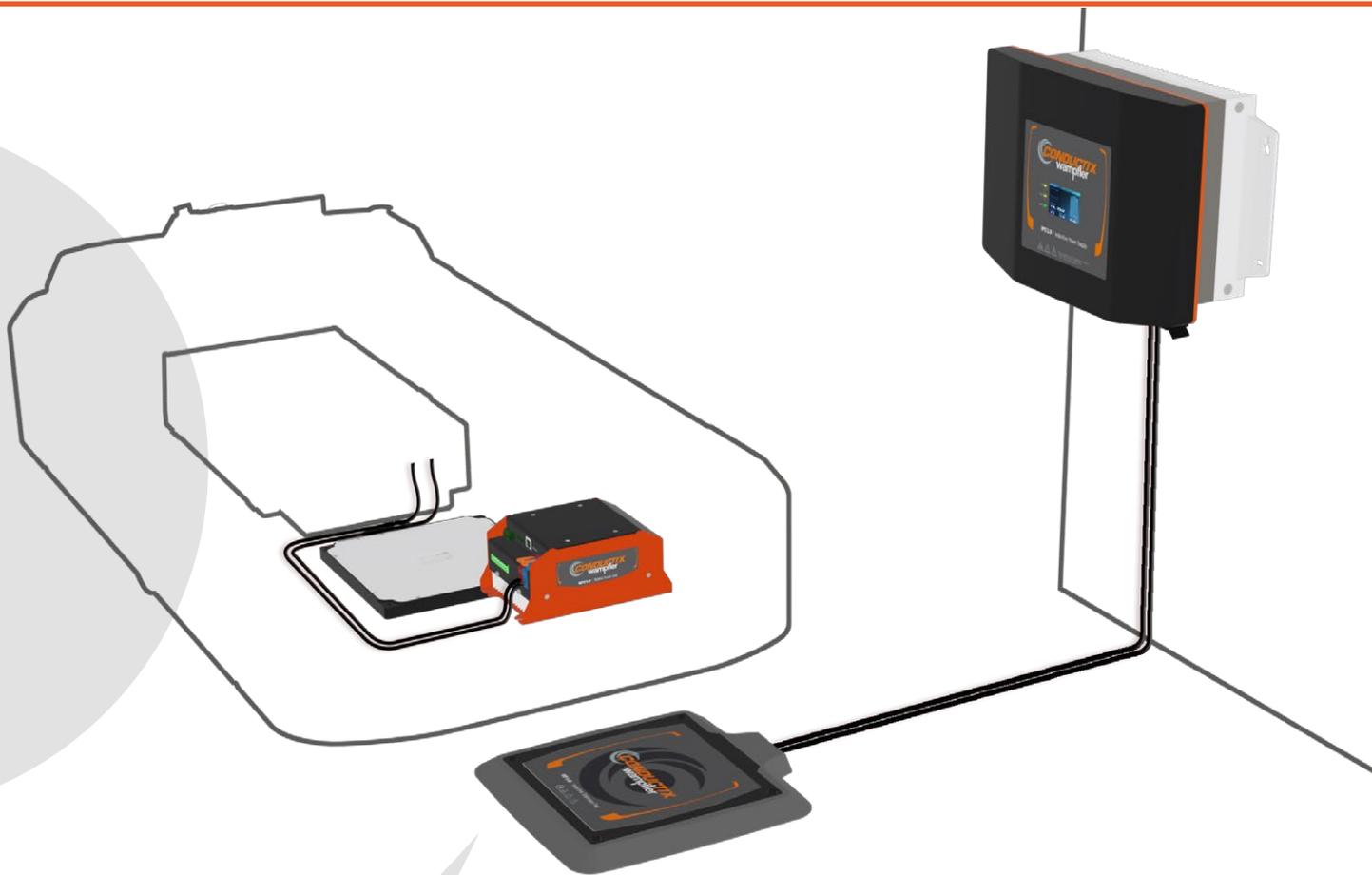


# Wireless Charger 3.0

Program 9200



**CONDUCTIX**  
wampfler

The ultimate  
solution for

A G V

A M R

F T S

A G C

L G V

M G V

M I R

S G V

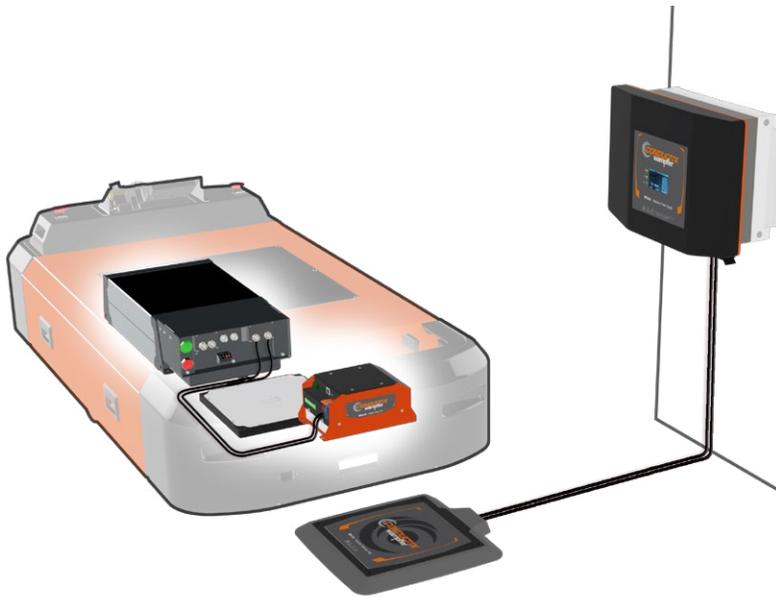
A I V



# Wireless Charger 3.0

## Powerful | Reliable | Efficient

**Wireless Charger 3.0** is a highly efficient power transfer system, ideal to provide electric power to charge batteries. **Wireless Charger 3.0** meets the more and more demanding requirements modern logistic solution ask for. Offering best-in-class charging to fully automated transport solutions, being very robust, having no vulnerable contact surface, providing high efficiency **Wireless Charger 3.0** allows highly dynamic and flexible transport solutions, at an extremely competitive cost level compared to other solutions so far considered for power transfer solution in the industry.



