TECHNICAL INFORMATION

Energous Corporation ("Energous") seeks special temporary authority ("STA") to operate and demonstrate for Federal Communications Commission ("FCC" or "Commission") staff devices using Energous' proprietary wireless power transmission ("WPT") at a distance ("AAD") technology. A more comprehensive description of this technology is contained in the Petition for Interpretation of 47 C.F.R. § 18.107(c) ("Petition") that Energous filed with the FCC's Office of Engineering and Technology on June 1, 2016, a date-stamped copy of which is appended to this Exhibit.

Energous proposes to demonstrate its Power Router, which, as described in the Petition, uses an array of small antenna elements and energy transmitters to focus radiofrequency ("RF") energy on a small energy Receiver Circuit. The Power Router contains RF electronics, control electronics, and an operating control software system. For purposes of the FCC demonstration, the Receiver Circuit will be embedded in a modified mobile telephone as well as in standalone LED wands.

Once activated, the Power Router will verify the eligibility of the Receiver Circuit using a standard Bluetooth communications channels and will focus transmitted energy in a fixed pocket around the Receiver Circuit. The Power Router uses a proprietary algorithm to provide a solution to each antenna that will cause the antennas to synchronously coincide at the pocket around the Receiver Circuit. This action has the effect of containing the transmitted energy to a small area around the Receiver Circuit and minimizing the transmission of energy elsewhere.

The mobile device in which the Receiver Circuit is embedded will use Bluetooth technology to communicate its charging status to the Power Router and to provide other technical information. Software installed on the mobile phone in which the Receiver Circuit is installed will visually display when the phone is receiving a power charge and when it is out of range. Energous also will utilize energy sensing devices in its demonstration to illustrate the precision with which its WPT AAD technology focuses RF energy on the Receiver Circuit.

The proposed demonstration will be of limited duration and, as set forth in the Petition, will not create any risk of potential interference or RF exposure in excess of FCC guidelines.

STAMP AND RETURN

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
ENERGOUS CORPORATION	)	RECEIVED - FCC
	)	
Petition for interpretation of 47 C.F.R. § 18.107(c)	)	JUN - 1 2016

To: Chief, Office of Engineering and Technology

Federal Communications Commission
Bureau / Office

PETITION FOR INTERPRETATION OF 47 C.F.R. § 18.107(C)

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June 1, 2016

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EXECUTIVE SUMMARY

Energous Corporation ("Energous") is seeking a determination by the Office of Engineering and Technology ("OET") of the Federal Communications Commission ("Commission" or "FCC") that certain wireless power transmission ("WPT") at a distance ("AAD") devices qualify as Part 18 industrial, scientific, and medical ("ISM") devices. Specifically, OET should interpret Section 18.107(c) of the Commission's rules to permit WPT AAD devices to be subject to equipment authorization as "Consumer ISM Equipment" if the WPT AAD devices (i) focus radiofrequency ("RF") energy on a specific location around a coupled device that is being charged and (ii) assure that humans are never exposed to RF energy in excess of applicable Commission requirements. This requested interpretation will enable developers of compliant WPT AAD technology to obtain equipment authorizations.

Energous' requested determination will serve the public interest by facilitating the rapid and safe deployment of WPT AAD technology. As the ubiquity of mobile devices, wearable technology, and the Internet of things becomes a reality, requiring these devices to be removed from use and tethered to a power cord for charging will significantly decrease their public benefits and potentially undermine the adoption of these technologies. This battery charging problem must be solved. WPT AAD is the innovative solution that will provide the public with the convenience of wire-free charging. It will simplify the everyday nuisance of charging battery-operated electronic devices, such as cell phones, smart watches, hearing aids, health devices, and other electronic devices. Currently, U.S. companies are leaders in WPT AAD innovation, which Energous forecasts to be a greater than $10 billion industry by 2020. However, the myriad of benefits derived from WPT AAD technology cannot be realized if manufacturers remain unable to secure equipment authorizations for WPT AAD devices.

In KDB 680106, OET invited manufacturers of WPT AAD systems to seek prior approval from the FCC for authorization under Part 18. Although recent informal OET guidance to Telecommunications Certification Bodies suggests that some WPT AAD devices that conduct "uncontained far-field radiative wireless power transfer at distance" may not utilize RF energy in a manner that is sufficiently "local" to qualify as ISM equipment, the Commission has yet to provide any formal guidance as to what types of WPT AAD devices may qualify under Part 18. Energous maintains that WPT AAD solutions that satisfy the criteria set forth above "generate and use locally RF energy" in a manner that is "contained" around the device being charged, and thus qualify for equipment authorization under Part 18.

