DIGITAL WE DAYS 2024





THE OVERVIEW OF THE WIRELESS POWER TECHNOLOGY MARKET

Dinesh Kithany
Founder and Chief Analyst | **WAWT (Wired & Wireless Technologies)**

WURTH ELEKTRONIK MORE THAN YOU EXPECT



Contents of this presentation

- About WAWT
- Wireless power technology evolution and landscape
- Adoption of wireless power across applications
- Wireless power market drivers and barriers
- How BIG is the wireless power market opportunity?
- Q&A Session





About WAWT and its Wireless Power Research



About Wired & Wireless Technologies (WAWT)

- Wired & Wireless Technologies (WAWT) is a strategic technology analyst and consultancy firm.
 - We deliver Research, Insights and Strategy
 - WAWT was founded and supported by Our Believers (our clients)
 - Our thorough research and analysis practice help us to drive our client's business strategy and growth.
 - Our SMEs operate as 'Trusted Advisors' and act as 'Strategic Business Partners' to our clients.
- Our 3i Approach helps us to offer tailormade solutions specific to client's needs: To Inform, To Intellect, To Interact
- Our SMEs (Subject Matter Experts) have extensive knowledge and experience and are well-networked in the industry.
 - Our SMEs are the most sought-after industry analysts, invited to speak at key industry events and webinars.
- Our Mission: "To grow when our clients grow and succeed".
- Our Vision: "To be the Most Trustworthy and Sought-After Analyst Firm in the areas we excel".



Our area of Expertise and Tailormade Solutions

- Our current Core Expertise areas where we provide strategic directions through critical data and market intelligence are:
 - Wireless Power
 - Power Supplies
- We offer the following Tailormade Solutions, moving data, insights, and market intelligence into action.
 - Research Data & Analysis
 - Intelligence Service The most comprehensive research solution on the respective technology markets
 - Strategic Consultancy & Bespoke Solutions
 - Thought Leadership Interactive Services Digital Events, Webinars, Whitepaper, Workshops
- Visit <u>www.wawt.tech</u> to know more about us and Follow (<u>WAWT</u>) our LinkedIn Page to get the latest news, insights, and updates on the technology sectors we cover.



WAWT's Wireless Power Intelligence Service

- Wireless Power Intelligence Service (WPIS) is the most comprehensive research on the wireless power technology market consisting of data, insights, and market intelligence. This annual subscription consists of:
 - Market Sizing Database files (Excel) One for every tracker report
 - Analysis & Insights Report (PDF) One for every tracker report
 - Direct Access with our SME throughout the year to discuss the market estimates, trends, insights, and strategic inputs.
- The intelligence service covers tracker reports published every 4 months, covering:
 - Critical market data, analyst insights, market intelligence, latest market trends, and strategic inputs
 - Key wireless power technology types; power classes; wide range of applications (30+)
 - Vital measures include TAM (total addressable market), wireless power adoption rates, unit shipments, BoM\$, revenues, share by technology/power class, Rx-Tx split...) and qualitative analysis refer following slides.
- Be free to request the sample output tables and sample report copy.



Wireless Power Market Research:

- Market segmentation and key measures

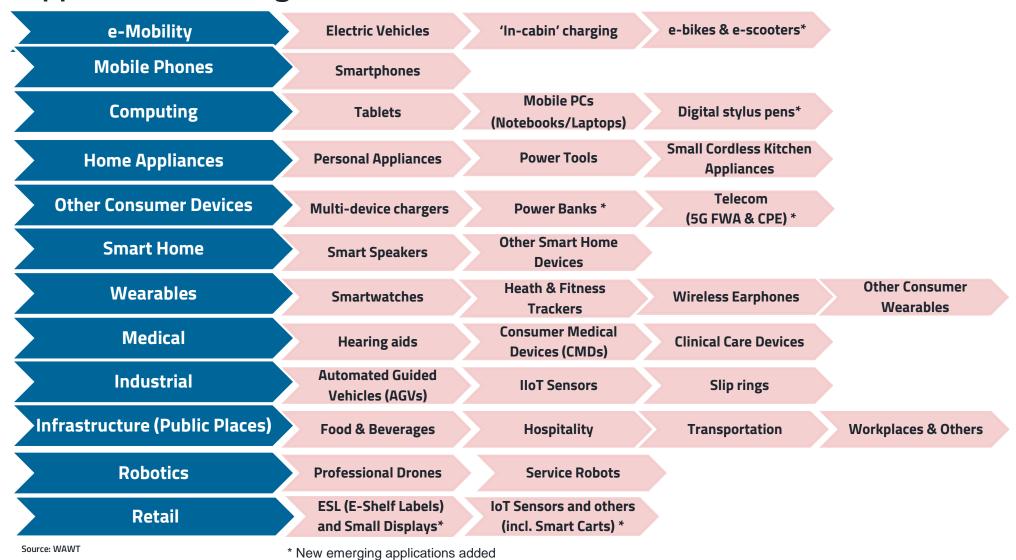
| Market Sizing (Estimate & Forecast)) | Historic: 2018-2020 | Base Year: 2021/2022 | 5 Year Outlook: 2024-2028 | 10 Year Outlook: 2021-2033 | |
|--------------------------------------|---|---------------------------------|----------------------------------|----------------------------------|---|
| Measures (Market Opportunity) | Total Addressable Market – TAM (Mn units) | Wireless Power Adoption (%) | Wireless Power Market (Mn units) | Wireless Power Market (Mn \$) | Average Selling Price – (ASP\$) – BoM\$ |
| Technology Types/Solutions | Low Frequency – Induction | Low Frequency – Resonance | High Frequency – Resonance | High Frequency – NFC Charging | Ultra-High Freq. 'Distance charging |
| Power Ratings/Classes | Very Low Power (<5W) | Low Power (5W-15W) | Medium Power (15W-200W) | High Power (200W-2200W) | Very High Power (3kW+) |
| Product Type | Receivers (Rx) | Transmitters (Tx) | Transceivers (TRx) | | |
| Solution Format | Integrated | After-Market (accessory) | | | |