Applying **opportunity charging** implemented in operation processes it allows typically smaller batteries and increases by the means of short but more frequent charging sessions the lifetime of batteries, as this method of charging results in less thermal stress in the battery.

Bundling it with the **Conductix-Wampfler batteries**, specially designed and build for industrial use, is a supplementary option. Not a must, but an optional feature worth looking at.

Based on experience with wireless solutions in very different applications since 1997, the option to add our supplementary industrial battery packages and supported by our global organization structures supporting our customers, a very unique bundle.

Conductix-Wampfler is comprising a long history in wireless power transfer, by the means of inductive power transfer. First charging systems were introduced to the market already in 1997. Combining State-of-the-art power electronics design with many years of experience in the field has resulted in the **Wireless Charger 3.0**. Adding the expertise in batteries in the Conductix-Wampfler Group extends the solution package by optional battery packs. It is your choice and freedom to use just the **Wireless Charger 3.0** or the battery packs or use the worry-free bundle.

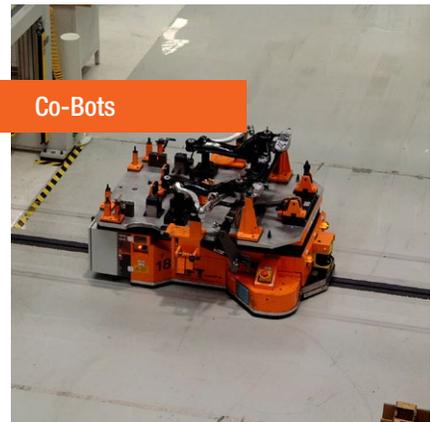
Automated Guided Vehicles



Mobile Service Robots



Co-Bots



Shuttle-Storage



# Wireless Charger 3.0

## A short introduction

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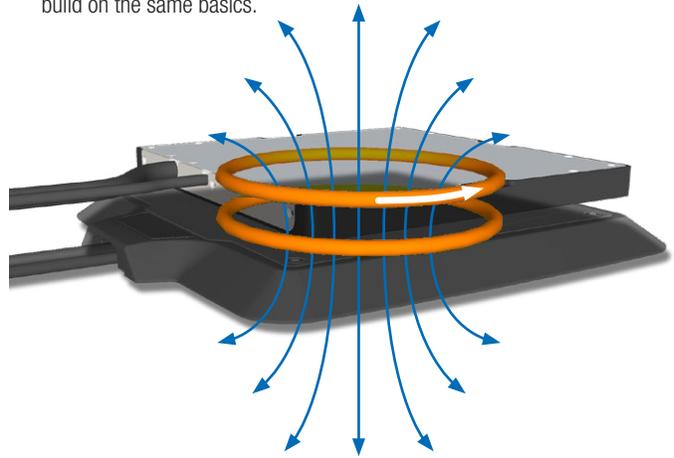
### Principle

It always looks like a wonder, that power is transferred through air. But the principles are known since a long time. Faraday and Maxwell are just two of the scientists working out the basics. Nikolas Tesla was, in addition to his breakthrough works on electrical motors and AC grid systems, famous for his works on wireless power transfer. While he looked on power transfer over large distances, the **Wireless Charger 3.0** focuses on distances defined by the operation practicability on vehicles served. Magnetic fields are designed and optimized for typical air gaps and are confined so near the active coils.

The principle is very close to transformers. To gain flexibility and the capability to move away the core applied in transformers to link the coils is naturally a no go. Applying higher AC frequencies, it is possible to overcome the absence of the core and transfer power efficiently over air gaps.

Power electronic units are needed to convert low frequency mains current on the stationary side and to provide a stable DC output on the vehicle side. It is not rocket science at all, when you know what you need to do.

A simple example of wireless power transfer familiar to many of us, are electric toothbrushes. Not exactly designed for the same demands but build on the same basics.

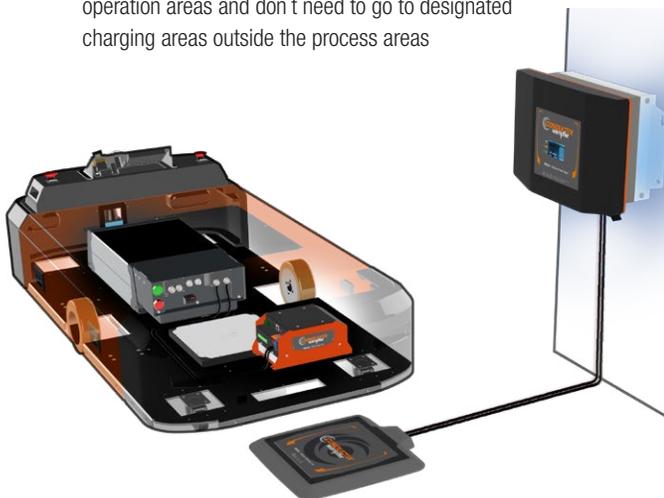


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### The Charging System

#### Wireless Charging means

- Automated charging without manual interventions
- Applying the advantages of opportunity charging in regular operations, resulting in smaller batteries
- Resistance against harsh and dirty operation theatres
- The absence of mechanical wear and tear in the power transfer process, so significantly reduced needs for service and maintenance as there are no vulnerable contact surfaces or wearing plugs
- The absence of abrasives allows the use in sensitive areas, i.e. food production
- Increased in service time as the vehicles are charged in operation areas and don't need to go to designated charging areas outside the process areas



#### Wireless Charger 3.0 is designed for

- Passive cooling, free of wear and tear
- Simple interfaces into the vehicle, resulting in simple integration
- Easy status recognition, even from distance, by the indicative halo light design
- Detailed status information on the displays or through bus interfaces
- Flexibility of horizontal or vertical mounting on vehicles
- An integrated inductive communication, not affected by WLAN or other radio based communication, is assuring by proximity communication the pairing of vehicle and charging station
- No accidental switch on by safety precautions, such as validations, pairing, defined charging orientation.
- Compatible with typical battery systems, only voltage needs to match
- By design current limited
- Galvanic separation of the onboard components from the stationary components

# Wireless Charger 3.0 Charging

## The Batteries

**Conductix-Wampfler batteries** are built up from long term proven battery cells. Power type cells and energy type cells, both using NMC technology, are available for various applications. Batteries are offered together with other Conductix-Wampfler products as a well aligned bundle. The overall design of **Conductix-Wampfler batteries** takes a big step forward to achieve robust and versatile battery systems for challenging industry use cases.

