Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Amendment of the Commission's Rules to Allow Next-Generation Wireless Charging Technology for Electric Vehicles Under Part 18	))))	RM-________

PETITION FOR RULEMAKING

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TABLE OF CONTENTS

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In the Matter of	)	
	)	
Amendment of the Commission's Rules to	)	RM-________
Allow Next-Generation Wireless Charging	)	
Technology for Electric Vehicles Under	)	
Part 18	)	

PETITION FOR RULEMAKING

Pursuant to Section 1.401 of the Commission's rules,[1] Toyota Motor North America, Inc. ("Toyota"), Ford Motor Company ("Ford"), BMW of North America, LLC ("BMW") and Nissan North America, Inc. ("Nissan," together with Toyota, Ford and BMW, the "Petitioners"), respectfully request that the Commission commence a rulemaking proceeding to amend the Part 18 rules to enable the deployment of next-generation wireless charging technologies for light-duty electric vehicles.

I. SUMMARY

Electric vehicle ("EV") adoption has proliferated in recent years, driven by consumer demand and advancements in automotive technology. EVs are emerging as a significant segment of the automotive sector, and EV-related infrastructure and technology development are poised to have a sizable impact on U.S. economic growth. Electric vehicle sales are expected to grow to 55 percent of all new sales by 2040.[2] Thus, to ease the transition into the EV economy, major automakers, including the Petitioners, are implementing plans to commercialize new

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[1] 47 C.F.R. § 1.401.

[2] Bloomberg New Energy Finance, "Electric Vehicle Outlook 2018," https://about.bnef.com/electric-vehicle-outlook/.

wireless power transfer ("WPT") technologies to enable wireless charging of EV batteries. WPT technologies promise to have a considerable impact on consumer adoption of EVs and will spark further technology development for handicapped customers, shared mobility and autonomous vehicles. As a critical step in these efforts, the Petitioners respectfully request that the Commission commence a rulemaking proceeding to adopt field strength limits in Section 18.305 that will allow higher power wireless charging technologies operating in the 79-90 kHz frequency range, which will enable faster, higher power wireless charging capabilities for light-duty EVs that are equivalent to wired alternating current technologies that consumers are accustomed to using today. Specifically, the Petitioners propose a field strength limit for light-duty EV wireless charging systems of 74.4 dBuA/m measured at 10 meters.

The proposed limits are consistent with the recommendations of the Society of Automotive Engineers International ("SAE"), an automotive industry standard-setting body, and are the result of extensive study and testing of WPT systems. That standard-setting process is now complete, and testing methodologies and design recommendations are in the final stages of preparation for publication in the form of a recommended practice. The American National Standards Institute ("ANSI") is establishing industry measurement guidelines for electric vehicle WPT system equipment based on the SAE recommendations, and ANSI's guidance is expected to be published later this year. Thus, the time is ripe for consideration of higher limits that will enable the broader commercial deployment of WPT technology. Testing and evaluation of WPT systems by the SAE in the standard-setting process confirm that the proposed limits would be compatible with other radio services and would comply with industry standards for human exposure and safety. The Petitioners therefore respectfully request that the Commission promptly commence a rulemaking proceeding to consider this proposal.

II. ADVANCING EV TECHNOLOGIES IS IN THE PUBLIC INTEREST

Vehicle electrification has become a critical component of the Petitioners' respective business strategies. Each of the Petitioners has made and/or announced significant investments in vehicle electrification technology and launched initiatives to advance EV deployment:

- Ford has announced an $11 billion investment in electrified vehicle solutions by 2022, resulting in a lineup of 40 hybrid and fully electric vehicles.[3] The extended electric vehicle strategy aligns with increasing calls for cleaner, more efficient vehicles, and Ford remains focused on delivering affordable electric vehicles at scale.

- By around 2030, Toyota aims to have sales of more than 5.5 million electrified vehicles. Toyota's electrification initiative also includes plans to offer electrified models of every Toyota and Lexus model by around 2025.[4]

- Nissan has announced plans to develop eight new pure electric vehicles and to sell 1 million electrified vehicles—either pure electric models or those with e-POWER powertrains—annually by 2022 under its global M.O.V.E to 2022 midterm plan. Nissan expects that electrified vehicles will make up about 20-30% of company sales in the U.S. by 2025.[5]

- BMW plans to offer 25 electrified vehicle models by 2025, twelve of which will be fully electric.[6] BMW has joined other carmakers to promote the deployment of high-performing fast-charge networks globally,[7] and has worked with an energy utility in

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[3] Nick Carey & Joseph White, "Ford plans $11 billion investment, 40 electrified vehicles by 2022" (Jan. 14, 2018), *available at* https://www.reuters.com/article/us-autoshow-detroit-ford-motor/ford-plans-11-billion-investment-40-electrified-vehicles-by-2022-idUSKBN1F30YZ.