Energous' WPT AAD devices use a system of technologies and safeguards that confine the wireless transfer of power to a small area. The technology uses an array or RF transmitters that act as a lens by focusing RF energy in a small area around the Energous receiver incorporated into the device being charged, and power only is transmitted when the receiver calls for the energy transmission. Further, Energous' technology ensures that power is not transferred if a human is in the proximity of the transmitters or the device being charged could be exposed to RF energy exceeding applicable exposure limits.

To enable deployment of Energous' WPT AAD devices, as well as devices that utilize controlled implementations that are similar to Energous' technology, Energous respectfully requests OET to timely act on this Petition.

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)
	)
ENERGOUS CORPORATION	)
	)
Petition for interpretation of 47 C.F.R. § 18.107(c)	)

To: Chief, Office of Engineering and Technology

PETITION FOR INTERPRETATION OF 47 C.F.R. § 18.107(c)

Energous Corporation ("Energous") is seeking a determination by the Office of Engineering and Technology ("OET") of the Federal Communications Commission ("Commission" or "FCC") that certain wireless power transmission ("WPT") at a distance ("AAD") devices qualify as Part 18 industrial, scientific, and medical ("ISM") devices.[1] Specifically, OET should interpret Section 18.107(c) of the Commission's rules to permit WPT AAD devices to be subject to equipment authorization as "Consumer ISM Equipment"[2] if the WPT AAD devices (i) focus radiofrequency ("RF") energy on a specific location around a coupled device that is being charged and (ii) assure that humans are never exposed to RF energy in excess of applicable Commission requirements.[3] This requested interpretation will enable developers of WPT AAD conforming devices to follow the equipment authorization procedures

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[1] *See* 47 C.F.R. § 18.107(c) ("Equipment or appliances designed to generate and use locally RF energy for industrial, scientific, medical, domestic or similar purposes, excluding applications in the field of telecommunication.").

[2] *See* 47 C.F.R. § 18.107(g) (defining the term "Consumer ISM Equipment" to mean "[a] category of ISM equipment used or intended to be used by the general public in a residential environment, notwithstanding use in other areas. Examples are domestic microwave ovens, jewelry cleaners for home use, ultrasonic humidifiers.").

[3] Devices meeting these criteria are referred to herein as WPT AAD "conforming devices."

set forth in section 18.203(a) of the Commission's rules.[4] Devices utilizing the Energous solution will comply with the criteria set forth above.

In KDB 680106, OET invited manufacturers of WPT AAD systems to seek prior approval from the FCC for authorization under Part 18. Although recent informal OET guidance to TCBs suggested that WPT AAD devices that conduct "uncontained far-field radiative wireless power transfer at distance" may not utilize RF energy in a manner that is sufficiently "local" to qualify as ISM equipment,[5] the Commission has yet to provide any formal guidance as to what types of WPT AAD devices may qualify under Part 18. Conforming WPT AAD devices are in harmony with the Consumer ISM Equipment definition 47 C.F.R. § 18.107(g). These devices do not generate an "uncontained" far-field RF emission, but instead "generate and use locally RF energy" in a manner that is "contained" around the device being charged. Consequently, OET should clarify that WPT AAD conforming devices qualify as Consumer ISM Equipment and are subject to Pre-Approval Guidance ("PAG") testing and equipment authorization procedures.

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[4] *See* 47 C.F.R. § 18.203 (a) ("Consumer ISM equipment, unless otherwise specified, must be authorized under either the Declaration of Conformity or certification procedure prior to use or marketing.").

[5] *See* Updated WPT Guidance, KDB Publication 680106 D01 PPT Presentation presented during Oct. 2015 TCB Workshop, Laboratory Division, Office of Engineering and Technology (OET), FCC, at 2, available at https://transition.fcc.gov/bureaus/oet/ea/presentations/files/oct15/6-FCC-Panel-2October-2015.pdf ("Uncontained far-field radiative wireless power transfer at distance is not considered to generate and use locally RF energy, as discussed in 18.107."); RF Exposure Considerations for Low Power Consumer Wireless Power Transfer Applications, Laboratory Division, OET, FCC, at 2 (May 31, 2013), available at https://apps.fcc.gov/kdb/GetAttachment.html?id=gDJO4az8eyw84%2BgyujPd%2Bw%3D%3D&desc=680106 D01 RF Exposure Wireless Charging Apps v02&tracking_number=41701 ("For transfer systems designed to provide power over a distance; for example, to facilitate charging multiple client devices simultaneously or for loosely coupled systems that permit operation at distance, the requirement to generate and use RF energy locally as specified in § 18.107 (c) may not be met. For any system where there is a separation distance between the primary and client; for example, where the client devices are not inserted or placed directly on the charger, prior approval from the FCC is required for authorization under Part 18.").