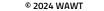
© 2024 WAWT



WAWT's Wireless Power Research:

- Application coverage (30+ devices)







Wireless power technology landscape

Wireless power technology continues to evolve rapidly as adoption expands across a wide range of applications, catering to specific needs (use cases) (Scenario: End 2018)

| Frequency class | Low frequency |
|----------------------------------|---------------------------|
| Technology type | Magnetic Induction |
| Coupling | "Tightly coupled" |
| Frequency band | 100 kHz-200 kHz (330 kHz) |
| Regulatory / Standard Body | WIRELESS POWER CONSORTIUM |
| Standard name/type | Qi + Other Proprietary |



Wireless power technology continues to evolve rapidly as adoption expands across a wide range of applications, catering to specific needs (use cases)

(Scenario: End 2018)

| Frequency class | Low freque | ency |
|----------------------------------|---------------------------|--------------------------------------|
| Technology type | Magnetic Induction | Magnetic Resonance |
| Coupling | "Tightly coupled" | 'Loosely coupled' |
| Frequency band | 100 kHz-200 kHz (330 kHz) | 79-90 kHz (85 kHz) (3 kHz-25 kHz) |
| Regulatory / Standard Body | WIRELESS POWER CONSORTIUM | ISO ENTERED INTERNATIONAL» |
| Standard name/type | Qi + Other Proprietary | SAE and other specification for EVs |



Wireless power technology continues to evolve rapidly as adoption expands across a wide range of applications, catering to specific needs (use cases)

(Scenario: End 2018)

| Frequency class | Low freque | ency | High frequency |
|----------------------------------|---------------------------|--------------------------------------|--|
| Technology type | Magnetic Induction | Magnetic Resonance | Magnetic Resonance |
| Coupling | "Tightly coupled" | 'Loosely coupled' | "Loosely coupled" |
| Frequency band | 100 kHz-200 kHz (330 kHz) | 79-90 kHz (85 kHz) (3 kHz-25 kHz) | 6.78 MHz |
| Regulatory / Standard Body | WIRELESS POWER CONSORTIUM | ISO ENTERED INTERNATIONAL. | AirFuel ®Alliance |
| Standard name/type | Qi + Other Proprietary | SAE and other specification for EVs | AirFuel Resonance (AFA) + Other Proprietary |



Wireless power technology continues to evolve rapidly as adoption expands across a wide range of applications, catering to specific needs (use cases)

(Scenario: End 2018)

| Frequency class | Low freque | ncy | High fred | quency | Ultra-High-Frequency | | | | |
|----------------------------------|---------------------------|--------------------------------------|--|--------|--|--|--|--|--|
| Technology type | Magnetic Induction | Magnetic Resonance | Magnetic Resonance | | 'Distance' Charging (RF, ultrasound, infrared, 5G, etc.) | | | | |
| Coupling | "Tightly coupled" | 'Loosely coupled' | "Loosely coupled" | | 'Uncoupled' No coupling needed | | | | |
| Frequency band | 100 kHz-200 kHz (330 kHz) | 79-90 kHz (85 kHz) (3 kHz-25 kHz) | 6.78 MHz | | • RF: 900 MHz, 2.4GHz-5.8GHz • US: 45 kHz-75 kHz/145-155 dB | | | | |
| Regulatory / Standard Body | WIRELESS POWER CONSORTIUM | INTERNATIONAL» (EXTRATE) | AirFuel Alliance | | AirFuel Alliance | | | | |
| Standard name/type | Qi + Other Proprietary | SAE and other specification for EVs | AirFuel Resonance (AFA) + Other Proprietary | | AirFuel RF + Other Proprietary | | | | |



