9 wireless power transfer projects PDF
To give you a taste what’s possible in wireless power transfer applications, we’d like to share some examples of this technology in combination with others, such as actuation, communication and sensing. The power levels we have worked with range from μWatt to hundreds of kWatt. During the past decade, we have applied this wireless power transmission technology to projects aimed at solving various problems such as:

- Sending power to sensor nodes which are not reachable.
- Charging sealed batteries that work in harsh conditions where cabling is troublesome.
- Sending power to moving or rotating parts.
- Driving moving or rotating parts wirelessly.
- Modulating wireless power signal to carry data bidirectionally.
- Sensing position via the wireless power channel.
- Sending power via walls, glass or other obstacles.
- Getting rid of cables for the ease of operators of medical devices.
Wireless power transfer table of contents

1. Wireless movable spotlight
2. Rotational system with high-power WPT
3. Remote sensing applications
4. Wireless traffic cone charging
5. Wireless power up of a sensor node in a tire
6. Wireless universal power plug
7. Contactless powered linear motors
8. Power and data over light
9. Wireless ultrasonic power transfer
1. **Wireless movable spotlight**
Robust and low-cost power transfer, combined with a pan/tilt actuator

**Application**
The 2D electromechanical actuator in combination with wireless power transfer to allow remote powering and repositioning of spotlights.

**Challenge**
Design and development of a wireless powered 2D actuator capable of +/- 30 degrees of movement in both x and y directions. The actuator is controlled by a touchpad or mobile phone app.

**Innovation**
The magnetics-assembly intended for power transfer has been given a secondary function – to create a stick-slip based pan/tilt mechanism. This mechanism can orient the luminaire, while adding no extra components or mechanical connections to the lamp itself, and requires no power when inactive. The wireless actuation and integral sensing, combined with intelligent control and a user interface, is an interesting solution for applications that require occasional movement.

**Key specifications**
- Power: 5 W
- Switching frequency: 80 kHz
- Power transfer efficiency: 50%
- Type: electromagnetic coupling
- Additional technology: electromechanical 2D actuation
2. **Rotational system with high-power WPT**
High-power WPT to minimize sound and wear for CT scanners

**Application**
Slip rings usually provide the high level of power required by generators in the high-speed rotational units of CT scanners. This high-power WPT system is intended to replace these slip rings.

**Challenge**
Designing wireless power transfer system for high-power rotational system. The conversion efficiency is critical.

**Innovation**
Very high-power and high-speed rotational interface by means of modular magnetic elements to create a robust – yet lightweight and efficient – power path.

**Key specifications**
- Power: 200 kW peak, 100 kW continuous
- Switching frequency: 20 kHz
- Power transfer efficiency: 98% for the couplers, 90% end-to-end
- Type: electromagnetic coupling
- Additional technologies: high rotational speed of 300 rpm, separate optical data links (Gbit/s)
3. **Remote sensing applications**

Compact customized power transfer and data channel for sensors in rotating machines

**Application**

Wireless power transfer system designed for an automotive application. The sensor data from the rotating part (wheel) is transferred back via the same wireless link.

**Challenge**

Power and data is to be transferred using a singular inductive coupler. Severe volume restrictions on the coils and circuitry.

**Innovation**

Wireless power to, and remote sensing from, a rotating unit is achieved by developing compact PCB-based transmitter and receiver coils.

**Key specifications**

- Power: 1 W
- Switching frequency: 100 kHz
- Power transfer efficiency: up to 80% depending on the distance
- Type: electromagnetic coupling
- Additional technologies: PCB coils, rotational system
4. **Wireless traffic cone charging**

Convenient workflow with wireless charging for smart traffic cones

**Application**

Wireless charging unit for *safety perimeter system* intellicone. Developed for highway maintenance and construction for the European Safelane project.

**Challenge**

Develop a wireless system for in situ recharging of smart-sensor enabled batteries in a lantern:
- Increase reliability of the lanterns by removing all external connectors.
- Create a lean workflow by establishing the wireless connection during storage–stacking.

**Innovation**

The implementation of wireless charging makes for a robust and effortless way to keep the batteries topped up.
- The intellicones improve safety for road workers compared to passive traffic cones.
- A sustainable solution (as opposed to disposable batteries) by implementing rechargeable batteries that require no extra user effort.

**Key specifications**

- Power: 5 W
- Switching frequency: 100–200 kHz
- Power transfer efficiency: 70–80%
- Type: electromagnetic coupling
- Additional technologies: PCB coils
5. Wireless power up of a sensor node in a tire
Powering a sensor node across a large distance

Application
This long-range WPT system has been designed for an automotive application: to power a sensor node within a rotating tire.

Innovation
Large-distance power transfer achieved from a stationary part to a rotating system.
• The large transmitter coil is located in the stationary part of the vehicle.
• A compact receiver coil, packaged together with the sensor node, is inserted inside the tire.