I. WPT AAD TECHNOLOGY WILL OFFER SUBSTANTIAL PUBLIC INTEREST BENEFITS AND IS POISED FOR COMMERCIAL DEPLOYMENT

Prompt action by OET is necessary to unleash the substantial public benefits described below that will result from the commercial deployment of WPT AAD technology. Until OET provides a way for companies like Energous to obtain equipment authorizations for conforming WPT AAD devices, U.S. consumers will be deprived of the benefits of this important innovation.

A. WPT AAD DEVICES OFFER SUBSTANTIAL PUBLIC INTEREST BENEFITS

Wireless charging at a distance will help change the world. As we enter into the age of the Internet of things ("IoT") and the number of mobile devices in each of our lives multiplies exponentially, relying on conventional charging systems will be untenable. In the near future, each individual will depend upon multiple connected wireless devices throughout their day. Whether for communication, health monitoring, education, entertainment, navigation, or personal safety, reliable all-day performance of mobile devices increasingly will be a necessity. These services make growing demands on devices' energy sources, and battery technology advancements have not kept up with these demands. In this near-term 21st century reality, it will not suffice to rely on wired charging solutions with their genesis in the 19th century. WPT AAD technology has the potential to fully unleash the public interest benefits of the explosion of new categories of wireless devices that have recently reached the market or that soon will be commercially deployed. A significant leap in wireless charging technology will be required to enable the American public to realize the full potential and benefits of new fixed wireless and mobile technologies.

1. IT IS ESSENTIAL FOR WIRELESS DEVICES USED FOR HEALTH AND SAFETY APPLICATIONS TO REMAIN CHARGED

As wireless devices increasingly become a vital component of health and safety monitoring, the present need to remove these devices in order to charge them will becomes a

serious problem limiting their optimal utilization. Whether a device is monitoring a person's vital signs or serving as a fall detector, for individuals with limited mobility the device must be actively monitoring its user at all times to be fully effective. Problematically, current devices must be removed and charged for an extended period of time. The risk of an individual not putting the device back on after charging, or of an event occurring while the device is removed, is significant, and this risk can compromise the utility of the device.

2. WPT AAD Will Facilitate the Ability of Disabled and Aged Individuals to Charge Devices

Certain disabled persons, especially individuals with musculoskeletal limitations of movement,[6] will significantly benefit from WPT AAD technology, as will most seniors. The mere task of connecting electronic devices to battery chargers can be difficult or even impossible for many people who suffer from these conditions. WPT AAD devices will improve their quality of life by increasing the convenience with which they charge their wireless devices and improving their health care and safety to the extent that the devices are used to monitor their wellbeing.

WPT AAD systems will enable disabled persons and seniors to charge their electronic devices by placing them in any location in the room where a WPT AAD transmitter is mounted. Users will no longer be required to plug their devices into wall sockets using specific charging cords or to place their devices into specific charging cradles. Furthermore, for IoT wearable

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[6] *See* National Institute of Arthritis and Musculoskeletal and Skin Diseases website at http://www.niams.nih.gov/. These conditions can include osteoarthritis, osteoporosis, scoliosis, lumbar spinal fusion, and joint disorders, as well as persons with neurological disorders such as cerebral palsy or tremor disorders such as essential, Parkinsonian, dystonic, cerebellar. *See* National Institute of Neurological Disorders and Stroke website; http://www.ninds.nih.gov/disorders; Cerebral Palsy: http://www.ninds.nih.gov/disorders/cerebral_palsy/cerebral_palsy.htm; Tremor Disorders: http://www.ninds.nih.gov/disorders/tremor/tremor.htm.

devices that require very low power, specially designed low-power WPT AAD transmitters may be developed that can be charged while they are being worn while remaining in compliance with RF exposure limits.