Wireless power technology continues to evolve rapidly as adoption expands across a wide range of applications, catering to specific needs (use cases) (Scenario: End 2018)

| Frequency class | Low freque | ency | High fred | Ultra High-Frequency | | | | |
|---|--|--|--|----------------------|--|--|--|--|
| Technology type | Magnetic Induction | Magnetic Resonance | Magnetic Resonance | | 'Distance' Charging (RF, ultrasound, infrared, 5G, etc.) | | | |
| Coupling | "Tightly coupled" | 'Loosely coupled' | "Loosely coupled" | | 'Uncoupled' No coupling needed | | | |
| Frequency band | 100 kHz-200 kHz (330 kHz) | 79-90 kHz (85 kHz) (3 kHz-25 kHz) | 6.78 MHz | | • RF: 900 MHz, 2.4GHz-5.8GHz • US: 45 kHz-75 kHz/145-155 dB | | | |
| Regulatory / Standard Body | WIRELESS POWER CONSORTIUM | ISO ENTRE | AirFuel Alliance | | AirFuel Alliance | | | |
| Standard name/type | Qi + Other Proprietary | SAE and other specification for EVs | AirFuel Resonance (AFA) + Other Proprietary | | AirFuel RF + Other Proprietary | | | |
| Key Applications (examples) Emerging applications | Smartphones, smartwatches, wireless earphones, power tools, cordless kitchen appliances, 5G FWA/CPE, automotive 'in-cabin', AGVs/AMRs, electric toothbrushes, e-bikes/e- scooters, reverse charging | Light-duty Electric vehicles (EVs) And possibly other consumer applications | Public places, laptops, wearables, robots, drones, AGVs/AMRs, 5G FWA/CPE, e-bikes/e-scooters | | Infrastructure (public places), IIoT sensors, wearables, hearables, smart home and gaming devices, smart clothing, retail ESLs. other consumer, medical and industrial devices, Multimode systems. | | | |



Emergence of new NFC charging solution for small battery-powered devices.

(Scenario: Early 2019)

| Frequency class | Low freque | ncy | High fred | quency techno | Ultra High-Frequency |
|-----------------------------------|--|--|--|--|--|
| Technology type | Magnetic Induction | Magnetic Resonance | Magnetic Resonance | NFC Charging | 'Distance' Charging (RF, ultrasound, infrared, 5G, etc.) |
| Coupling | "Tightly coupled" | 'Loosely coupled' | "Loosely coupled" | "Loosely coupled" | 'Uncoupled' No coupling needed |
| Frequency band | 100 kHz-200 kHz (330 kHz) | 79-90 kHz (85 kHz) (3 kHz-25 kHz) | 6.78 MHz | 13.56 MHz | • RF: 900 MHz, 2.4GHz-5.8GHz • US: 45 kHz-75 kHz/145-155 dB |
| Regulatory / Standard Body | WIRELESS POWER CONSORTIUM | INTERNATIONAL DE CONTRE | AirFuel ®Alliance | NFC FORUM | AirFuel Alliance |
| Standard name/type | Qi + Other Proprietary | SAE and other specification for EVs | AirFuel Resonance (AFA) + Other Proprietary | NFC Charging | AirFuel RF + Other Proprietary |
| Key Applications (examples) | Smartphones, smartwatches, wireless earphones, power tools, cordless kitchen appliances, 5G FWA/CPE, automotive 'in-cabin', AGVs/AMRs, electric toothbrushes, e-bikes/e- scooters, reverse charging | Light-duty Electric vehicles (EVs) And possibly other consumer applications | Public places, laptops, wearables, robots, drones, AGVs/AMRs, 5G FWA/CPE, e-bikes/e-scooters | Small battery-powered devices. Smart glasses, fitness trackers, hearing aids, wireless earphones, wearables, digital stylus pens, key-fobs | Infrastructure (public places), IloT sensors, wearables, hearables, smart home and gaming devices, smart clothing, retail ESLs. other consumer, medical and industrial devices, Multimode systems. |





Emergence of new NFC charging solution for small battery-powered devices. And further segmentation of the market based on power classes and distance (Scenario: Early 2019)

| Frequency class | | | Low freque | ency | | | | High frequency | | | | | | | Ultra High-Frequency | | | |
|---|---|--|------------------------------|---|-------------------------------------|----------|--------|---|--------------------------|---|-------------------------|------------|-----------|--|---|---|-----------------------------|--|
| Technology type | Ma | gnetic Induc | ction | Ma | gnetic | Resona | ance | M | agnetic Res | sonance | | NFC Ch | arging | | 'Distance' Charging (RF, ultrasound, infrared, 5G, etc.) | | | |
| Coupling | "Т | ightly coupl | ed" | ʻL | oosely | couple | eď' | 11 | Loosely co | upled" | "L | oosely | coupled | l" | 'Uncoup | led' No coupl | ling needed | |
| Frequency band | 100 kH | z-200 kHz (| 330 kHz) | l . | -90 kH (3 kHz- | = | - | | 6.78 MI | Hz | | 13.56 | MHz | | | MHz, 2.4GHz (Hz-75 kHz/1 | | |
| Regulatory / Standard Body | - | LESS PC | | INTERNA | ITIONAL» | SO EC | NINRE | P | AirFuel® | Alliance | 7 | 1 | VF(| (<u>)</u> M | AirFuel Alliance | | | |
| Standard name/type | + 0 | Qi Other Proprie | etary | | SAE and other specification for EVs | | | | uel Resona Other Prop | | NF | C Ch | arg | ing | + | AirFuel RF Other Propri | | |
| Key Applications (examples) | earphon kitchen a automotiv electric t | hes, wireless s, cordless FWA/CPE, GVs/AMRs, e-bikes/e- narging | | ossibly o | Vs) | | robots | places, laptop s, drones, AG\ /CPE, e-bikes | | Smart g hearing earphor | lasses, fi aids, wir | ables, dig | ckers, | sensors, w home and clothing, re | ture (public plac vearables, heara gaming devices etail ESLs. other and industrial dev tems. | ables, smart s, smart r consumer, | | |
| Power Classes Evolving power classes | (Low-PC0) 5W-15W | (Med-PC1) 30W-200W | (High-PC2) 200W- 2200W | (WPT1) (WPT2) (WPT3) 22kW 3.7kW 7.7kW 11.1k (WPT5) W 60kW | | | | OW- 5OW (AFA) | 50W- 100W (AFA) | 100W-3000W (AFA Custom + Proprietary) | 250 mW | 500 mW | 750 mW | 1W- 2W | Near- Field (4 inches) | Medium- Field (4 feet) | Far- Field (4 meters) | |