**Conductix-Wampfler batteries** are particularly characterized by:

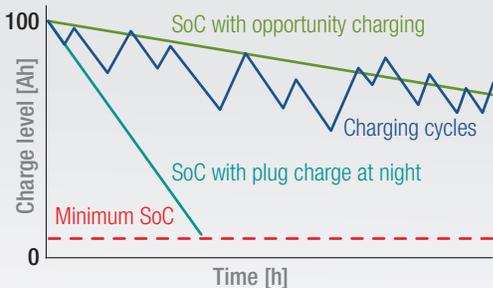
- Robust and compact packaging, targeting to industrial use needs and operating conditions.
- Battery condition is constantly monitored by a battery management system, making the batteries very suitable for opportunity charging.
- Featuring well defined and simple interfaces to other bundle components, like various charging solutions, as well as to surrounding customer components.
- Configurable cell pack design allows the flexibility to size optimized battery packages, including special variants for heavy duty applications.



## Opportunity Charging

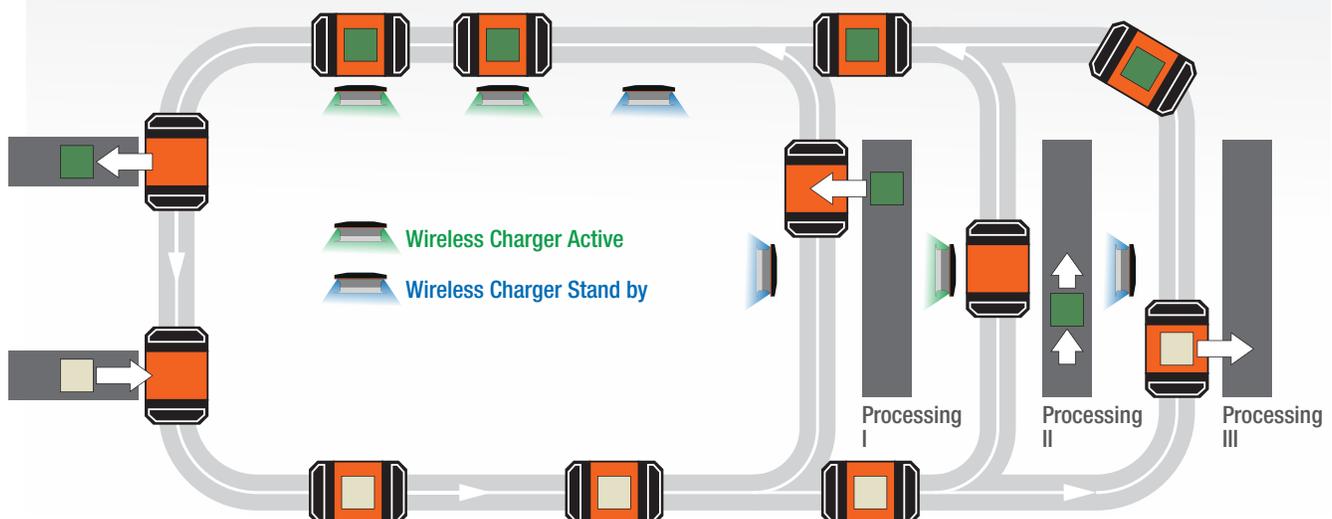
Opportunity Charging means the use of available time slots during operations. Typically, these are short but frequent stops. Which means you never recharge the battery completely; you just refill it to a certain extend.

But as this happens frequently, it helps to run vehicles with less onboard capacity. A "side effect" is the reduction of thermal stress on batteries. Being charged in short intervals and outside of situations most stressful for batteries (low and high states of charge) the thermal load is significantly reduced, which results in very healthy operation of batteries.



So resulting in

- Lower investment in batteries
- Smaller battery volume, easier integration
- Improved life cycle of batteries
- Easier handling of batteries



# Wireless Charger 3.0 Components

## Functional Components

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The **IPS** (Inductive Power Supply), converts the 50 or 60 Hz mains frequency into a high frequency allowing highly efficient power transfer. Charging requirements and other information coming from the Battery management system onboard the vehicle is taken up by the ISP and transferred in corresponding action.

If you want to say so, the **IPS** is the heart and the brain of the **Wireless Charger 3.0**. Mains required is 230 V (200 – 270 V) 2-phase, fused at 16 Amps.



The **ISP** (Inductive Stationary Pad), includes the sending coil for the power transfer and inductive communication. Horizontal and vertical arrangements are possible. The **ISP** comes with a cable connection that can be easily cut to length.

The **IMP** (Inductive Mobile Pad), is the matching counterpart to the ISP. Design and build are widely identical to the ISP. The **IMP** comes with a cable connection that can be easily cut to length.