WPT AAD also will facilitate the emergence of Mobile Health ("mHealth"). mHealth utilizes technology to enhance communication with health providers, monitor treatment-related side effects, and monitor patients. This will be a quickly adopted technology. As reported in a recent study of usage of mHealth technology to assist patients over 60 years old with chronic pain, "[t]he vast majority (85%) of participants reported they were very willing to use mHealth to help manage their pain conditions."[7] This study determined that the major barrier to usage of mHealth technology was concern about the battery dying in an mHealth device. This concern was more prevalent than concerns related to the cost of, or lack of familiarity with, these technologies.[8] Further, industry statistics show that as soon as someone takes off a wearable device there is a more than one-third chance they will not put it back on.[9] In addition, a study of important hearing aid attributes found that "[o]lder hearing-impaired participants rated speech understanding in noise and speech understanding in quiet as the only two hearing aid features more important than handling issues."[10] Another study determined:

> It appears that manual dexterity and hearing aid ergonomics are important consideration in the minds of patients who wear hearing aids, and they are extremely important factors that determine

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[7] Parker, *Older adults are mobile too! Identifying the barriers and facilitators to older adults use of mHealth for pain management,* BMC Geriatrics 2013.

[8] *Id.*

[9] *See* Andrew Hooge, *3 Barriers To Success For Wearables*, http://readwrite.com/2015/08/07/obstacles-wearable-devices-battery-data-fashion.

[10] *See* http://www.ncbi.nlm.nih.gov/pubmed/12434187.

> successful hearing aid use in terms of who keeps, wears, benefits, and experiences satisfaction from their hearing aid. [11]

Consequently, the increased convenience of being able to charge these devices while they are being worn is essential. Solving the ergonomics issue of power management in wearable medical devices such as hearing aids will result in greater adoption and use of the devices by patients.

3. WPT AAD Will Greatly Simplify the Ability of Consumers Generally to Maintain Their Wireless Devices in a Charged State

The public also will benefit from the convenience of wire-free, uncoupled charging, which will simplify the everyday nuisance of charging battery-operated electronic devices, such as cell phones, smart watches, and other wearables, as well as security cameras and other small portable or fixed mounted devices. Once commercially available, WPT AAD charging technology will become the preferred way of charging batteries. Market surveys demonstrate the currently unmet demand for WPT AAD technology. For example, a recent article by IHS Technology points out the benefits of WPT AAD to the general public:

> The results of the survey show that just over 70% of the market is in the "potential market" category: they have never used the technology but would like to choose it on their next device. Almost 90% of all consumers say they would like wireless charging on their next phone. This is a clear consumer pull for the technology that didn't exist 12 months ago.[12]

The article further notes:

> When customers have never used wireless charging before, they are happy with their first experience.... However, an experienced

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[11] *See* http://www.phonak.com/content/dam/phonak/b2b/Events/conference_proceedings/chicago_2009/proceedings/41_P69344_Pho_Kapitel_26_S265_276.pdf.

[12] David Green, *Wireless Charging –From Industry Push to Consumer Pull*, IHS Technology, at 5 (November 2015), available at https://technology.ihs.com/api/binary/550361.

> user of wireless charging will want the next generation of the technology to improve in key areas – perhaps spatial freedom in positioning or a faster charging speed. This knowledge learned through interaction with a mobile phone will also influence expectations for wireless charging on other device types too – even if the use-case does not directly call for it.[13]

In addition, a recent article from EE Times explains:

> While the large industry groups such as AirFuel Alliance and the Wireless Power Consortium (WPC) battle for wireless charging dominance in furniture and cars, the answer is in the air. Far field communications – which we define as beaming focused power to coupled devices at specific locations – will ultimately triumph in the wireless charging race.[14]

B. *LACK OF U.S. REGULATORY CLARITY WILL CAUSE U.S. COMPANIES TO FALL BEHIND IN THE BURGEONING WPT AAD SECTOR*

The development of commercial WPT AAD technologies is accelerating. There are several U.S. companies that are investing heavily in this technology with the most visible being Energous, Ossia,[15] and Supply,[16] as well as international companies like Humavox[17] and Haier.[18] The potential market for this technology is huge. The technology can be used to power all mobile, portable, and IoT devices—a market that is forecasted to include 700 million units as of 2018.[19] Energous forecasts that the WPT AAD device market will exceed $10 billion in revenues in 2020. This key market will have a dramatic and positive effect on the U.S.

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[13] *Id.*

[14] Jessica Lipsky, *Over-The-Air Charging Is the Future*, EE Times, at 1 (Jan. 21, 2016), available at http://www.eetimes.com/document.asp?doc_id=1328746.

[15] Ossia: http://www.ossia.com/.