New (Ki) standard launched by WPC for small cordless kitchen appliances.

(Scenario: End 2019)

| Frequency class | | | Low freque | ency | | | | High frequency | | | | | | | | Ultra High-Frequency | | | |
|-----------------------------------|--|---|--|--|----------|--|---------------------|--|---|-----------|-------------------------------|-------------------------|------------|------------------------------|--|---|---|--|--|
| Technology type | Ma | agnetic Indu | iction | Ma | gnetic | Resona | ance | Ma | agnetic Res | sonance | | NFC Ch | narging | | 'Distance' Charging (RF, ultrasound, infrared, 5G, etc. | | | | |
| Coupling | "7 | Γightly coup | led" | 'Լ | oosel | / couple | ed' | " | Loosely co | upled" | "l | oosely | coupled | d" | 'Uncoup | led' No coup | ling needed | | |
| Frequency band | 100 kH | lz-200 kHz | (330 kHz) | 1 | | lz (85 k -25 kHz | - | | 6.78 MI | Hz | | 13.56 | MHz | | | MHz, 2.4GHz Hz-75 kHz/14 | | | |
| Regulatory / Standard Body | | LESS P | | INTERNA | ATIONAL» | EC. | NINRE | 1 | AirFuel | Alliance | | | VF | C | AirFuel Alliance | | | | |
| Standard New standard | + (| Qi & Ki Other Propri | | SAE and other specification for EVs | | | | AirFuel Resonance (AFA) + Other Proprietary | | | NFC Charging | | | | + | AirFuel RF Other Propri | | | |
| Key Applications (examples) | earphor kitchen automoti electric | nes, smartwat nes, power too appliances, 50 ve 'in-cabin', toothbrushes, ters, reverse o | i FWA/CPE, AGVs/AMRs, e-bikes/e- | | (E | lectric ve EVs) other cor cations | | robots | places, laptop s, drones, AG\ ′CPE, e-bikes | • | Smart g hearing earphor | glasses, f aids, wii | rables, di | ickers, | sensors, w home and clothing, re | ture (public plac vearables, heara gaming devices etail ESLs. othe nd industrial dev cems. | ables, smart s, smart r consumer, | | |
| Power Classes | (Low-PC0) 5W-15W | (Med-PC1) 30W- 200W | (High-PC2) 200W- 2200W | (WPT1) (WPT2) (WPT3) 22kW 3.7kW 7.7kW 11.1kW (WPT5) 60kW | | | OW- 5OW (AFA) | 50W- 100W (AFA) | 100W- 3000W (AFA Custom + Proprietary) | 250 mW | 500 mW | 750 mW | 1W- 2W | Near- Field (4 inches) | Medium- Field (4 feet) | Far- Field (4 meters) | | | |



As power classes evolve, frequency bands expand, and proprietary solutions increase (MagSafe launched), there appears to be less/no interoperability across adjacent power classes, mainly within low-frequency-based inductive solutions (Scenario: 2020)