[4] Press Release, "Toyota Aims for Sales of More than 5.5 Million Electrified Vehicles including 1 Million Zero-Emission Vehicles per Year by 2030" (Dec. 18, 2017), *available at* https://newsroom.toyota.co.jp/en/corporate/20353243.html.

[5] Press Release, "Nissan aims to sell 1 million electrified vehicles a year by FY2022," Nissan Sustainability Report 2017 at 26, *available at* https://newsroom.nissan-global.com/releases/release-487297034c80023008bd9722aa05f858-180323-01-e.

[6] BMW Sustainable Value Report (2017) at 46, *available at* https://www.bmwgroup.com/content/dam/bmw-group-websites/bmwgroup_com/ir/downloads/en/2017/BMW-Group-SustainableValueReport-2017--EN.pdf.

[7] *Id*. at 60.

> the U.S. to develop EV charging systems that can optimize efficiency in electricity use and electricity grid management.[8]

As reflected in the releases cited above, EVs are viewed by the auto industry and others as an increasingly important automotive technology for the future. Increased EV adoption can help the nation accomplish its energy and environmental goals, as noted by the U.S. Department of Energy ("U.S. DOE"):

> … EVs can help the United States have a greater diversity of fuel choices available for transportation. The U.S. used nearly nine billion barrels of petroleum last year, two-thirds of which went towards transportation. Our reliance on petroleum makes us vulnerable to price spikes and supply disruptions. EVs help reduce this threat because almost all U.S. electricity is produced from domestic sources, including coal, nuclear, natural gas, and renewable sources.
>
> EVs can also reduce the emissions that contribute to climate change and smog, improving public health and reducing ecological damage. Charging your EV on renewable energy such as solar or wind minimizes these emissions even more.[9]

Although U.S. production of oil is increasing, the U.S. still relies on imported oil. Net imports were equivalent to roughly 25 percent of U.S. petroleum consumption in 2016, with over a third of U.S. imports coming from OPEC countries.[10] And since electricity production in the U.S. relies on a diverse range of fuels, this diversity of fuel sources for EVs can provide consumers with enhanced protection from price fluctuations that are often experienced with gasoline. In general, electricity prices tend to be lower than gasoline prices, and thus EVs have

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[8] *Id.* at 62.

[9] "Electric Vehicle Benefits," Office of Energy Efficiency & Renewable Energy, U.S. DOE, *available at* https://www.energy.gov/eere/electricvehicles/electric-vehicle-benefits.

[10] U.S. Energy Information Administration ("EIA"), "Oil Imports and Exports" (last updated May 1, 2018), *available at* https://www.eia.gov/energyexplained/index.cfm?page=oil_imports.

lower fuel costs on average than conventional gasoline vehicles, resulting in savings and benefits to consumers.[11]

In addition to the societal benefits noted above, EVs can offer consumers an improved driving experience, including quieter and smoother vehicle operation and improved acceleration, relative to conventional automotive technologies. EVs may also require less maintenance than conventional vehicles,[12] and they can even offer performance benefits as well.[13] Thus, EVs offer the potential for increased consumer driving enjoyment and satisfaction, an important public interest objective in its own right.

While EVs have made some inroads into the U.S. market, their market share has remained small. In 2015, for example, EVs accounted for only approximately 0.41% of light-duty vehicle sales.[14] Efforts to increase EV market share face a number of obstacles, most notably the difficulty in convincing consumers to depart from the convenience and familiarity of gasoline-powered vehicles to try out an unfamiliar technology that relies on an entirely different infrastructure.

One of the key issues in this regard has been a relative lack of EV charging infrastructure. But that deficiency is gradually being addressed through various ongoing initiatives. Automakers, utilities and governmental entities are investing in and providing funding for EV

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[11] U.S. DOE NREL, "At A Glance: Electric-Drive Vehicles" at 2; U.S. DOE NREL, "Hybrid and Plug-in Electric Vehicles" (2014) at 2, *available at* https://www.afdc.energy.gov/uploads/publication/hybrid_plugin_ev.pdf.

[12] U.S. DOE, Office of Energy Efficiency & Renewable Energy, "All-Electric Vehicles," www.fueleconomy.gov, *available at* https://www.fueleconomy.gov/feg/evtech.shtml (last visited June 6, 2018).

[13] David Tracy, Jalopnik, "Here Are Five Major Performance Benefits of An Electric Car" (Oct. 11, 2017), *available at* https://jalopnik.com/five-major-performance-benefits-of-an-electric-car-over-1819376881.