[16] Supply Inc.: http://www.madebysupply.com/.

[17] Humavox: http://www.humavox.com/.

[18] Haier: http://www.haier.com/us/;
http://www.engadget.com/2010/01/07/haiers-wireless-hdtv-lacks-wires-svelte-profile-video/.

[19] IHS "Wirelss power in 2016- Sizing the Market and Seizing the Opportunity Air Fuel Alliance Meeting – Phoenix" May 17th 2016.

technology sector if U.S. companies are the first to bring WPT AAD technology to the market. Working with the AirFuel Alliance, Energous is taking a leading role in accomplishing this objective.

These benefits will only come to U.S. companies if they bring this technology to market first. It is critical to have a near-term path that allows authorization of conforming devices so that U.S. consumers will benefit from these technologies. The U.S. has a long history of being a technology leader. From the first mass-produced automobile to the latest wireless technology, the main benefit comes to the company, and therefore the country, that is first to market. WPT AAD technology will be ready for commercial deployment shortly. Therefore, it is critical that OET act promptly to enable U.S. companies to retain their leadership in this emerging market.

Canadian regulators already have taken the action that Energous requests in this Petition. Specifically, Innovation, Science and Economic Development Canada (ISEDC) (formerly Industry Canada) recently released RSS-216 Issue 2,[20] which classifies non-intelligent WPT AAD devices as ISM devices. This release directs applicants for authorization of WPT AAD devices operating at distances of more than 10 cm and at frequencies of 400 MHz or above to submit an inquiry to determine the administrative and technical requirements. This action will permit applications for WPT AAD to be reviewed by the Canadian regulators in a similar manner as the FCC's PAG/KDB[21] inquiry process that Energous is requesting the Commission to apply to conforming WPT AAD devices in the United States.

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[20] *See* RSS-216 (Issue 2)—Wireless Power Transfer Devices (Jan. 20, 2016), available at http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf10871.html.

[21] KDB 388624 (Oct. 16, 2015), available at https://apps.fcc.gov/oetcf/kdb/forms/FTSSearchResultPage.cfm?switch=P&id=28319. A list of devices subject to PAG testing by TCBs is set forth in 388624 D02 Pre-Approval Guidance List v16r01. *See* Pre-Approval Guidance List, Laboratory Division, OET, FCC (Oct. 16, 2015), available at

II. THE ENERGOUS TECHNOLOGY

A. DESCRIPTION OF THE ENERGOUS TECHNOLOGY

Energous has created a technology that uses arrays of small antenna elements and energy transmitters ("Power Router") to focus RF energy on a small energy receiver circuit ("Receiver Circuit") incorporated in an Energous-powered device ("Receiving Device"), such as a cellphone, fitness bracelet, wireless headset, hearing aid, or other portable or wearable device. The Power Router contains RF electronics, control electronics, an operating control software system, and, where required, a sensor system to detect the presence of obstructions and humans ("Sensor System") in the vicinity of the Receiving Device. The Power Router only transmits RF energy when a Receiving Device calls for that energy and only when there is no possibility that humans are exposed to energy above Commission-imposed thresholds. It uses frequencies specifically assigned for ISM devices such as 0.915, 2.45, 5.8, and 61.25 GHz. The device will only transmit in a portion of the ISM band, for example in the 5.8 GHz band, the device will only occupy 5.850 GHz to 5.875 GHz.

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https://apps.fcc.gov/kdb/GetAttachment.html?id=GR5BT4xVepqTKpHMWkhroQ%3D%3D&desc=388624 D02 Pre-Approval Guidance List v16r01&tracking_number=28319. OET should specify that a conforming device qualifies as a "device for which there are new or unique operation or installation issues" in conformance with paragraphs (g) for non-standard SAR measurement methods or techniques and or phantom usage, (j) for dynamic tuning of antennae, (m) for proximity or sensing features, and (q) for WPT applications not specifically excluded. *Id.* In turn, OET's PAG procedure is set forth in 388624 D01 Pre-Approval Guidance v11r01. *See* Pre-Approval Guidance Procedure, Laboratory Division, OET, FCC (Oct. 16, 2015), available at https://apps.fcc.gov/kdb/GetAttachment.html?id=hx9UL7ryC1OviB2AVMgDZg%3D%3D&desc=388624 D01 Pre-Approval Guidance v11r01&tracking_number=28319. Energous and any other applicants will confer with TCBs to construct a testing regime and submit the testing regime to OET through the PAG process. Once consent is provided by OET, applicants can then proceed with compliance testing at an authorized laboratory and submit the results to the TCB. After test result documents are reviewed and deemed acceptable, the TCB will process the Grant of Authorization.