| Frequency class | | | Low freque | | High frequency | | | | | | | Ultra High-Frequency | | | | | | |
|-----------------------------------|---|---|---|---------|---|---|-------------------------|---|--|---|--|---|---|---------------------------------|---|---|---|--|
| Technology type | Mag | netic Indu | ction | Mag | gnetic R | Resona | nce | Ma | agnetic Res | onance | | NFC Ch | arging | S | 'Distance' Charging (RF, ultrasound, infrared, 5G, etc | | | |
| Coupling | "Tig | ghtly coup | led" | 'L | oosely | couple | d' | " | Loosely co | upled" | "L | oosely | couple | ed" | 'Uncoup | led' No coup | ling needed | |
| Frequency band | 100 kHz- | -200 kHz (| (330 kHz) | 1 | -90 kHz 3 kHz-2 | | | | 6.78 MI | łz | | 13.56 | MHz | | | MHz, 2.4GHz (Hz-75 kHz/1 | | |
| Regulatory / Standard Body | | LESS PONSORT | OWER I U M | INTERNA | TIONAL» | ® (5) (5) (6) (6) (6) (6) (6) (6) (6) (6) (6) (6 | JINRE) | 1 | AirFuel® | Alliance | | | VF | C | AirFuel ®Alliance | | | |
| Standard name/type | + MagSafe | Qi & Ki | | SAE and | | | AirF | uel Resona | nce (AFA) | NFC Charging | | | | | AirFuel RF | | | |
| | _ | Other P | roprietary | spe | cification | on for E | EVs | + | Other Prop | rietary | | ivi e en | ui gii ig | • | + (| Other Propri | etary | |
| Key Applications (examples) | earphones kitchen ap automotive electric too | | ches, wireless ls, cordless FWA/CPE, AGVs/AMRs, e-bikes/e- | Light. | -duty Ele (EV ossibly ot applica | ctric veh (s) :her cons | nicles | Public robots | other Propolaces, laptops, drones, AGV | s, wearables, s/AMRs, 5G | Smart g hearing earphor | attery-po ;lasses, fi aids, wir nes, wear ens, key- | wered of tness tr eless ables, d | devices. rackers, | Infrastruct sensors, w home and clothing, re | cure (public plac vearables, heard gaming devices etail ESLs. othe and industrial dev | res), lloT ables, smart s, smart r consumer, | |
| Applications | earphones kitchen ap automotive electric too scoote (Low-PC0) 5W-15W | s, smartwatos, power toolopliances, 5Gerin-cabin', Aothbrushes, | ches, wireless ls, cordless FWA/CPE, AGVs/AMRs, e-bikes/e- harging (High-PC2) 200W- 2200W | And po | -duty Ele (EV ossibly ot applica (WPT2) | ctric veh (s) ther cons ations (WPT3) 11.1kW | (WPT4) 22kW (WPT5) 60kW | Public robots FWA/ OW- 50W (AFA) | places, laptop s, drones, AGV | s, wearables, 's/AMRs, 5G 'e-scooters 100W- 3000W (AFA Custom + Proprietary) | Smart g hearing earphor stylus p 250 mW | attery-po ;lasses, fi aids, wir nes, wear | wered of tness treeless ables, of fobs | devices. rackers, ligital | Infrastruct sensors, w home and clothing, re medical ar | cure (public plac vearables, heard gaming devices etail ESLs. othe and industrial dev | res), lloT ables, smart s, smart r consumer, | |





While 'distance' wireless charging gained traction amongst existing players, with entry of few new players in 2021, other complimenting solutions like RFID, Energy Harvesting, and Hybrid (multi-freq.) solutions start to emerge.

(Scenario: 2021-2022)

| Frequency class | | | Low freq | uenc | У | | | | High frequency | | | | | | | Ultra High-Frequency | | | |
|-----------------------------------|---|--|--|------------|---|--------------------|--------|--------|----------------|---|---|---------------------------|------------|-----------|--|---|---|-----------------------------|--|
| Technology type | Ma | agnetic Indu | ıction | | Magr | Magnetic Resonance | | | | Magnetic Resonance | | | | narging | | 'Distance' Charging (RF, ultrasound, infrared, 5G, et | | | |
| Coupling | "1 | Γightly coup | oled" | Hybri | 'Lo | osely o | ouple | ď | " | Loosely co | upled" | " | Loosely | coupled | j " | 'Uncoup | led' No coup | ling needed | |
| Frequency band | 100 kH | lz-200 kHz | (330 kHz) | id 'multi | | 90 kHz kHz-2 | - | - | | 6.78 M | Hz | | 13.56 | 6 MHz | | | MHz, 2.4GHz (Hz-75 kHz/1 | | |
| Regulatory / Standard Body | | LESS P | Market Committee of the | -frequency | 54 ITERNATIO | IS DNAL» | © C | TRE | 1 | AirFuel | ™Alliance | | | VF | <u>3</u> () | AirFuel®Alliance | | | |
| Standard name/type | + MagSaf | Qi & Ki fe + Other F | | /' start t | SAE and other specification for EVs | | | | | uel Resona Other Prop | | | NFC Ch | narging | | + | AirFuel RF Other Propri | | |
| Key Applications (examples) | earphon kitchen automotiv electric | nes, smartwat nes, power too appliances, 50 ve 'in-cabin', toothbrushes ters, reverse o | FWA/CPE, AGVs/AMRs, , e-bikes/e- | o emerge | Light-duty Electric vehicles (EVs) nd possibly other consumer applications | | | robots | s, drones, AG | os, wearables, Vs/AMRs, 5G s/e-scooters | Smart g hearing earpho | glasses, f g aids, wir | rables, di | ckers, | sensors, w home and clothing, re | cure (public plac vearables, heara gaming devices etail ESLs. othe nd industrial dev cems. | ables, smart s, smart r consumer, | | |
| Power Classes | (Low-PC0) 5W-15W | (Med-PC1) 30W- 200W | (High-PC2) 200W- 2200W | | | | | | | 50W- 100W (AFA) | 100W- 3000W (AFA Custom + Proprietary) | 250 mW | 500 mW | 750 mW | 1W- 2W | Near- Field (4 inches) | Medium- Field (4 feet) | Far- Field (4 meters) | |



WPC announces development of advanced Qi2 standard based on Magnetic Power Profile (MPP = EPP + MagSafe compactible).