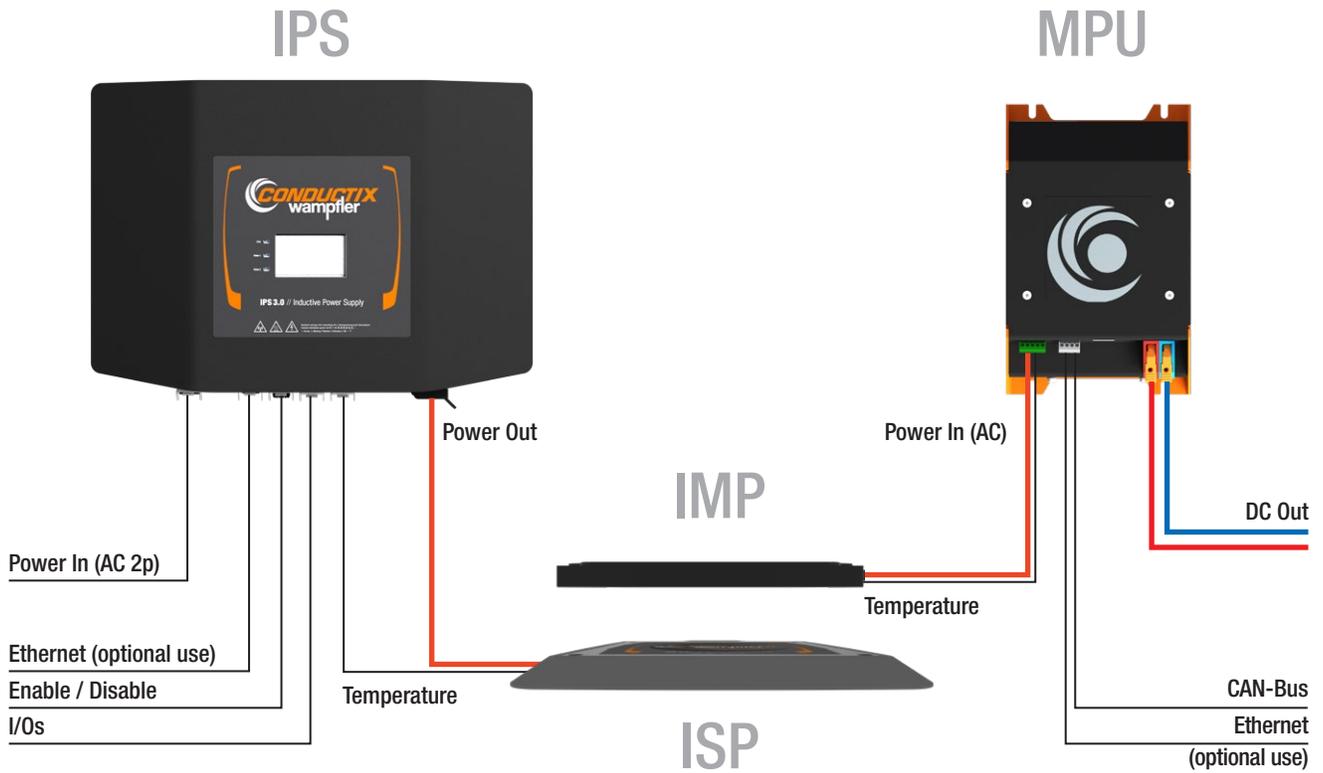
The **MPU** (Mobile Power Unit) is taking up the current induced in the **IMP** and provides a stable DC output towards the battery. The output voltage range is 21 to 59 V DC. The wireless charger can charge on demand when communication to the battery management system is active, or to set values when no communication is present.



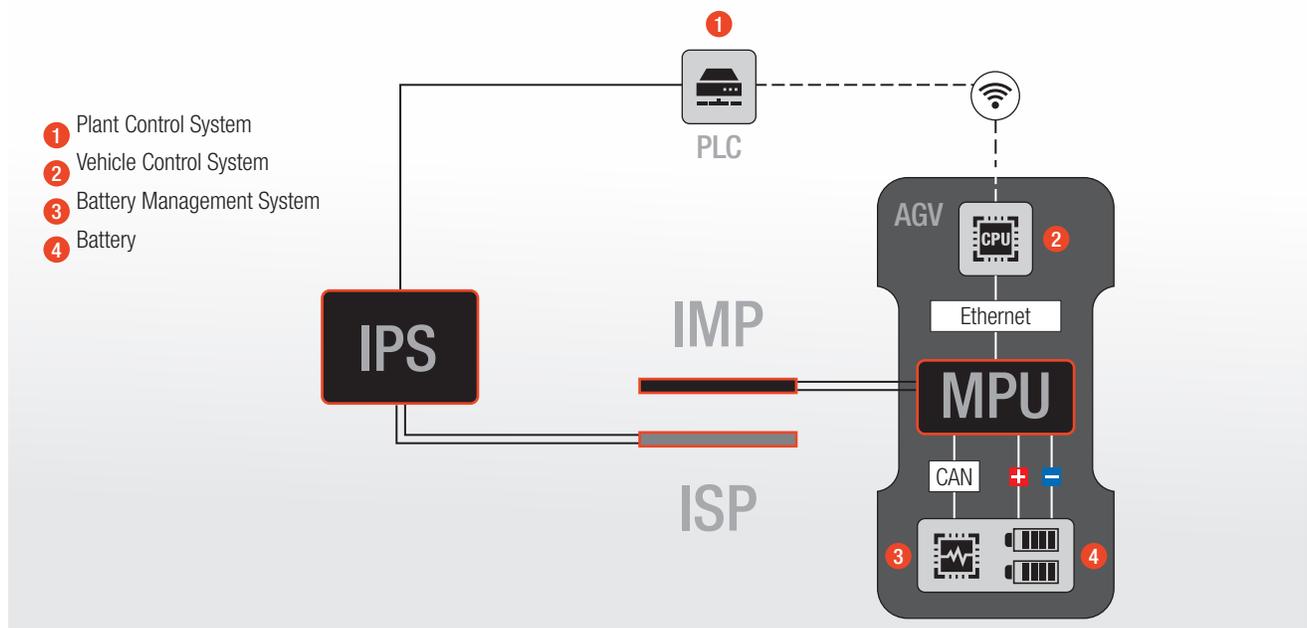
# Wireless Charger 3.0

## Operating Principle

### Functional Structure



### Applicational Structure



# Wireless Charger 3.0 Arrangements

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## Requirements

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**Wireless Charger 3.0** is providing implementation freedom. There is no preferred or required mounting orientation for the pads. Depending on vehicle design, available installation space and building structures in the operational environment the chargers can be installed horizontally or vertically.

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## Vertical Arrangement

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The **vertical arrangement** doesn't require the mounting on a specific side of the vehicle. Practice is in most cases to mount the **IMP** (Inductive Mobile Pad) on the left or the right side of the vehicle, so that a drive through situation is given. However also a front side mounting is possible if the local situation is making it necessary or recommendable. Naturally, it is mandatory to keep consistently one arrangement in an installation. A mix is possible, means however designated charging stations for designated vehicles.

The vertical arrangement requires building structures or extra stands of matching height to hold the **ISP** in correct position to the **IMP**, when in charging position.

The **ISP** (Inductive Power Supply) is foreseen for wall mounting typically. However, it can also be mounted on any building structures or stands. The **MPU** (Mobile Power Unit) can be placed flexibly on the vehicle.



# Wireless Charger 3.0 Arrangements

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## Horizontal Arrangement

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The **horizontal arrangement** is simply fixing the **ISP** (Inductive Stationary Pad) with 4 screws (at least 2) on the floor. A flat even floor underneath is recommendable to provide mechanical stability to the **ISP**, hollow spaces underneath should be filled with spacers if floor is not flat.