[14] WardsAuto Fuel Economy Index 2015 State of the Industry.

and other alternative fueling infrastructure to make charging/refueling more convenient for consumers.[15] In particular, electric utilities across the U.S. have already invested tens of millions of dollars in EV charging infrastructure programs.[16] Based on data from the U.S. DOE Alternative Fuels Data Center, there were approximately 13,400 EV charging outlets in 2012, whereas there are more than 56,000 EV charging outlets today located at over 20,000 different stations across the U.S.[17]

In addition to the question of "Where can I charge my electric vehicle?," another key barrier to EV adoption is the issue of battery charging time. Consumers driving gasoline-powered vehicles have become used to gas station stops in which they can refuel in five to ten minutes and be on their way. EV charging times can take considerably longer, potentially hampering consumers' ability to use their EVs when they want. As some observers have noted, charging time is becoming the primary concern of many EV users:

> An oft-cited reason people don't buy electric cars is "range anxiety"—if batteries struggle to take you as far as gas and charging stations are limited in number, the thinking goes, who would want one?

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[15] Adam Cooper & Kellen Schefter, Edison Electric Institute and the Institute for Electric Innovation, "Plug-in Electric Vehicle Sales Forecast Through 2025 and the Charging Infrastructure Required" (June 2017) at 13 (Table A-1), *available at* http://www.edisonfoundation.net/iei/publications/Documents/IEI_EEI%20PEV%20Sales%20and%20Infrastructure%20thru%202025_FINAL%20(2).pdf.

[16] *See* M.J. Bradley & Associates, LLC, "Accelerating the Electric Vehicle Market Potential Roles of Electric Utilities in the Northeast and Mid-Atlantic States" (Mar. 2017), at Appendix A, *available at* http://www.mjbradley.com/sites/default/files/MJBA_Accelerating_the_Electric_Vehicle_Market_FINAL.pdf.

[17] U.S. DOE Alternative Fuel Data Center, "Alternative Fueling Station Counts by States," https://www.afdc.energy.gov/fuels/stations_counts.html (last updated May 15, 2018); U.S. DOE Alternative Fuel Data Center, "U.S. Alternative Fueling Stations by Fuel Type," https://www.afdc.energy.gov/data/10332 (last visited May 15, 2018). These totals includes both public and private charging locations, but not residential electric charging infrastructure.

> But there is another obstacle: charging time trauma. Compared with a five-minute pit stop at your local gas station, charging an electric vehicle is a glacially slow experience. Modern electric cars still often need an entire night to recharge at home, and even at a commercial fast charging station, a fill-up can take an hour or more.[18]

This petition seeks rule changes that will facilitate the emergence of new, high-speed wireless charging technology for EVs. The development and proliferation of this technology will help to overcome one of the key remaining obstacles to the more widespread adoption of EVs.

III. HIGHER POWER WIRELESS CHARGING WILL HELP REDUCE BARRIERS TO CONSUMER ACCEPTANCE OF ELECTRIC VEHICLES

Wireless charging of EVs will promote greater adoption and deployment of EVs and will speed the advancement of mobility and autonomous vehicles and other automotive technologies, thereby reducing the barriers to EV deployment highlighted above.

Today, in the United States, consumers typically charge EVs through a plug-in connection. EV charging technologies using electrical cords that currently are available for consumers at varying levels of charging. Level 1 charging typically is a 1.3 kW to 1.9 kW system that uses a conventional 120-Volt alternating current ("AC") plug and charges an EV battery at a rate of two to five miles of range per hour of charging, or about 20 hours total for a 90-mile range battery.[19] Level 2 AC charging typically is a 7.2 kW system that requires the installation of additional charging equipment that uses a 240-Volt plug, and charges an EV battery at a rate of 10 to 20 miles of range per hour of charging, or in the range of five to ten

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[18] Eric A. Taub, New York Times, "For Electric Car Owners, 'Range Anxiety' Gives Way to 'Charging Time Trauma'" (Oct. 5, 2017), *available at* https://www.nytimes.com/2017/10/05/automobiles/wheels/electric-cars-charging.html.

[19] U.S. DOE, Office of Energy Efficiency & Renewable Energy, "Electric-Drive Vehicles" (Sept. 2017), at 2-3, *available at* https://www.afdc.energy.gov/uploads/publication/electric_vehicles.pdf.

hours for a 90-mile range battery.[20] Faster, Level 2 AC charging is also available at 11.5 kW, but such systems require a higher amount of available power. These higher power Level 2 AC systems can provide charging at a rate of 25 to 45 miles of range per hour of charging, or between 2 to 4 hours for a 90-mile range battery. An alternative to these three levels of AC charging, is by means of a DC-Fast-Charger, which requires additional charging hardware and a compatible vehicle coupling port. A DC fast charge requires as little as 35 to 40 minutes to fully-charge a 90-mile range EV battery.[21]

The Petitioners and others in the industry are developing wireless charging technologies for light-duty EVs that would allow consumers to charge the batteries in a parked vehicle without a plug or a cord. Wireless charging systems use resonant magnetic fields to transfer electricity from the electric supply to an EV battery. Magnetic resonance utilizes current circulating between ground pad inductors and capacitors to generate a localized high intensity magnetic "near" field from which a secondary coil installed on the bottom of a vehicle can extract power. Charging is initiated when the vehicle is parked over the ground assembly, and appropriate communication between the ground assembly and the vehicle are activated.