(Scenario: Year 2023, so far)

| Frequency class | | | Low freque | | High frequency | | | | | | | | Ultra High-Frequency | | | | |
|-----------------------------------|---|-----------------------------|--|--|---|--|-----------------------|---|--|--------------|-------------------------------|-------------------------|------------------------------|------------------------------|---|---|---|
| Technology type | Ma | ignetic Indu | ıction | Mag | netic R | Resona | nce | Ma | agnetic Res | sonance | | NFC Ch | arging | | 'Distance' Charging (RF, ultrasound, infrared, 5G, etc.) | | |
| Coupling | "Т | ightly coup | led" | 'Loosely coupled' | | | | " | Loosely co | upled" | " I | oosely | coupled | ! " | 'Uncoup | led' No coup | ling needed |
| Frequency band | 100 kH | z-200 kHz | (330 kHz) | | 90 kHz 3 kHz-2 | - | - | | 6.78 MI | Нz | | 13.56 | MHz | | | MHz, 2.4GHz Hz-75 kHz/1 | |
| Regulatory / Standard Body | The second second | LESS P | William Charles and Charles an | INTERNATI | ONAL» | ************************************** | TRRE | 1 | AirFuel | Alliance | | | VF | C | AirFuel ®Alliance | | |
| Standard New standard | | Qi & Ki + Qi e + Other r | | SAE and other specification for EVs | | | | | uel Resona Other Prop | NFC Charging | | | | + | AirFuel RF Other Propri | | |
| Key Applications (examples) | + MagSafe + Other Proprietary Smartphones, smartwatches, wireless earphones, power tools, cordless kitchen appliances, 5G FWA/CPE, automotive 'in-cabin', AGVs/AMRs, electric toothbrushes, e-bikes/e-scooters, reverse charging | | | J | duty Ele (EV ssibly ot applica | /s) :her cons | | robots | places, laptop s, drones, AGV CPE, e-bikes | | Smart g hearing earphoi | glasses, f aids, wir | ables, dig | ckers, | sensors, w home and clothing, re | cure (public plac vearables, heara gaming devices etail ESLs. othe ad industrial dev eems. | ables, smart s, smart r consumer, |
| Power Classes | (Low-PC0) 5W-15W | (Med-PC1) 30W- 200W | (High-PC2) 200W- 2200W | (WPT1) (WPT2) (WPT3) 22kW 3.7kW 7.7kW 11.1kW (WPT5) 60kW | | OW- 5OW (AFA) | 50W- 100W (AFA) | 100W- 3000W (AFA Custom + Proprietary) | 250 mW | 500 mW | 750 mW | 1W- 2W | Near- Field (4 inches) | Medium- Field (4 feet) | Far- Field (4 meters) | | |





To summarise, the wireless power technology market continues to evolve

- In the last few years, we witnessed advancement of existing technology, new standard, new wireless power technology, evolving power classes, hybrid (multi-freq.) solutions.

| Frequency class | Low frequency | | | | | High frequency | | | | | Emerg | Ultra High-Frequency | | | | | |
|---|--|-----------------------|------------------------------|-------------|---|------------------|----------------------------------|---|-----------------------|---|--|----------------------|--------------------------------|--|--|------------------------------|-----------------------------|
| Technology type | Ma | agnetic Indu | | | Magnetic Resonance 'Loosely coupled' | | Magnetic Resonance | | | NFC Charging | | | | 'Distance' Charging (RF, ultrasound, infrared, 5G, etc.) | | | |
| Coupling | "7 | Fightly coup | led" | Hybri | | | " | Loosely co | "Loosely coupled" | | | | 'Uncoupled' No coupling needed | | | | |
| Frequency band | 100 kH | lz-200 kHz (| 330 kHz) | d 'multi | 79-90 kHz (85 kHz) (3 kHz-25 kHz) | | | 6.78 MHz | | | 13.56 MHz | | | • RF: 900 MHz, 2.4GHz-5.8GHz • US: 45 kHz-75 kHz/145-155 dB | | | |
| Regulatory / Standard Body | - | LESS PO | | -frequency | TSO ENTRE | | | AirFuel®Alliance | | | NFC FORUM | | | AirFuel Alliance | | | |
| Standard New standards | Qi & Ki + Qi2 + MagSafe + Other Proprietary | | | ' start t | SAE and other specification for EVs | | | AirFuel Resonance (AFA) + Other Proprietary | | | NFC Charging | | | AirFuel RF + Other Proprietary | | | |
| Key Applications (examples) Emerging applications | Smartphones, smartwatches, wireless earphones, power tools, cordless kitchen appliances, 5G FWA/CPE, automotive 'in-cabin', AGVs/AMRs, electric toothbrushes, e-bikes/e- scooters, reverse charging | | | erge | Light-duty Electric vehicles (EVs) nd possibly other consumer applications | | | Public places, laptops, wearables, robots, drones, AGVs/AMRs, 5G FWA/CPE, e-bikes/e-scooters, | | | Small battery-powered devices. Smart glasses, fitness trackers, hearing aids, wireless earphones, wearables, digital stylus pens, key-fobs | | | | Infrastructure (public places), IIoT sensors, wearables, hearables, smart home and gaming devices, smart clothing, retail ESLs. other consumer, medical and industrial devices, Multimode systems. | | |
| Power Classes | (Low-PCO) 5W-15W | (Med-PC1) 30W-200W | (High-PC2) 200W- 2200W | (WP 3.7k | T1) (WPT2) | (WPT3) 11.1kW | (WPT4) 22kW (WPT5) 60kW | OW- 50W (AFA) | 50W- 100W (AFA) | 100W- 3000W (AFA Custom + Proprietary) | 250 mW | 500 mW | 750 mW | 1W- 2W | Near- Field (4 inches) | Medium- Field (4 feet) | Far- Field (4 meters) |



