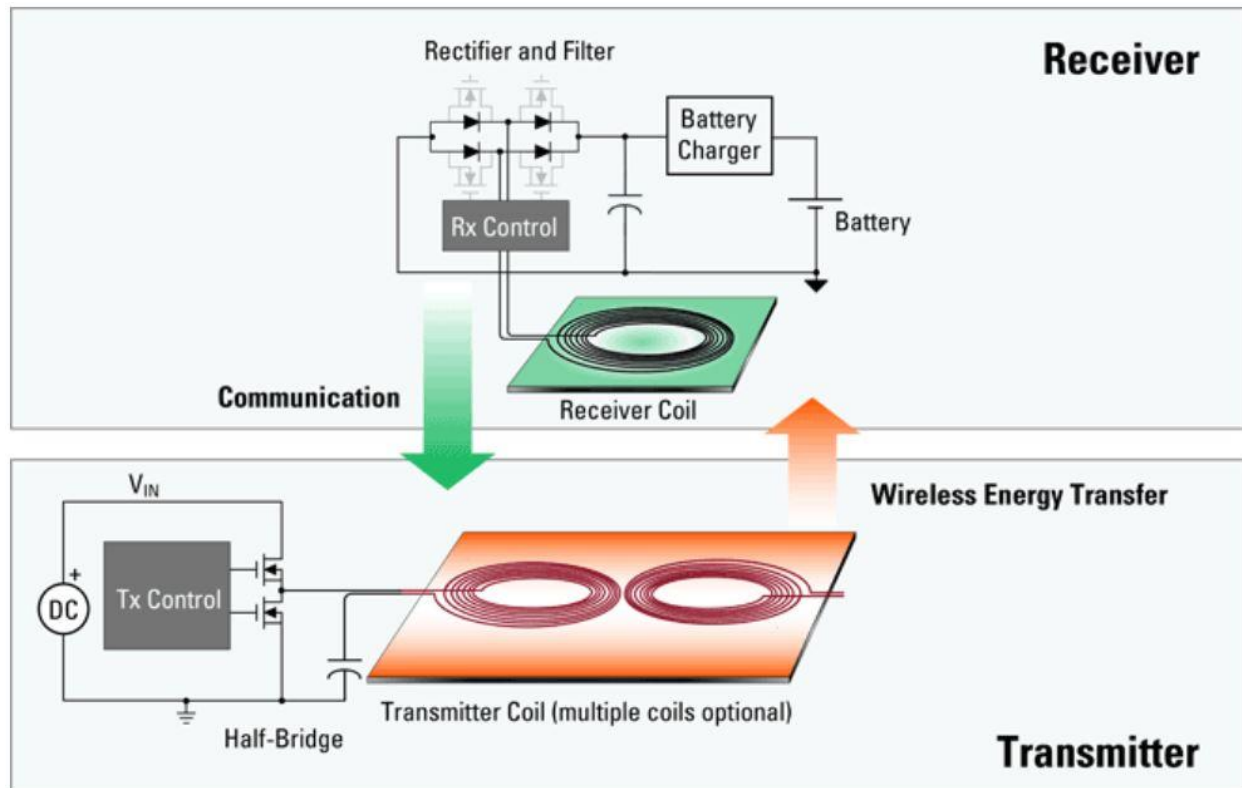
FOD (Foreign Object Detection)

- Qi uses the method of power balance to estimate the presence of foreign object.
- If the TX transmits more power than what the RX reports, a foreign object is present



Summary:

1. The wireless charging transmitter is powered by an input DC rail of 5 V to 19 V, typically derived from a USB port or an AC/DC power adapter.
2. A switched transistor bridge using two or four FETs drives a coil and series capacitor. A resonant frequency is set internally, by means of the series capacitor.
3. The transmitter has a coil to transfer power by electromagnetic induction. Some transmitters support multi-coil arrays, driven by separate bridges which are automatically selected to deliver the highest coupled power into the wireless power receiver.
4. The induced power is coupled to the wireless power receiver, which has a similar coil to collect the incoming power.
5. The receiver rectifies the power by means of diode rectifiers, usually made of FETs for improving efficiency. It also filters the power using ceramic output capacitors and then applies it to the battery that needs to be charged, either through a linear stage or a switching regulator.
6. The battery inside the portable device receives the power and charges up. The receiver can command the transmitter to adjust the charging current or voltage, and also stop transmitting power completely when the end of charge is indicated.



Q2. Write about the construction of a DSLR camera. And what is the difference between a SLR camera and a non-SLR camera.

Ans:

DSLR Cameras are equipped with mirrors that guide light from the lens into the viewfinder by reflecting it upward, hence the term “reflex.” The light that is reflected upward falls on the viewfinder focusing screen; after passing through the screen, it then proceeds through a pentaprism or pentamirror to the viewfinder eyepiece window. This allows the photographer to view the image from the camera lens directly in the viewfinder. When the shutter-release button is pressed all the way down, the mirror is raised and the light coming through the lens proceeds straight through to the shutter curtain. The curtain simultaneously opens to allow the light to fall on the image sensor and a photograph is taken. The shutter then closes and the mirror drops back into its original position. By linking the action of the shutter with the movement of the mirror, the light passing through the lens can be made to fall on either the viewfinder focusing screen or the image sensor.

Digital cameras take photographs using an image sensor that converts light to electronic signals. The distinguishing feature of single-lens reflex (SLR) cameras is that the optical viewfinder displays the view through the camera lens. The “single lens” in the

name “single-lens reflex” is a reference to this feature: a single lens serves both for taking photographs and for the viewfinder. The “reflex” portion refers to the reflection of light.