A second version of floor based installation is the floor embedded installation. Works on the floor itself are necessary to make cut-outs for the **ISP** and the feeding cable. The full integration installation's benefit is the undisturbed floor level, allowing for cross traffic and avoiding stumbling edges.

Connection cables between **IPS** and **ISP** can be run on floor in cable bridges or in floor. When run in floor in slots it has been proven good practice to provide extra protection by Epoxy potting or to cover the slots. Which cable routing is preferable, depends at the end on chosen pad arrangement, local situation and ways of operation.

Principally drive-through use and forward/backward cross charging are both possible. With either use, it must be assured that cable routing does not create impacts on operation or safety hazards.

- Standards **ISP** and **IMP** are based on a square design. Other designs, i.e. rectangular, can be provided on request.
- For both, the **IPS** and as well the **MPU** do require a free air flow to provide cooling. If not possible on a guaranteed basis forced air cooling might be worth a consideration.



# Wireless Charger 3.0

## Set Stationary Side

### IPS 3.0 | Inductive Power Supply



|   |   |
|---|---|
| Nominal Power                               | 3.000 W   |
| Supply Voltage                              | 220-277 V AC +/-10% 50/60 Hz  |
| Supply Net                                  | 1 Phase + PE  |
| Input Current Rating                        | 16 A  |
| Output Current Rating                       | max. 25 Arms  |
| Operating Frequency                         | 85 – 130 kHz  |
| Interfaces in use with Wireless Charger 3.0 | Power/Ethernet/Digital I/O  |
| Switches                                    | On/Off  |
| Color                                       | RAL7016/RAL2009/Metal Surfaces  |
| Environmental Conditions                    | for industrial applications, indoor, dry and clean, no special requirements |
| Operating Temperature                       | 0 ... +45°C   |
| Cooling                                     | Convection – Passive  |
| Mounting Orientation                        | vertical  |
| Protection Class                            | IP54  |
| Accessories (optional)                      | Plug Set  |

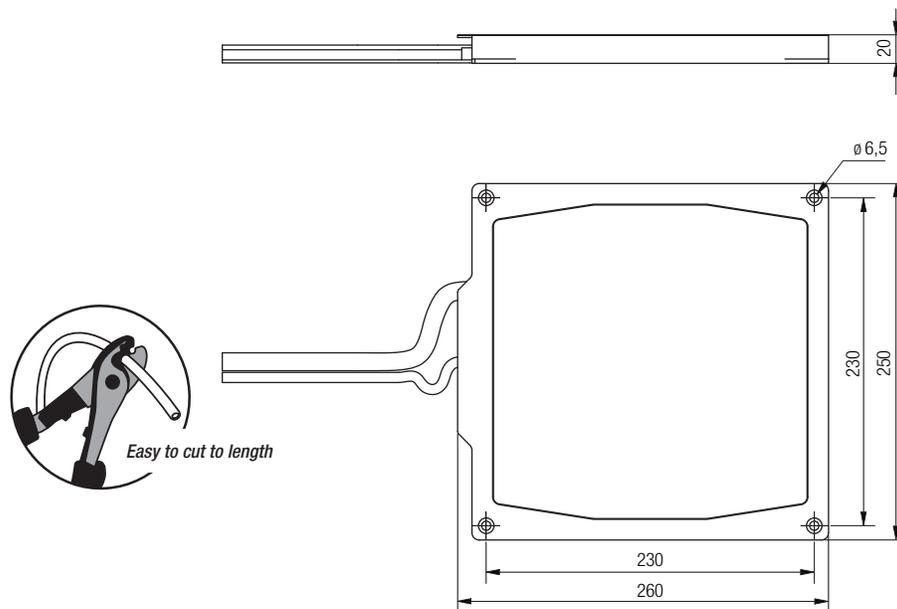
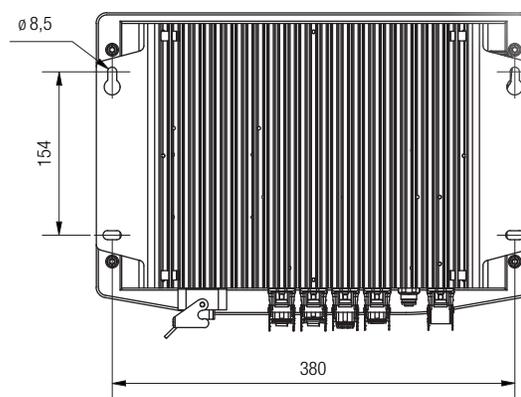
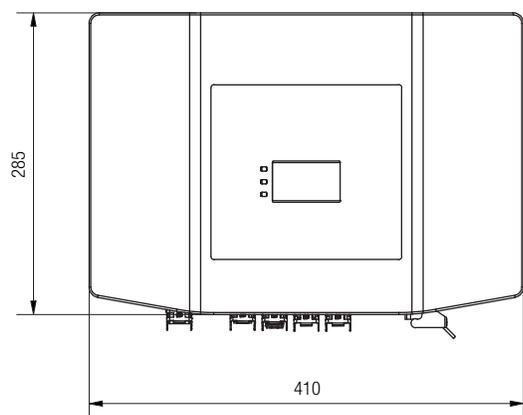
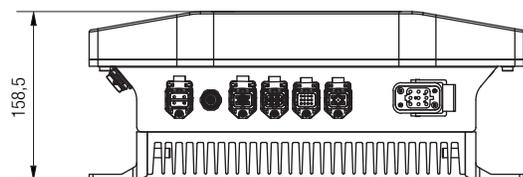
### ISP 3.0 | Inductive Stationary Pad



image shows accessories

|                                     |   |
|-------------------------------------|---|
| Nominal Power                       | 3.000 W   |
| Feed                                | exclusively with IPS 3.0, 3kW   |
| Cable Lengths                       | 10.000 mm   |
| Cable Termination and Cut to Length | On Site   |
| Operating Frequency                 | 85 – 130 kHz  |
| Interfaces                          | Power Cable + Temperature Signal  |
| Accessories (optional)              | Frame Floor Mounting<br>Frame Vertical Mounting                             |
| Color                               | RAL7016/RAL2009   |
| Environmental Conditions            | for industrial applications, indoor, dry and clean, no special requirements |
| Operating Temperature               | 0 ... +45°C   |
| Cooling                             | Convection – Passive  |
| Mounting Orientation                | horizontal or vertical  |
| Protection Class                    | IP65  |
| Accessories (optional)              | Mounting Frame  |