Low frequency inductive based solution holds the largest share of the wireless power technology market, with installed based on more than billion devices

- This technology segment continues to advance and grow
- This is where Wurth Electronics focuses on and excels, with its standard and custom-based solutions

| Frequency class | Low frequency | | | | | | | |
|--|--|--|--|--|--|--|--|--|
| Technology type | Magnetic Induction | | | | | | | |
| Coupling | "Tightly coupled" | | | | | | | |
| Frequency band | 100 kHz-200 kHz (330 kHz) | | | | | | | |
| Regulatory / Standard Body | WIRELESS POWER CONSORTIUM | | | | | | | |
| Standard name/type New standards | Qi & Ki + Qi2 (EPP + MPP) + Apple MagSafe + Other Proprietary | | | | | | | |
| Key Applications (examples) Emerging applications | Smartphones, smartwatches, wireless earphones, power tools, cordless kitchen appliances, 5G FWA/CPE, automotive 'in-cabin', AGVs/AMRs, electric toothbrushes, e-bikes/e-scooters, reverse charging | | | | | | | |
| Power Classes Evolving power classes | (Low-PC0) (Med-PC1) (High-PC2) 5W-15W 30W-200W 200W-2200W | | | | | | | |

Wireless power technology adoption expands beyond electric toothbrushes and smartphones

From electric toothbrushes and smartphones

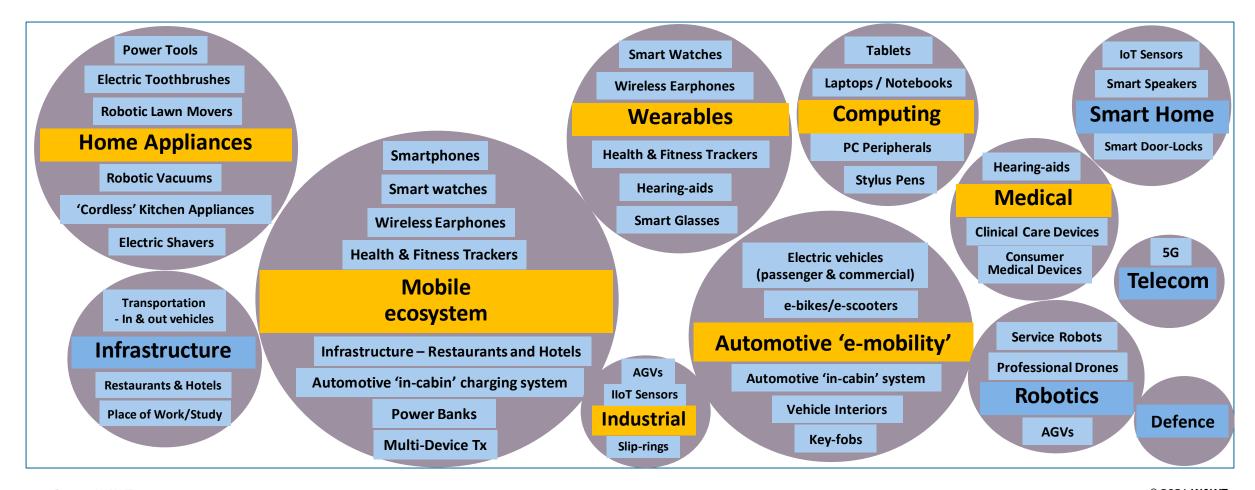
2016-2017 (Past scenario)

Electric Toothbrushes Smartphones Source: WAWT Source: WAWT's Wireless Power Intelligence Service © 2024 WAWT



... to wider application markets across sectors

2023-2024 (Current scenario)