Challenge
The unique challenge of this project is to transfer power across large distances (greater than 500 mm).

Key specifications
• Power: 5 mW
• Switching frequency: 100 kHz
• Power transfer efficiency: negligible, input power large
• Type: electromagnetic coupling
• Additional technologies: sensor node and receiver coil in a compact package
6. **Wireless universal power plug**

Isolating AC mains

**Application**
Wireless universal power plug for home or garden applications that use AC mains (220 V). This plug can transform electrical power from conventional wall outlets to work without galvanic contacts.

**Challenge**
Designing an efficient, hermetically sealed, compact wireless power plug operating at mains voltages.

**Innovation**
- Connection through obstacles (glass, wall, etc.).
- No bare pins for safe use in e.g. children’s rooms, kitchens, wet environments. Also allows safe outdoor use of conventional garden tools or lights in the rain.
- Better robustness of power connection.
- Ease of connection via magnetic connection.
- Convenient and recognizable form factor, with the power source and the connected appliance being agnostic towards the presence of the wireless plug.

**Key specifications**
- Power: 70 W peak, 50 W continuous
- Switching frequency: 100 kHz
- Power transfer efficiency: around 90% depending on distance
- Type: electromagnetic coupling
- Additional technologies: magnetic connection, all electronics in the compact plug design
7. **Contactless powered linear motors**

Contactless power across a long-stroke XY stage

**Application**
The linear motors of an XY stage has been powered wirelessly within a WICOR project (Wireless Interconnected Robot). Industrial automation systems such as pick-and-place, wafer processing equipment, and any application requiring reliable wireless power transfer to the moving axes can benefit from this technology.

**Challenge**
Create a contactless alternative for cable slabs to enable actuation and metrology of long-stroke XY stages to get:
- No cable-slab wear
- No cable-slab dynamics
- Space savings

**Innovation**
The primary coil of the inductive coupler is elongated in the direction of movement, while the core and secondary coil travel freely with the stage over its stroke. This modular coupler may be cascaded for each motion axis of the stage.

This technology is well adaptable for different stage concepts by merely changing the geometry of the coupler. Its scalability allows for diverse power requirements. It exhibits a good efficiency and favorable EMC.

**Key specifications**
- Power: y-axis: 600 W peak/300 W continuous, x-axis: 100 W peak/50 W continuous
- Switching frequency: 100 kHz
- Power transfer efficiency: 90%
- Type: electromagnetic coupling
- Additional technologies: linear motors, XY stage, elongated coupler transformer coils, optical data transfer
8. **Power and data over light**
Power transfer over a light beam, over a large distance

**Application**
Based on an invention and research conducted by Philips Research Laboratories, we have built a tech demonstrator to show the transfer of substantial power and data over light (a free-space link in this case). This technology can be used to energize and read sensors or actuators over large distances without cables.

**Challenge**
WPT where electromagnetic interference is undesirable, or a long distance needs to be bridged over a free-space link, with limited space available for a transducer.

**Innovation**
- Long-distance power transfer
- Bidirectional communication
- Galvanic isolation
- Off-the-shelf components
- High optical quantum efficiency (compared to IR systems)
- High data rates at little extra cost
- Relatively high power and voltage
- Directly generated 3 V DC can power processors, sensors without convertors

**Key specifications**
- Power: 100 mW
- Switching frequency: n/a (DC)
- Power transfer efficiency: 40% optical; 12% end-to-end
- Type: power and bidirectional data over light
- Additional technologies: communication > 100 kbps with the native devices; higher data rates possible if separate communication lasers are used

Based on original research of
Dr. Martin B. van der Mark
Philips Research

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8. **Power and data over light**

Power transfer over a light beam, over a large distance

Based on original research of Dr. Martin B. van der Mark
Philips Research
9. **Wireless ultrasonic power transfer**

Power transfer over soundwaves providing power to buried, embedded or submerged devices

**Application**

We have identified ultrasonic power transfer as a potential option for electromagnetic WPT, suitable for several applications such as charging wireless medical implants and sending power to unreachable sensor nodes. Ultrasonic power transfer is suitable inside a medium such as water, polymers, or the human body. Air is usually not an effective medium for ultrasonic WPT.

**Challenge**

WPT where electromagnetic interference is undesirable, or a suitable medium for electromagnetic power transfer is not available; no optical path to the target.

**Innovation**

Long-distance power transfer can be achieved inside media such as water, human tissue, concrete, girders, soil, glass, metal, plastics or other suitable materials. Piezoelectric transducers are used as transmitter and receiver units. In order to increase the efficiency, the type of the piezo elements and the distances should be optimized.

**Key specifications**

- Power: 100 mW output
- Switching frequency: 1.6 MHz (Ultrasonic frequency)
- Power transfer efficiency: 15%
- Type: ultrasonic (acoustomechanical) power transfer via medium
- Additional technologies: piezoelectric transducers
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