# Set Order-No. 60765271



# Wireless Charger 3.0

## Set Vehicle Side

### IMP 3.0 | Inductive Mobile Pad



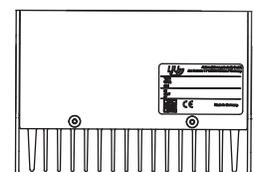
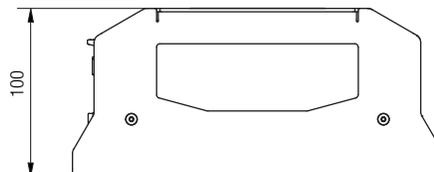
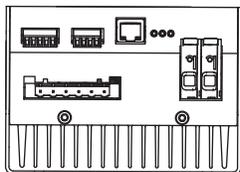
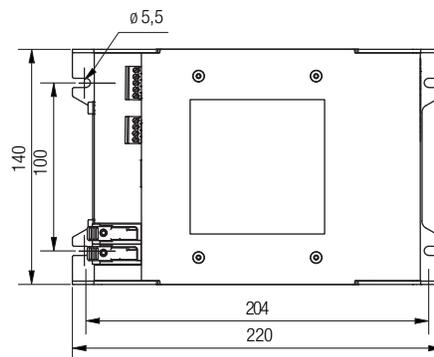
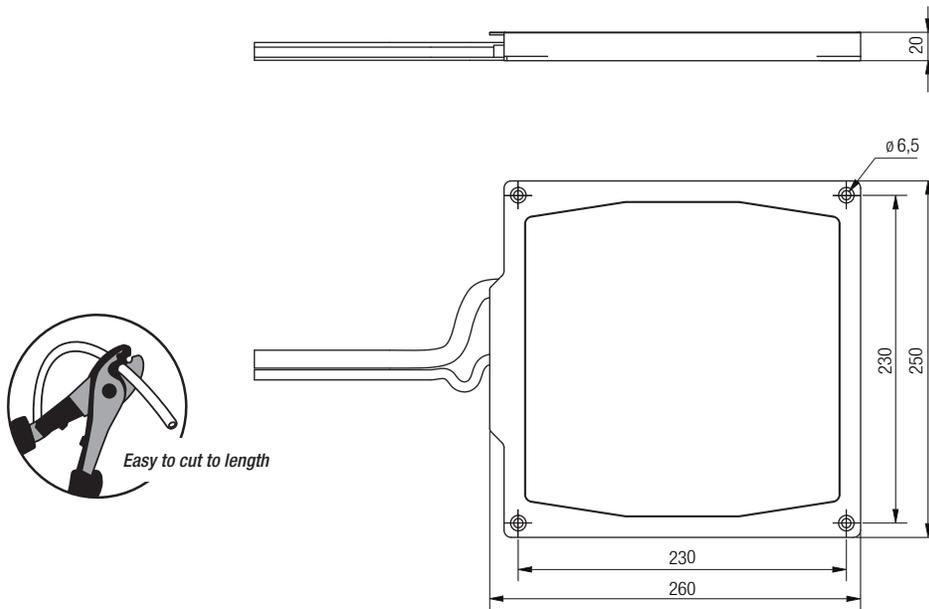
|                          |   |
|--------------------------|---|
| Nominal Power (Maximum)  | 3.000 W   |
| Supply                   | Exclusively with Components Wireless Charger 3.0, 3 kW                      |
| Cable Lengths            | 1.000 mm  |
| Cable Termination        | On Site   |
| Interfaces               | Power Cable + Temperature Signal  |
| Switches                 | None  |
| Color                    | RAL7016/RAL2009   |
| Environmental Conditions | for industrial applications, indoor, dry and clean, no special requirements |
| Operating Temperature    | 0 ... +45°C   |
| Cooling                  | Convection – Passive  |
| Mounting Orientation     | Horizontal or Vertical  |
| Protection Class         | IP65  |

### MPU 3.0 | Mobile Power Unit



|                                     |   |
|-------------------------------------|---|
| Nominal Power (Maximum)             | 3.000 W   |
| Supply                              | Exclusively with Components Wireless Charger 3.0, 3 kW                      |
| Output Voltage                      | 21 .. 59 V DC   |
| Output Current                      | 60A at 50V (derating to 51A at 59V)   |
| Output Connection Terminals (Power) | 16 mm <sup>2</sup> terminals +/-  |
| Interfaces                          | Power/Ethernet/CAN/Digital I/O  |
| Switches                            | None  |
| Color                               | RAL7016/RAL2009/Metal Surfaces  |
| Environmental Conditions            | for industrial applications, indoor, dry and clean, no special requirements |
| Operating Temperature               | 0 ... +45°C   |
| Cooling                             | Convection – Passive  |
| Mounting Orientation                | vertical  |
| Protection Class                    | IP20  |

# Set Order-No. 60765272

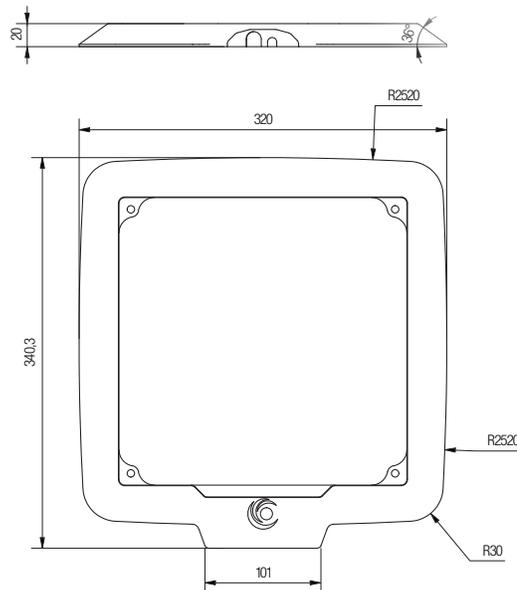




# Wireless Charger 3.0 Accessories

## Mounting Frame

Order-No. 60420039



|                                 |  |
|---------------------------------|--|
| <b>Material</b>                 | Plastic  |
| <b>Color</b>                    | silver-grey  |
| <b>Use</b>                      | In combination with Inductive Stationary Pad (ISP) 3.0, 3 kW or Wireless Charger Set WCS 3.0, 3 kW |
| <b>Environmental conditions</b> | Standard Indoor, no specific requirements in respect to chemicals and temperatures                 |
| <b>Mounting</b>                 | Held in position by Inductive Stationary Pad (ISP), no extra holes and screws                      |

The frame Floor Mounting provides extra mechanical protection to the Inductive Stationary Pad (ISP) in respect to forces on the sides or the top edges. At the same time the frame provides a smooth incline and removes potentially dangerous trip hazards.