Source: WAWT

Source: WAWT's Wireless Power Intelligence Service

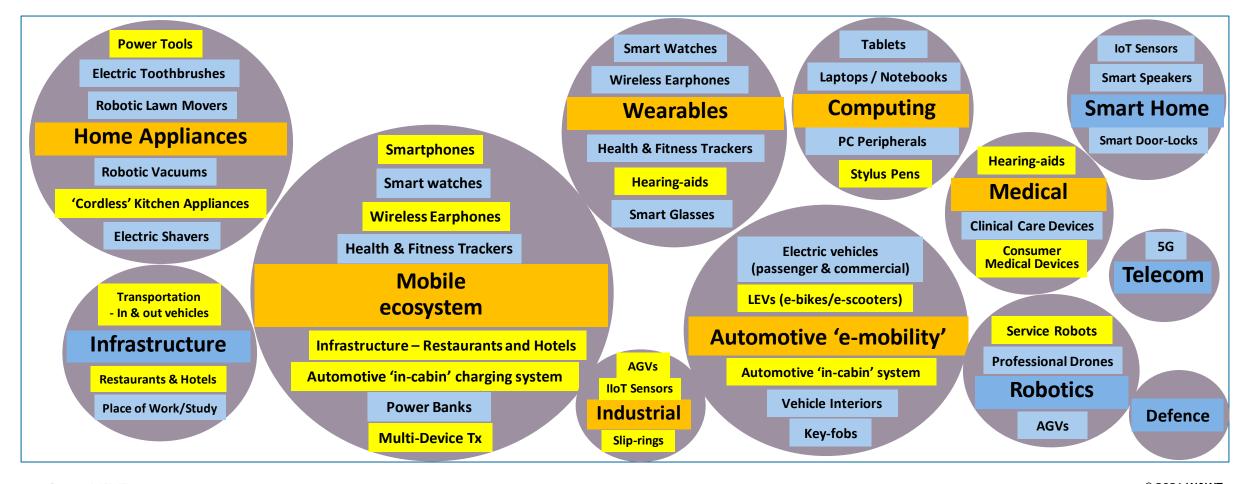
© 2024 WAWT

AGVs: Automated Guided Vehicles



... to wider application markets across sectors

2023-2024 (Current scenario)



Source: WAWT

Source: WAWT's Wireless Power Intelligence Service

© 2024 WAWT

AGVs: Automated Guided Vehicles



Wireless power market drivers and barriers

- An overall summary

Wireless power market drivers and barriers

- An overall summary

Market Driv

- Convenience
- Favourable customer demand (enhances user experience)
- Sealed device (facilitates enclosed design)
- Green benefits (use of no or less batteries).
- Safety benefits (Eliminates contacts with wired cables)
- More reliable (Few moving parts, less wear & tear, low down-time.
- Infrastructure and data capture (Integration with data/comm.)
- Market differentiation (Competitive advantage)
- Monetization (Increase revenues, footprints, business opportunities)

- Costs
- Health and safety concerns
- Design constraints and better performance
- Standards, certification, interoperability process
- High-capacity batteries being used (less need)
- High unrealistic expectations set
- Battery and heat management 'thermal' issues
- Low awareness and lack of understanding of the benefits
- Mind-set change (Complements, not competes with wired technology)
- Commoditization of market (Deteriorating/lower margins)
- Infrastructure challenges (costs/set-up/Tx deployment)
- Not enough or costly Tx
- Other competing technologies

Market **Barriers**

Source: WAWT

© 2024 WAW1





How BIG is the wireless power market opportunity?

- Market size estimation and forecast

How BIG is the WPT market opportunity?

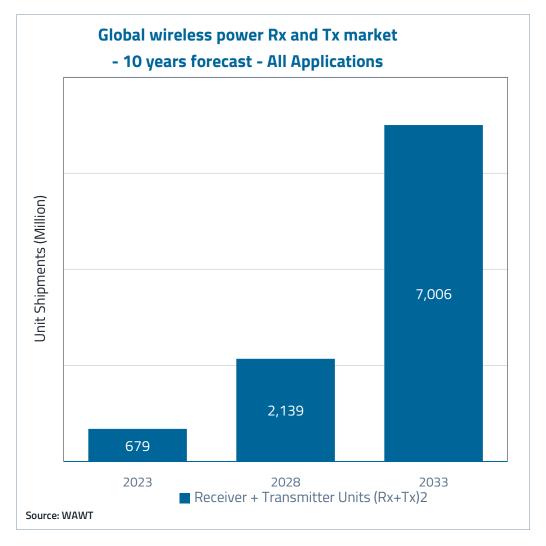
- The size of the wireless power market
- 1) What was the **size of wireless power market in 2023**, in terms of unit shipments, considering wireless power receivers and transmitters, all application markets and all WPT technology types?
- 2) Currently, which are the **top three application markets**, in terms of unit shipments?
- 3) How many wireless power receiver (Rx) and transmitter (Tx) units in total are expected to be **shipped in the next 5 years?**

Source: WAWT's Wireless Power Intelligence Service

With more than 1 billion installed base, the wireless power market opportunity is still <u>HUGH</u>

- The total wireless power receivers and transmitters
 (Rx+Tx) market is expected to grow from around 679
 million units in 2023 to 2.1 billion units in 2028, to 7.0
 billion units in 2033
- Smartphones, electric toothbrushes and smart watches are currently the top three application markets, in terms of unit shipments
- In total there we expect around 8.1 billion units of wireless power Rx+Tx units to be shipped in the next 5 years

Source: WAWT's Wireless Power Intelligence Service – 2023 Report Edition





THE OVERVIEW OF THE WIRELESS POWER TECHNOLOGY MARKET

- BY WAWT







We are here for you now!

Ask us directly via our chat or via e-mail

digital-we-days@we-online.com dinesh.kithany@wawt.tech

Dinesh Kithany
Founder and Chief Analyst, Wireless Power & Power Supplies
Wired & Wireless Technologies (WAWT)

<u>Dinesh.Kithany@wawt.tech</u>
UK Mobile: + 44 7935 855255



Website: www.wawt.tech