Similar to conductive wired charging, power levels for wireless power transfer ("WPT") can vary. WPT power levels are defined in the SAE J2954 standard.[22] The power level for WPT 1 is specified at 3.7 kW, which is between a typical Level 1 and Level 2 AC conductive charge. WPT 1 charges at a rate of approximately 5 to 10 miles of range per hour. For a

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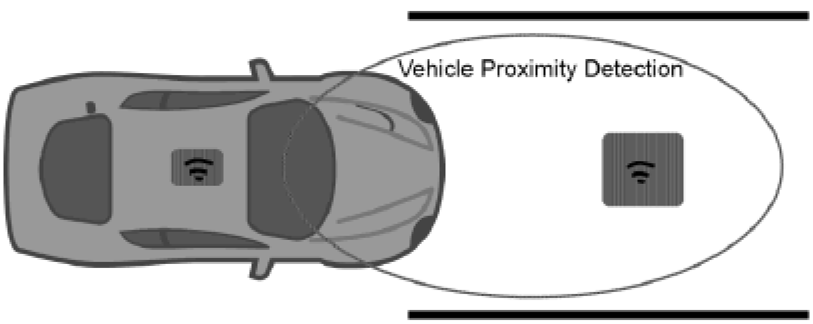
[20] *Id.*

[21] *Id.*

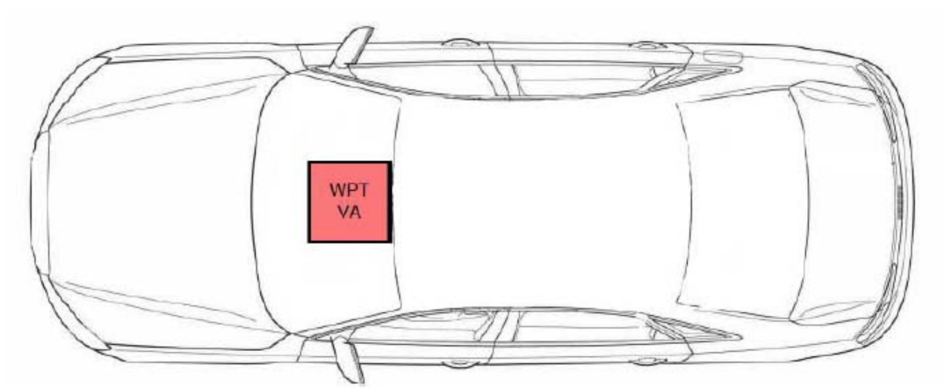
[22] SAE International, "J2954 Wireless Power Transfer for Light-Duty Plug-in/Electric Vehicles and Alignment Methodology" (Nov. 27, 2017), *available for download at* https://www.sae.org/standards/content/j2954_201711/ ("SAE Recommended Practice J2954").

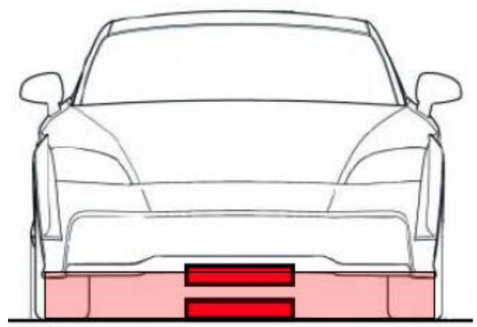
charging level similar to a typical Level 2 AC charger, the power level for WPT 2 is approximately 7.7 kW. Finally, WPT 3 requires power levels at 11.1 kW to enable charging speeds similar to the higher power Level 2 AC charging that requires higher power levels at homes and businesses.

The figure below depicts a vehicle approaching a wireless charging pad. Vehicles with WPT charging capabilities typically will have separate on-board vehicle proximity detection systems that will guide the driver to maneuver the vehicle to the right position over the charging pad.



The following figures illustrate a typical installation of a WPT unit located underneath the vehicle, as well as the coupling of the WPT unit with the charging pad on the ground.