The frame is hold in position by the mounting screws of the Inductive Stationary Pad (ISP), no extra holes and screws needed.

## Set of Plugs for IPS 3.0 | Inductive Power Supply

Order-No. 60365267

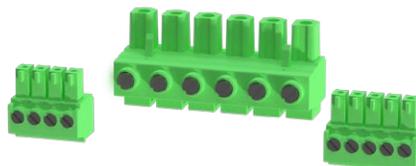
Cables and tools are not included but available on request.



## Set of Plugs for MPU 3.0 | Mobile Power Unit

Order-No. 60365266

Cables and tools are not included but available on request.



# Wireless Charger 3.0

## FAQs

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### Charging many vehicles on a Charging Station?

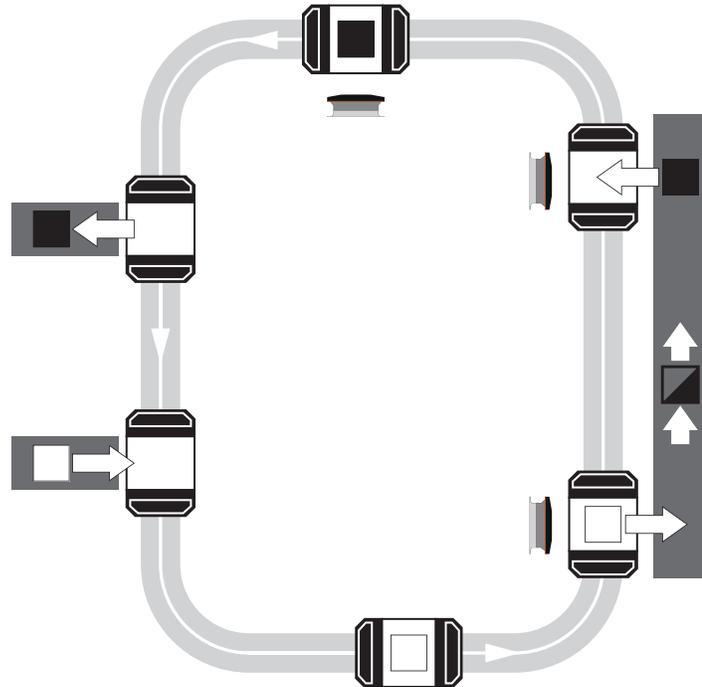
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While charging is in process, there is always a 1:1 link between the Charging Station and the vehicle to charge. But this does not mean this is generally the case of the Charging Station, any suitable vehicle can use any free Charging Station.

Typically, you usually have more vehicles than Charging Stations in a facility. This may not be always the case, i.e. with 1 or 2 shift operation and long-time windows for charging it might be a consideration to have a Charging Station per vehicle.

But even then, it is to keep in mind that we speak about automated charging and automated vehicles, so vehicles can change positions when being charged to a satisfactory SOC (state of charge).

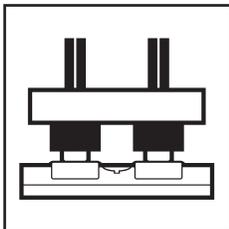
At the end it means to analyse the operating scenario, the local setup, etc. to determine the best ration between Charging Stations and vehicles. The nice thing is, that Charging Stations can be installed rather quickly, de-mounted or relocated rather quickly to adjust to operational needs. Just a mains connection not to far away must be considered.



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### Aren't charging contacts a cheaper alternative?

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Charging contacts are indeed an alternative to apply for winning the advantages of opportunity charging. Conductix-Wampfler has also charging contacts in the product portfolio. And yes, they do look more simple and cheaper than a **Wireless Charger 3.0**. Topics to consider with charging contacts are wear and tear, the vulnerability of the contact surfaces and the limitations resulting from the open contact surfaces. Contact quality very much effects the efficiency, typically contact pressure is a compromise between contact quality and wear and tear.

If contact pressure is insufficient or if contact surfaces are damaged or worn, transfer efficiency will suffer, extra warming occur, worst case being a potential hazard. And you must consider that there needs to be a power electronics unit extra per contact plate, to provide DC going over the contacts.

With **Wireless Charger 3.0** you have this already included. The features and design make **Wireless Charger 3.0** a very robust and indestructible power transfer system. Not exactly with the **Wireless Charger 3.0** MPU shown herein, but with other setups you can also realize much higher output voltages safely, as well go so for higher powers.

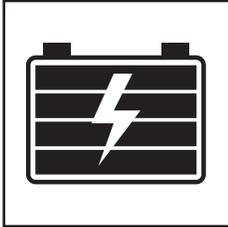
# Wireless Charger 3.0

## FAQs

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### Batteries, why do you speak about batteries – do you not rather mean accumulators?

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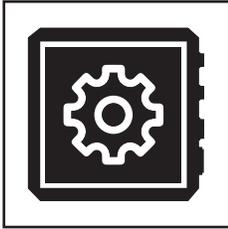
Yes, we know battery is actually a wrong term, as batteries are not rechargeable. Correctly we should use the term accumulator, as only those are suitable for recharging. But as it is most common to speak about batteries very generally, we decided to follow this for easier reading of the document.

But correctly, you should replace the term battery by accumulator when it is used herein.

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### Who controls how batteries are charged?

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The **Wireless Charger 3.0** never determines how batteries must be charged, it always follows charging demands originated by the battery, respectively the battery management system (BMS). So required charging currents and voltages are always requested from there.