The Power Router's antenna array is similar to the phased arrays that are used in telecommunications applications, but Energous' technology uses these arrays in an entirely different way. Traditional phased array systems assume that the array is a point source because its dimensions are small compared with the distance to the target receiving devices. Traditional arrays then create a "beam" that projects RF energy in a narrow path. In contrast, the Energous array has an area that is significant compared with the distance to the Receiving Device. The array acts as a lens that focuses the RF energy on the Receiver Circuit, thereby creating a small area of energy at the Receiver Circuit. This small area of energy is located in space using software that adjusts the phase and amplitude of signals emitted from each element of the Power Router's array.

Aside from its primary function, the Receiving Device contains the Receiver Circuit which uses its antennae to capture RF energy transmitted by the Power Router and converts the energy into a charging current that is used to charge the Receiving Device's energy storage system. The Energous system uses RF communications connections that are separate and distinct from the battery charging application to register and locate the Receiver Circuit in space. This separate wireless communication is transmitted via Bluetooth or through other technology operating under Part 15 of the Commission's rules.[22] It establishes pairing between the Power Router and the Receiver Circuit and determines the Receiver Circuit's location and eligibility. Only Receiver Devices equipped with Receiving Circuits using the Energous technology can be authorized to connect to the Power Router.

Once the Power Router has verified the eligibility and spatial location of the Receiver Circuit, it establishes an (x, y, z) coordinate centroid on which to focused transmitted energy.

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[22] *See, e.g.*, 47 C.F.R. §§ 15.247, 15.407.

The Power Router uses an algorithm that provides a solution to each antenna that causes the antenna to synchronously coincide at the Receiver Circuit's centroid. This contains the transmitted energy to a small area around the Receiver Circuit, which may range in height or depth or both from a few inches to a few feet depending on the power level needed by the Receiving Device and the distance between the Power Router and the Receiver Circuit. The algorithm is optimized to concentrate the transmitted energy at the Receiver Circuit and minimize the energy elsewhere.

Certain Receiving Devices, such as some wearables, mHealth monitoring devices, and passive IoT devices, will have very low power consumption levels and require low recharging rates. As the Energous technology evolves, including through the development of higher efficiency antennae and higher efficiency circuits, the energy densities transmitted by the Power Router and within the immediate vicinity of the low-power Receiving Device are expected to be sufficiently low that all points outside of the Receiving Device's casing will be compliant with the Commission's RF exposure guidelines. Consequently, such Receiving Devices may be able to be charged while being worn by users without exposing the users to RF levels that exceed Commission requirements.

For systems under current development that have higher power requirements, the Power Router's Sensor System may be required to ensure that RF exposure to humans remains at all times below Commission limits. In these systems, energy levels in the immediate vicinity of both the Power Router and the Receiving Device may exceed Commission-mandated RF thresholds during periods when the Power Router is transmitting. Therefore, to avoid any possibility of human exposure in excess of Commission requirements, the Power Router's Sensor System will detect the presence of people (and pets) within or near a virtual buffer

region—an equipotential perimeter zone ("Perimeter Zone") surrounding the Power Router and Receiving Device. As further discussed below, the Power Router will reduce power or shut down within milliseconds if its Sensor System detects that a person is approaching the Perimeter Zone to ensure that RF exposure to humans remains at all times below Commission limits. Outside of the Perimeter Zone, the RF energy density transmitted by the Power Router will remain below current regulatory limits.[23]

This schematic shows the energy distribution in the (x, y) or top / plane-view inside a typical desk top in which a Power Router might be deployed. It shows the locally contained small area of energy around the Receiving Device (the dashed oval at the lower left corner of the desk) that is generated by the Power Router.

B. THE ENERGOUS TECHNOLOGY WAS DEVELOPED TO BE FULLY FAIL SAFE AND COMPLIANT WITH ALL RF EXPOSURE REQUIREMENTS

As set forth above, Energous expects that low-power Receiving Devices will be able to be charged using the Energous technology without any risk of human RF exposure in excess of Commission guidelines while being worn. With small technological advancements, at no point outside of a low-power Receiving Device's case will there be sufficient RF energy to exceed Commission thresholds. Initial deployments of the Energous technology, however, are likely to

[23] *See* 47 C.F.R. § 1.1310(e) Table 1 (B) Limits for General Population/Uncontrolled Exposure.

involve higher power Receiving Devices that utilize Sensor Systems to prevent RF exposure in excess of Commission requirements to humans in the vicinity of a Power Router or Receiving Device.