From a Commission perspective, WPT 1 wireless charging capabilities are feasible today under the existing Part 18 limits, which as discussed in more detail in Section IV below, is equivalent to a magnetic field measurement of 60.6 dBuA/m for the frequency band at issue. WPT 2 wireless charging, which is in the late stages of development, would exceed the current Part 18 limit. Deployment of WPT 2 wireless charging systems to date has occurred predominantly outside of the U.S., particularly in Japan, where regulations have been relaxed to allow the higher power levels needed to accommodate WPT 2 wireless charging. Japan Ministry of Internal Affairs and Communications ("Japan Ministry") has established a limit of 68.4 dBuA/m to accommodate WPT 2 wireless charging. However, WPT 3 charging at 11.1 kW will offer even higher power, faster charging capabilities that may be necessary for mobility services and autonomous vehicles. WPT 3 capabilities would require a limit of 74.4 dBuA/m. Many manufacturers are planning for WPT 2 system technologies in the near term and are developing plans for future deployment of WPT 3 technologies, and thus, consideration of limits to accommodate this charging level is warranted.

In general, wireless charging has not been widely deployed and has not been launched commercially for consumer applications because the automotive industry had been awaiting the finalization of WPT system standards necessary to facilitate interoperability among manufacturers. As discussed below, the Petitioners and others in the industry have worked through the SAE, an automotive industry standard-setting body, to develop standards for EV wireless charging up to WPT 3. That process is now complete, and ANSI is drafting the measurement procedures for WPT systems based on the SAE recommendations. The ANSI standards are expected to be published later this year. Thus, the time is ripe for consideration of higher limits consistent with those standards in order to enable the broader commercial deployment of advanced WPT technologies.

Making higher speed wireless charging available to consumers will further accelerate the benefits of EV deployment and adoption. As mentioned, charging burdens are a major barrier to widespread consumer adoption of EVs that wireless charging can help to eliminate. One charging technology manufacturer reports that nearly 70 percent of plug-in hybrid buyers simply "never bother" to actually plug in their cars.[23] In another survey conducted in the United Kingdom, the majority of private EV users responded that the most important factor to them for adopting wireless technology was "improved practicality/simplicity of charging."[24]

Wireless charging obviates the need to plug in a charger manually, eliminating the need for drivers to remember to plug in their vehicles and alleviating "range anxiety" reported by potential buyers who may fear the prospect of being "stranded" after one night of forgetting to charge.[25] Automating the charging process improves convenience and increases simplicity and

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[23] Philip E. Ross, "Mystery Brand EV Will Offer WiTricity's Wireless Charging This Year," IEEE Spectrum (Apr. 19, 2018, 13:00 GMT), *available at* https://spectrum.ieee.org/cars-that-think/transportation/infrastructure/mystery-brand-ev-will-offer-witricitys-wireless-charging-this-year.

[24] Unplugged EU, Final Report 57 (2015), *available at* http://unplugged-project.eu/ (follow "Public Deliverables" hyperlink; then download "Summary Report of the Project").

[25] *See* Hiawatha Bray, "WiTricity Teams with GM on Wireless Car Chargers," Boston Globe (Dec. 21, 2016), *available at* https://www.bostonglobe.com/business/2016/12/20/witricity-teams-with-wireless-car-chargers/Bytynu7vyu8iINkjos6YQO/story.html; *see also* David Howell *et al.*,

ease of use for consumers, thereby making EVs more accessible.[26] Promoting broader consumer adoption of EVs will also result in improved affordability of the vehicles themselves and also will spur greater investment in and availability of charging infrastructure, furthering the cycle of EV demand and amplifying the public interest benefits of EVs.

The Petitioners' proposal, detailed below, seeks an increased field strength limit for EV wireless charging equipment to accommodate WPT 3 charging. Just as with a higher power wired connection, higher power wireless charging reduces the time necessary to charge. Although WPT 3 wireless charging technology is still in development, planning for this higher level is critical to meet future consumer and industry demands for larger EV batteries that are capable of longer trips without needing to recharge. WPT 3 charging also stands as a critical input for next-generation automotive technologies, most notably mobility services and autonomous vehicles. These technologies promise to radically change the business case and the timeline for profitability of EVs.[27] Significantly, wireless charging will facilitate the automation of battery charging, and thus broader deployment of WPT charging and consumer acceptance is a key component of an autonomous vehicle ecosystem.[28]

U.S. DOE, "Enabling Fast Charging: A Technology Gap Assessment" at 4 (Oct. 2017) (noting "range anxiety" as a commonly named reason consumers choose not to buy EVs).

[26] *See* Bray, "WiTricity Teams with GM on Wireless Car Chargers," Boston Globe.

[27] A. Narayanan, Investor's Business Daily, "Can Electric Cars Make It To Profits?," A1, at A10 (May 21, 2018).

[28] *See, e.g.,* Oak Ridge Nat'l Lab., "ORNL Surges Forward with 20-kilowatt Wireless Charging for Vehicles" (Mar. 31, 2016), *available at* https://www.ornl.gov/news/ornl-surges-forward-20-kilowatt-wireless-charging-vehicles.

