



**Industrial Consultancy & Sponsored Research (IC&SR)**

**WIRELESS CHARGING UNIT INCLUDING TUNNELLING  
MAGNETORESISTANCE SENSORS**

**IITM Technology Available for Licensing**

**PROBLEM STATEMENT**

- **Environmental concerns** over fossil fuel-operated ICE vehicles have **sparked interest in electric vehicle (EV)-based** transportation infrastructure.
- **EVs are environmentally sustainable** due to their independence from carbon-based fuel, eliminating carbon by-product emissions.
- However, **effective charging technologies are needed** to address safety, operational costs, and driving range concerns.
- **Inductive Power Transfer (IPT)** has gained popularity due to its **improved safety and convenience**, but conventional wireless charging units **struggle to identify charging pad types** and differentiate between chargeable devices and non-chargeable metallic objects, leading to power wastage.
- **A wireless charging unit is needed to address these issues.**

**TECHNOLOGY CATEGORY MARKET**

**Technology:** Tunnelling Magneto Resistance (TMR) sensors for detecting type of charging pads.

**Category:** **Wireless charging**

**Industry:** Automotive

**Application:** **Electric Vehicle**

**Market:** The global market size of the electric vehicle (EV) market is projected to grow from **\$500.48 billion in 2023 to \$1,579.10 billion in 2030** at a **CAGR of 17.8%** in forecast period, **2023-2030**.

**INTELLECTUAL PROPERTY**

IITM IDF Ref. 2196

Patent No: IN 536149

**TRL (Technology Readiness Level)**

TRL-4, Experimentally validated in Lab;

**Research Lab**

**Prof. Boby George,**  
Dept. of Electrical Engineering, IIT Madras.

**TECHNOLOGY**

- The Proposed wireless charging unit **Tunnelling Magneto Resistance (TMR) sensors**, a system that transmits wireless power to a secondary pad of a wireless chargeable device.
- The Unit consists of a
  - ❖ **Primary pad** with coils,
  - ❖ **A sensor pad** above it, and
  - ❖ A plurality of **TMR sensors** positioned at different locations to **identify the type of secondary pad** by sensing changes in **magnetic field**.
- The Primary Pad can be a
  - **Bipolar Pad (BPP), Circular Pad (CP), or Double-D Pad (DDP).**
- wherein the magnetic field is produced by the **one or more primary coils** of the primary pad.
- The wireless charging unit can **detect the presence of a metallic object** in front of the primary pad.