The **Wireless Charger 3.0** limits the requests only when they are exceeding the actual capabilities on the **Wireless Charger 3.0**, i.e. when the maximum output current providable is lower the requested one. If the **Wireless Charger 3.0** is ordered in a bundle with Conductix-Wampfler battery pack the two blocks closely interact. If third party batteries are used, the requests and state information must be exchanged via CAN.

Conductix-Wampfler provides a detailed specification of the CAN-signals and the interface in such case. If for certain reason the CAN matrix needs adaptation to request from the battery or vehicle side, such adaptation is possible on request. Please do consult us in advance for consulting and specific conditions.

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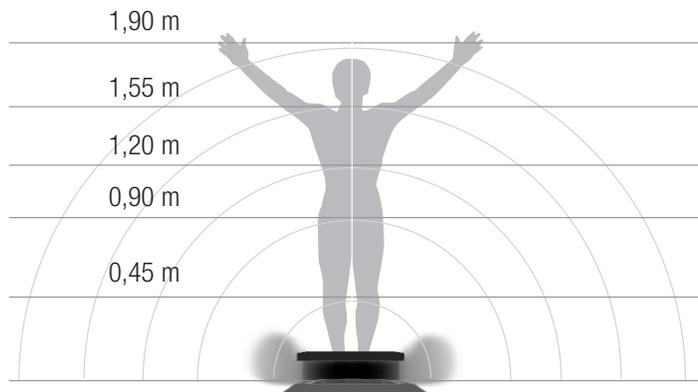
### Field and Health Effects?

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Yes, there is a magnetic field around the pads when power is transferred. As our designers are aware of this, it is a top target that the field strength does not exceed the legal limits and recommendations as given i.e. by the ICNIRP (International Commission for Non-Ionizing Radiation) in 2010.

The ICNIRP recommendation is worldwide recognized and the basis for most national legislation and standards. However, it must also notice that fields as used in the **Wireless Charger 3.0** as means for power transfer are linked to their source, so they are always limited to the proximity of the pads.

The fields are not to compare with fields as occurring in radio communication or with mobile phones. There are electro magnetic waves are designed to be send out and bridge large distances.



Magnetic field strength near a Wireless Charger System

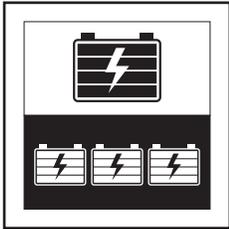
# Wireless Charger 3.0

## FAQs

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### What makes your batteries different to other batteries?

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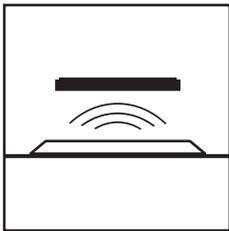
**Conductix-Wampfler batteries** are characterized by a high flexibility to build up the battery for special customer requirements. They are scalable in voltage and in capacity within a wide range. Like this, they are providing a good cost to performance ratio for mid-size AGV and similar applications.

**Conductix-Wampfler batteries** are featuring a very robust and heavy-duty switching technology, suitable for challenging industry requirements and environments.

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### Does the transfer of power over the air gap mean poor efficiency?

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Normally you think the air gap is making power transfer impossible or at least very inefficient but knowing what to do and using higher operation frequencies when used in the mains it is possible to transfer power very efficiently. The power electronic elements used in the **Wireless Charger 3.0** are state-of-the-art, and they are comparable to such used in high-end plug-in chargers.

Combining higher operating frequencies with advanced power electronics and many years of expertise in the Conductix-Wampfler Group it is possible to build top-notch wireless chargers coming close to absolute high-end plug-in chargers. Considering overall efficiency, i.e. smaller batteries to move, smarter charging applying opportunity charging, and such the wireless power transfer technology is competitive with best-in-class plug-in chargers.

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### Metal in proximity?

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Power transfer in the **Wireless Charger 3.0** is realized by the means of induction. Unfortunately, induction induces eddy currents in metal structure exposed to the magnetic fields created. Our designers know this and therefore design systems accordingly. There are different means to guide, shape and shield magnetic fields. Applied by our experts, the effects in the surrounding of the in the **Wireless Charger 3.0** are practically not of importance, when using the system in its designated way. Fields are only emitted for induction when a matching counter part (IMP) is close to the sending pad (ISP).

Together the pads form a very closed system for power transfer. However, it should naturally be avoided to insert metal objects in the room between the pads while charging is in progress. Such may result in heating of objects or result in a stop of power transfer.



# Your Applications – our Solutions

The solutions we deliver for your applications are based on your specific requirements. In many cases, a combination of several different Conductix-Wampfler systems can prove advantageous. You can count on Conductix-Wampfler for hands-on engineering support together with the optimum solution to safely meet your needs.



## Cable and Hose Reels

Motor driven and spring driven reels by Conductix-Wampfler provide energy, data and media over a variety of distances, in all directions, fast and safe.



## Festoon Systems

Conductix-Wampfler cable trolleys can be used in virtually every industrial application. They are reliable, robust and available in an enormous variety of dimensions and designs.



## Conductor Rails

Available as enclosed or multiple unipole systems, Conductix-Wampfler conductor rails reliably move people and material.



## Inductive Power Transfer IPT®

The no-contact system for transferring energy and data. For all tasks that depend on high speeds and absolute resistance to wear. Flexible installation when used with Automated Guided Vehicles.



## Non-insulated Conductor Rails

Robust, non-insulated aluminum conductor rails with stainless steel cap provide the ideal basis for power supply of people movers and transit networks.



## Radio Remote Controls

Safety remote control solutions customized to meet our customer needs with modern ergonomic design.



## Reels, Retractors and Balancers

Available for hoses and cables, as classical reels or high-precision positioning aids for tools, we offer a complete range of reels and spring balancers.



## Jib Booms

Complete with tool transporters, reels or an entire media supply system – safety and flexibility are key to the completion of difficult tasks.



## Slip Ring Assemblies

Whenever things are really “moving in circles”, the proven slip ring assemblies by Conductix-Wampfler ensure the flawless transfer of energy and data. Here, everything revolves around flexibility and reliability!



## Mobile Control Systems

Mobile control solutions for your plant – whether straightforward or intricate. Control and communication systems from LJU have been tried and tested in the automotive industry for decades.



## ProfiDAT

This data transfer system is a compact slotted waveguide and furthermore can be used as Grounding rail (PE) as well as positioning rail at the same time.

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