IV. INCREASED PART 18 FIELD STRENGTH LIMITS ARE NECESSARY TO ACCOMMODATE HIGHER LEVEL EV BATTERY CHARGING

Given the benefits of faster EV wireless charging, the Petitioners urge the Commission to adopt higher Part 18 power limits to accommodate WPT systems. Establishing higher power limits in the United States will drive commercial development of wireless charging technology for EVs and will position the United States as a leader in promoting WPT technology development. It has long been the Commission's policy to foster innovation by enabling novel uses of technology, and the Commission has stated its commitment to advancing these goals through improved processes for enabling the introduction of new technologies and services to the public.[29] Commencing the proposed proceeding would provide an opportunity for the Commission, and thus the U.S., to be on the forefront of standardizing higher-order wireless charging, and to provide the certainty that automakers and technology developers need to commercialize the technology both in the U.S. and globally.

A. Proposed Rule

To support commercialization of wireless charging at WPT 2 and 3, Petitioners respectfully request that the Commission commence a rulemaking proceeding to adopt a Part 18 field strength limit for light-duty EV wireless charging systems of 74.4 dBuA/m at 10 meters for frequencies in the 79-90 kHz range, as measured in accordance with the specifications of ANSI C63.30. Specifically, the Petitioners propose that a new subsection be added to Section 18.305 of the Commission's rules, which addresses field strength limits for industrial, scientific and medical ("ISM") equipment:

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[29] *See* 47 U.S.C. § 157 (directing the Commission to complete its review of petitions or applications for new services within one year); *see also Encouraging the Provision of New Technologies and Services to the Public*, GN Docket No. 18-22, Notice of Proposed Rulemaking, FCC 18-18 ¶ 1 (rel. Feb. 23, 2018).

> *18.305(d) The magnetic field strength for light-duty electric vehicle battery wireless charging systems operating in the 79-90 kHz frequencies shall be limited to 74.4 dBuA/m measured at a distance of 10 meters on an open area test site or equivalent (e.g., an absorber-lined shielded enclosure utilizing a metallic ground plane).*

This proposed rule is based on the standards that have been developed through a working group of automotive industry stakeholders as part of a standard-setting process by the SAE. The SAE's Vehicle Wireless Power and Alignment Task Force has developed standards for vehicle WPT systems to promote interoperability among equipment manufacturers and a uniform testing methodology for validating performance and confirming compliance with safety standards. SAE recently published the SAE J2954 Recommended Practice memorializing these standards.[30]

The J2954 recommended practices establish the industry-wide specification guideline developed to help define acceptable criteria for RF emissions for wireless charging of light duty electric and plug-in electric vehicles. The J2954 standard serves as the basis for the ANSI C63.30 testing methodology for EV wireless charging equipment that currently is being drafted and will incorporate the measurement and testing procedures developed through the SAE process.

Identification of a common operating frequency is critical to interoperability. The SAE process identified fundamental frequencies in the 79-90 kHz range for wireless power transfer systems because other radio frequency devices and services using this band are unlikely to operate in the vicinity of WPT system operations. A standard frequency range for WPT systems will enable systems to be designed in a manner that allows consumers to use the same charging infrastructure regardless of the make and model of the vehicle. As the Commission has recognized, device interoperability is essential for ensuring the robust development of a device

[30] *See* SAE Recommended Practice J2954.

ecosystem in order to promote competition among suppliers, thereby expanding consumer choice.[31] In the Part 18 context, the Commission has acknowledged that "[h]armonizing rules with international standards will allow manufacturers to produce products for distribution in several markets without any modification, thus reducing costs."[32] A uniform standard operating frequency will facilitate broader and widespread implementation of EV WPT technology, because common charging infrastructure among manufacturers, both in the U.S. and globally, will ensure the efficient use of resources and reduce the cost of deployment.

Moreover, the proposed increase in the field strength limit to 74.4 dBuA/m to accommodate up to WPT 3 wireless charging would "future-proof" the rules to reflect the ongoing development and plans for WPT 3 wireless charging systems. The current field strength limits in Section 18.305(b) of the Commission's rules for industrial, scientific and medical ("ISM") devices for the 79-90 kHz frequency range is 15 uV/m measured at a distance of 300 meters.[33] Converting this current limit to a magnetic field measurement at a 10-meter distance yields a value of 60.6 dBuA/m, which is sufficient to support WPT 1 wireless charging systems. WPT 2 wireless charging systems would require a field strength limit of 68.4 dBuA/m, which is the limit that has been adopted in Japan specifically to support WPT 2 wireless charging.[34]

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[31] *See, e.g., Promoting Interoperability in the 700 MHz Commercial Spectrum*, Report and Order and Order of Proposed Modification, 28 FCC Rcd 15122 ¶¶ 1-2 (2013).