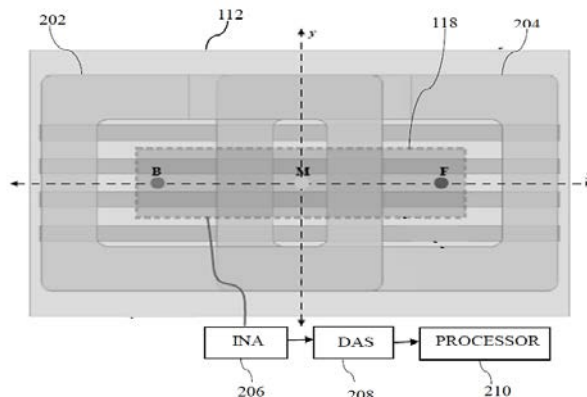


Fig 1 illustrates the proposed **locations of TMR sensors** on primary pad

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### Block diagram

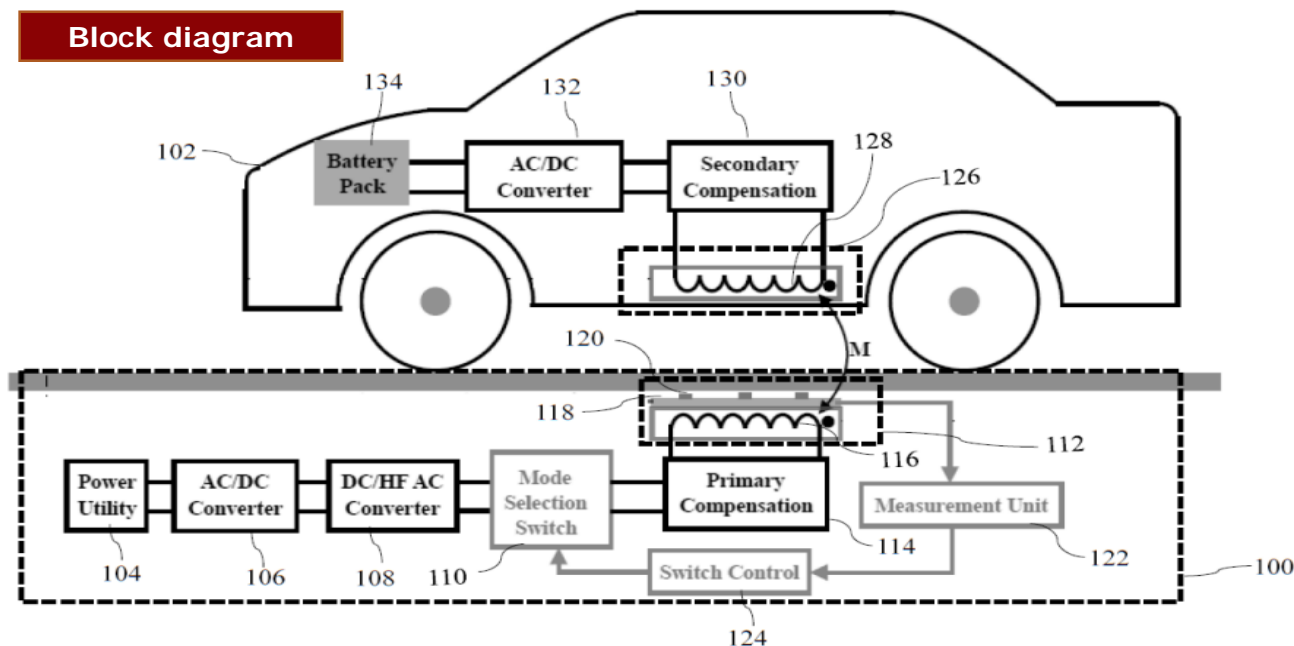


Fig 2 illustrates a block diagram showing components of a wireless charging unit and a chargeable device.

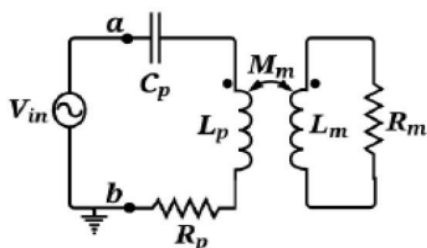


Fig 3 shows a Electrical equivalent circuit of a primary pad with a metallic object present on a secondary side

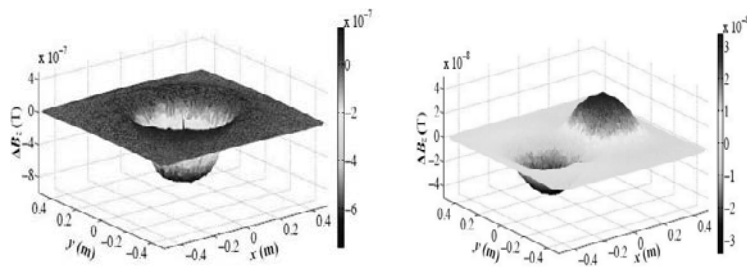


Fig 4 shows a change in magnetic flux density ( $\Delta B_z$ ) for CP and DPP sensed in the secondary pad

### Key Features / Value Proposition

- Wireless Charging Unit for **EV Applications**.
- **Automatically detects** and identifies secondary pad in EVs.
- **Switches charging pad mode** based on secondary pad type.
- **Detects metallic objects** to prevent accidental activation.
- Utilizes **frequency bifurcation and magnetic field change pattern** for pad detection and identification.
- Requires **no expensive components** and can be **easily integrated into BPP pads**.
- Based on magnetic sensing, **less affected by dust, snow, oil, and humidity**.
- Can **transfer power to a bipolar pad primary, circular pad, or double-D pad secondary**.
- Prototype sensor system integrates **TMR sensors for magnetic flux density change**.
- Tested in detail to identify secondary pad type under various conditions.

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