Power Routers used to charge these Receiving Devices will incorporate Sensor Systems in the periphery of the Power Router's emitter elements to detect living beings and provide distance data. The Sensor System will have an operational viewing span that is wider than the directional span of the Power Router energy emissions. It also will be able to detect objects and temperatures at distances greater than the distance over which the Power Router is capable of providing energies to Receiver Circuits above the RF exposure limits. A processor within the Power Router will manage the data generated by the Sensor System and command the Power Router's safety functions, thereby assuring that no human can be exposed to RF energy in excess of the Commission requirement.[24] Further, should any component of the Sensor System fail, the Sensor System will prevent the Power Router from transmitting energy to a Receiver Circuit.

The Sensor System's safety algorithm continuously determines the separation distance between humans and the Power Router and Receiver Circuits. It actively and continuously computes whether to reduce or terminate RF energy transmission to the Receiver Circuit based on multiple factors, including the location of the Receiver Circuit, the rate of approach of a living being to the Power Router or Receiver Circuit; ambient temperatures; reflective, opaque or transparent obstructions; and other measurements. Using this data, the Sensor System's software dynamically adjusts the contours of the Perimeter Zone, which is defined with a generous safety margin. Specifically, the Sensor System will not permit RF transmissions by the Power Router if

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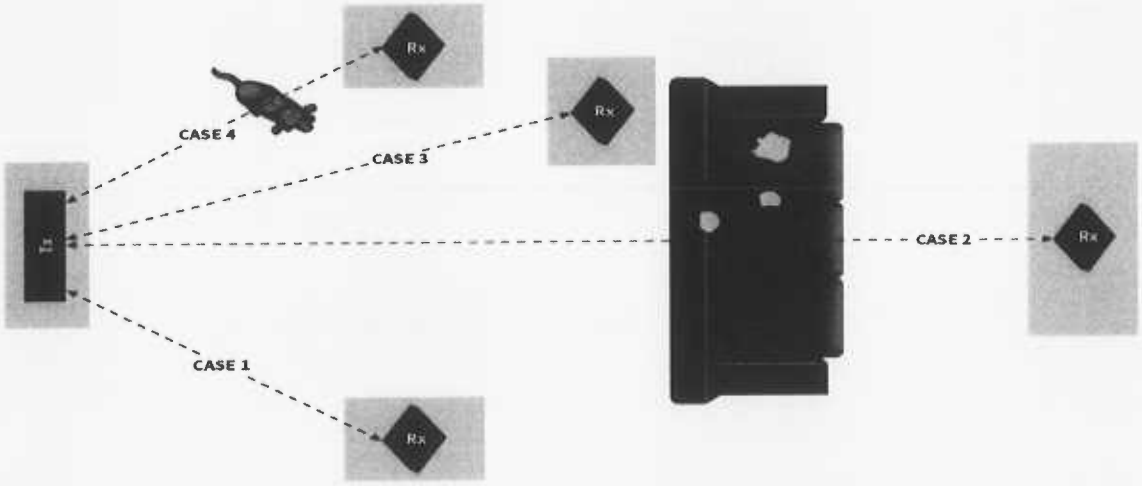
[24] *See* 47 C.F.R. § 1.1310(c). In lieu of Maximum Permissible Exposure power density measurements, RF exposure compliance may be demonstrated using Specific Absorption Rate ("SAR") measurement techniques which measure energy dosage. SAR limits for the general population are 1.6 W/kg on any 1 g volume and a maximum of 0.08 W/Kg over the whole body.

living beings could be exposed to RF energy in excess of current regulatory limits. The Sensor System will reduce or terminate RF energy transmission within milliseconds as a living being approaches the Perimeter Zone, or prevent a Power Receiver from commencing RF transmissions if a human is within the Perimeter Zone when a Receiver Circuit calls for power transmission. Similarly, if there are intervening objects between the Power Router and a Receiver Circuit, whether RF-opaque or not, the Sensor System will not allow energy transmission to occur.

These capabilities are illustrated in the diagram below.



- In case 1, there is an unobstructed path to the Receiving Device and no objects are inside the Perimeter Zone. As a result, the Receiver Circuit in case 1 can command the Power Router to commence energy transmissions and charging occurs.