[32] *See 1998 Biennial Regulatory Review—Conducted Emissions Limits Below 30 MHz for Equipment Regulated under Parts 15 and 18 of the Commission's Rules*, Report and Order, 17 FCC Rcd 10806 ¶ 9 (2002).

[33] 47 C.F.R. § 18.305(a).

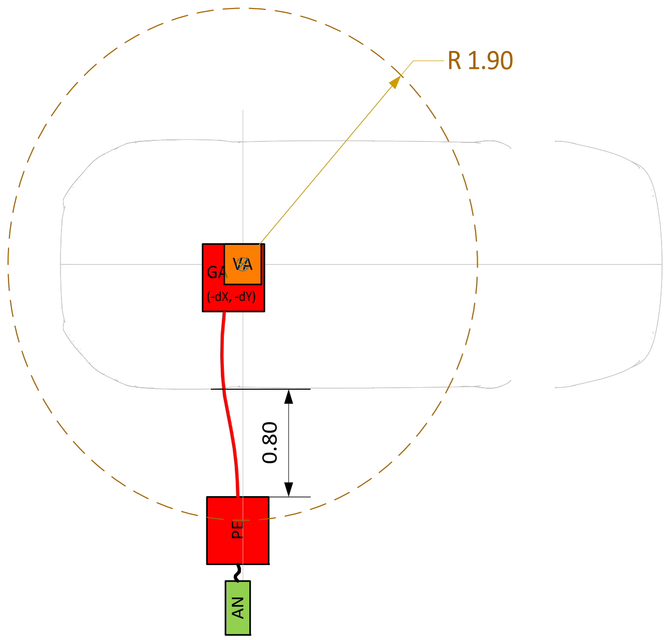
[34] As an alternative to a single limit of 74.4 dBuA/m proposed here, industry objectives could also be met through a power scaling approach that would limit Level 2 (6.7 kW) WPT system emissions to 68.4 dBuA/m (consistent with Japan Ministry regulations) and Level 3 (11 kW) emissions to 74.4 dBuA/m.

Although the current field strength limit is expressed as an electrical signal (in volts per meter), the Petitioners propose a limit that reflects a magnetic field (in amps per meter). Expressing the limit as a magnetic field strength would be consistent with the actual near-field signal characteristics from WPT system operations, as well as with the units in which the signals are measured in actual testing.

B. Proposed Measurement Methodology

The Petitioners urge the Commission to consider a measurement distance for the proposed limit that reflects realistic testing conditions. The proposed limit is based on a distance of 10 meters, as measured pursuant to the ANSI C63.30 guidelines, which reflect the SAE recommendations. Under that guidance, measurements would need to be made at a distance of 10 meters from the edge of a fixed radius around the equipment under test ("EUT"). The radius recommended is 1.9 meters centered on the power coupling assembly of the WPT system. Establishing an EUT ring for measurement ensures uniformity and repeatability of device testing, regardless of the system type or vehicle design.

The diagram below depicts an exemplary EUT ring and the recommended WPT system set-up for testing.



The Petitioners respectfully suggest that a 10 meter measurement distance from the EUT ring as currently defined by ANSI 63.30 would better reflect actual testing conditions. As a practical matter, most facilities where compliance testing occurs cannot accommodate measurements at 300 meters, which is the basis for many of the current Part 18 field strength limits. Demonstrating compliance with the 300-meter distance in the current rules thus requires measurements to be made at multiple shorter distances and linearly extrapolated by fitting on a log-log scale (or with a specified but overly conservative constant decay rate). However, physics dictates that the actual decay rate has dependencies on frequency, distance, and site parameters, which cannot be adequately captured in the empirical extrapolation process. By contrast, a 10-meter measurement distance would result in a more accurate and reproducible signal measurement, as there would be no need to factor in an assumption regarding the dissipation of signals out to 300 meters.

In sum, adopting Part 18 rules for wireless EV battery charging that reflect the industry-wide standards established in the SAE process and the measurement methodology established by ANSI will promote broader adoption of WPT technology in the U.S. and globally, resulting in increased competition and lower prices for consumers.

V. THE PROPOSED POWER LEVEL INCREASE WOULD NOT CAUSE HARMFUL INTERFERENCE OR RF EXPOSURE SAFETY RISKS

A. The Proposed Power Level Will Not Cause Harmful Interference into Other Spectrum Uses

The proposed increase in field strength limit to 74.4 dBuA/m would not cause harmful interference into other spectrum uses. In general, magnetic field strength in the SAE J2954 fundamental operating frequency band drops off very rapidly with distance—specifically as $1/\text{distance}^3$ —within a very large reactive near field zone extending to 562 meters. In light of these characteristics, the SAE working group identified the 79-90 kHz frequency range based on its evaluation of other likely radio frequency uses in the vicinity of charging locations. In particular, this review focused on RF system frequencies utilized in on-board vehicle systems and other RF equipment and devices that might occur in the vicinity of charging locations, such as standard time and frequency receivers, asset tracking systems, radio navigation systems, avalanche beacons, and automotive low frequency receivers (*e.g.*, for tire pressure monitoring and passive entry). The SAE working group also studied extensively the potential effects on medical devices, as discussed in more detail below. Based on these considerations, the 79-90 kHz operating frequency range was selected based on a lack of other uses, both in the U.S. and internationally.

Given the consumer applications addressed in this proposal, WPT system operations are unlikely to cause harmful interference into any allocated radio services in the frequencies proposed. In the U.S. Table of Frequency Allocations, the 79-90 kHz frequency band is within the 70-90 kHz allocations for federal fixed and maritime mobile services, and non-federal fixed services, on a primary basis, and federal and non-federal radiolocation on a secondary basis.[35] The primary federal maritime mobile allocation is limited to coast radiotelegraph stations.[36] In the 9-490 kHz band, electric utilities operate Power Line Carrier ("PLC") systems on power transmission lines for communications relating to the reliability and security of electric service to the public, operated under Part 15 rules on an unlicensed, non-interference and unprotected basis with respect to authorized radio users.[37] Due to the rapid dissipation of the magnetic signals from WPT systems, it is unlikely that any of these allocated radio services will be impacted by wireless charging activities. However, the Petitioners expect that input and technical analysis by any existing spectrum users as part of the rulemaking proceeding will adequately identify any potential interference issues, and that any such issues can be resolved during the course of the proceeding.

B. The Proposed Power Level Is Consistent with Human Exposure Limits and Medical Device Compatibility Requirements

The SAE recommendations identify the acceptable limits for human exposure to electromagnetic fields as those defined by the International Commission on Non-Ionizing Radiation Protection ("ICNIRP"),[38] and the acceptable limits for effects on pacemaker devices as defined in ANSI/AAMI/ISO 14117.[39] Because the Commission has not adopted exposure limits

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[35] 47 C.F.R. § 2.106.

[36] *Id.* at n.5.57.

[37] *Id.* at n.US2.

[38] International Commission on Non-Ionizing Radiation Protection, *Guidelines for Limiting Exposure to Time-Varying Electric and Magnetic Fields (1 Hz – 100 kHz)* (2010).

[39] ANSI/AAMI/ISO 14117, *Active implantable medical devices – Electromagnetic compatibility – EMC test protocols for implantable cardiac pacemakers, implantable cardioverter defibrillators, and cardiac resynchronization devices*, Appendix M (2012). This standard is well

for frequencies under 100 kHz, the Petitioners request that the Commission consider these internationally-accepted guidelines as the basis for the Commission's exposure limits for the WPT systems proposed. The Petitioners acknowledge that the Commission typically defers to other organizations and expert agencies in matters impacting human health and safety, and expect that such entities will weigh in on these issues during the course of this proceeding. The SAE members are continuing to test prototype WPT systems for compliance with these health and safety standards, and are coordinating with the U.S. Food and Drug Administration regarding the test results.

Significantly, testing and evaluation of WPT systems in the SAE process confirm that the operation of these systems at the proposed field strength limit can be consistent with both human exposure safety standards and requirements for electromagnetic compatibility with implanted medical devices.[40] The testing was conducted using actual WPT systems employing different types of coil topologies and in different operating scenarios and alignments, including under worst-case conditions. The test set-up mimicked the anticipated operating conditions of a WPT system as installed on a vehicle through the use of shielding to replicate a vehicle chassis. These tests confirmed that systems operating below the proposed Part 18 field strength limit were compliant with ICNIRP 2010 and ANSI/AAMI/ISO 14117. Further, the SAE recommendations direct manufacturers to take reasonable measures to prevent exposure in regions underneath the vehicle and surrounding the wireless power assemblies.

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established in the industry as a basis for evaluating medical device compatibility. Although there may be other implanted medical devices in use, ISO 14117 has been used as a representative standard.

[40] *See* SAE Recommended Practice J2954.

VI. CONCLUSION

The Petitioners' proposal to increase the Part 18 field strength limits to 74.4 dBuA/m to accommodate wireless charging of light-duty EV batteries would enable the deployment of higher power WPT technology that will promote greater adoption of EVs, thereby expanding the impact of the public interest benefits of EVs. WPT systems operating up to the proposed limit would be compatible with radio services and devices operating in the same frequency range, and would be consistent with internationally recognized human exposure and safety standards. The Petitioners therefore respectfully request that the Commission act on this petition and promptly commence a rulemaking proceeding to evaluate this proposal.

Respectfully submitted,

/s/

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