- In case 2, there is a couch obstructing the path to the Receiving Device. Therefore, the Sensor System will not authorize the Power Router to transmit energy to the Receiver Circuit beyond the couch.

- In case 3, the Receiving Device is sufficiently close to the couch that the couch may be within the Perimeter Zone. Consequently, the Sensor System will determine the distance

between the Receiver Circuit and the couch and then determine whether the Perimeter Zone envelops a portion of the couch. The Sensor System may permit the Power Router to commence energy transmission at reduced power if it determined that the couch is outside of the Perimeter Zone, and it will monitor the scenario on a continual basis to adjust or disable the Power Router's energy transmission as required.

- In case 4, there is a living being (a pet) between the Power Router and the Receiving Device. As a result, the Sensor System will not permit energy transmission by the Power Router until the living being has exited the Perimeter Zone.

Thus, as set forth above, the Power Router's dynamic Sensor System provides a failsafe means of ensuring that the Energous technology never exposes a human to RF levels in excess of Commission requirements.

C. THE ENERGOUS TECHNOLOGY COMPLIES WITH ALL APPLICABLE COMMISSION REQUIREMENTS

This Energous technology complies with all existing Commission rules and limits applicable to both its use of RF energy and its communications channel, including all Part 15 and Part 18 rules and all rules governing emissions, spurious emissions, harmonics, and out-of-band emissions. Further, compliance with Commission's requirements outside of the controlled environment of the Perimeter Zone is achieved through the diminishing and diverging nature of the Energous RF energy transfer at the edge of the Perimeter Zone. Compliance will be demonstrated through testing at an FCC-approved or recognized electromagnetic compatibility laboratory.[25]

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[25] To develop and measure the performance of the Energous technology and ensure its compliance with applicable Commission regulations, Energous has designed and constructed multiple RF chambers. The largest is a full anechoic chamber with the following attributes: (i) anechoic Chamber with "black-tip" ETS-Lindgren Absorbers capable of measurements up to and within the millimeter bands; (ii) Sunol Sciences 2-meter non-conductive turn-table; (iii) Sunol Sciences custom antenna tower with variable distance, variable height and antenna boresight rotation; (iv) SPEAG MPE/SAR measurement system (to 6 GHz) EAYSY4 with DAE, MPE Probe EF3DVX and SAR probe EXDV4; and (v) measurement software with the capability of measuring field strength, power density, harmonics, antenna patterns as well as MPE and SAR in Cartesian, cylindrical and spherical coordinates.

- Interference Potential. WPT AAD technology may be used alongside consumer and commercial devices operating under the Commission's rules. Current ISM rules require consumer ISM devices to prevent harmful interference to authorized radio communication devices. Energous' WPT AAD devices operate in frequency bands designated for ISM devices and when possible in ISM sub-bands not being shared with other authorized radio communication devices. Even when operating in a shared ISM sub-band, the interference potential is minimal due to the narrow occupied bandwidth nature of the Power Router's emissions.

- Spurious and Harmonic emission will comply with current Part 18 limits thus maintaining compliance to rules.

- Fundamental Emissions. The fundamental emission operates within the ISM band and occupies the minimum amount of spectrum. The emission algorithm focuses the energy at a determined location around the Receiver Circuit and diminishes rapidly beyond the focus location.

- In-Band Spurious Emissions. In-band spurious emissions will be attenuated to typical levels outside the controlled environment of operation.

- Out-of-Band Spurious and Harmonic Emissions. Out-of-band and harmonic emissions will comply with typical levels outside the controlled environment of operation. These emissions will be in compliance with Section 18.305(b) of the Commission's rules.[26]

- Spectrum Sharing. The narrow bandwidth of the energy transmission in the ISM band allows for spectrum sharing. Only a small fraction of the ISM band is used for energy transmission with minimal occupied bandwidth requirements.

III. CONCLUSION

For the reasons set forth herein, Energous respectfully requests OET to interpret its ISM rules to enable WPT AAD conforming devices that satisfy the criteria specified in this Petition to qualify as Part 18 ISM devices subject to PAG TCB testing and equipment authorization. Energous has demonstrated herein that its technology complies with the Commission's Part 18 ISM rules, as well as other applicable Commission regulations. Further, Energous' requested determination will unleash the public interest benefits that can be obtained from WPT AAD

[26] *See* 47 C.F.R. § 18.305(b).

technologies. However, this only can happen if OET adopts a process that enables equipment manufacturers to secure equipment authorizations for conforming WPT AAD devices.

Respectfully submitted,

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