

FAQs: Wireless Power Transfer (WPT) & LTC4120

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Q. What is wireless power transfer (WPT)?

A. Wireless Power Transfer (WPT) is the process where electrical energy is transmitted from a power source to an electrical load across an air gap using induction coils. These coils produce an electromagnetic field which sends energy from a charging base station (transmitter) to a coil on a portable device (receiver) with complete galvanic isolation. The receiver coil takes power from the electromagnetic field and converts it into electrical power.

Q. What constitutes the LTC4120 wireless power transfer system?

A. The system is comprised of transmitter electronics, transmit coil, receive coil and LTC4120-based receiver electronics. Transmitter options are discussed later in this document.

Q. At what distances can power be transferred?

A. The existing LTC4120-based systems with PowerbyProxi (Proxi) transmitters were designed to transmit up to 2W across a gap up to 1.0cm. When used with the basic reference design transmitter, this distance increases to 1.2cm. However, if lower power levels are acceptable, it is possible to transmit at even greater distances. Please contact Linear Technology for additional information.

Q. Who is PowerbyProxi?

A. PowerbyProxi is a spin-out of the University of Auckland's world-leading engineering department. Proxi holds an unrivaled patent portfolio related to wireless power transfer with 126 patents issued worldwide, making them the leading innovator and IP leader in the wireless power field. Proxi's solutions give electronics designers the freedom to wirelessly transfer efficient power in the most difficult places: from a miniaturized receiver inside a AA battery form factor to a mission critical solution in the demanding and hostile environment of a wind turbine control system.

PowerbyProxi has worked with customers on over 50 real world projects and built its deep technical know-how by initially focusing on complex industrial applications. For more information visit: www.powerbyproxi.com.

Q. What is the relationship between Linear Technology and PowerbyProxi?

A. The LTC4120 and related products and applications is the first result of an ongoing partnership between LTC and Proxi that includes a nonexclusive license to LTC, and LTC customers, to Proxi's patent portfolio. The LTC – Proxi partnership offers our customers the leading technology in the industry and the assurance that our products are fully backed by patented intellectual property.

Q. Will I need to pay PowerbyProxi or Linear Technology a royalty or fee to use this wireless power technology?

No. An agreement between PowerbyProxi and Linear Technology provides LTC customers free use of the Linear Technology wireless power product.

Q. Will the LTC4120 Wireless Power Transfer System interfere with other electronic devices?

A. No - the Proxi-Point transmitter has been tested to the CISPR11 and MPE20 standards and is currently undergoing UL testing. These standards ensure that our products do not interfere with other electronic devices.

Q. What is Dynamic Harmonization Control?

A. PowerbyProxi's patented dynamic harmonization control (DHC) tuning technology embedded in the LTC4120 provides significant advantages over other wireless power solutions. In response to environmental and load changes, DHC varies the resonant frequency of the receiver dynamically. DHC achieves greater power transfer efficiency, enabling smaller receiver sizes and generating

negligible electromagnetic interference, even as it allows greater transmission range. Unlike other wireless power transfer technologies, DHC allows intrinsic power level management via the inductive power field, eliminating the need for a separate communication channel to validate receivers or to manage variation in load demand during the battery charge cycle.

Said another way, DHC solves a problem fundamental to all wireless power systems. Every system must be designed to receive a certain amount of power at a given maximum transmit distance. Every system must also be designed to survive a no load condition at minimum transmit distance. Competing solutions solve this problem with a complicated digital communication system that adds complexity and cost, and limits power transmission distance. The LTC4120-based wireless power system solves this problem with PowerbyProxi's DHC technology.

Q. How much power can be transferred? What is the maximum charge current?

A. The LTC4120 wireless power transfer system using PowerbyProxi's patented DHC technology can support power transfer of up to 2W at the battery. However, for single-cell Li-ion batteries, the maximum charge voltage of 4.2V and maximum charge current of 400mA limits this value to 1.7W. Similarly, the 2W maximum will limit 2S Li-ion batteries (8.4V maximum charge voltage) to 240mA charge current.

Q. How much misalignment can be tolerated between the transmit and receive coils?

A. When used with Proxi-Point and Proxi-2D, full power can be transmitted with up to 1.0cm of misalignment. In fact, full power is available with 1.0cm of misalignment *and* 0.7cm of distance. Performance of the basic transmitter reference design is nearly identical.

Q. Can power be transmitted through materials other than air? What are the limitations?

A. Yes, power can be transmitted through any non-metallic material including liquids, solids and gases. Power cannot be transmitted through metallic or ferrous materials.

Q. What transmitter solutions are available and how much do they cost?

A. PowerbyProxi offers two off-the-shelf transmitters for purchase: the Proxi-Point™ and Proxi-2D™. Quotes for these products are available on request via the PowerbyProxi website (www.powerbyproxi.com), although the Proxi-2D is not expected to be available until early 2014. In addition, Application Note AN138: Wireless Power User Guide (<http://www.linear.com/docs/43968>) provides an LTC reference design for a basic transmit solution. Furthermore, demoboard DC1968A documentation will include schematics, BOM and layout files for the basic transmitter reference design. This information should be available by the end of CY2013 (<http://www.linear.com/product/LTC4120#demoboards>).

Q. Does PowerbyProxi offer customized transmitter solutions?

A. Yes, PowerbyProxi can build a solution for your application or recommend an off-the-shelf model that matches your requirements.

Q. What is the power efficiency of LTC4120-based systems?

A. The LTC4120-based wireless power system has been designed to receive up to 2W at the battery up to a distance of 1.2cm for the basic reference design transmitter and 1.0cm for the Proxi-Point and Proxi-2D transmitter options. Efficiency calculations vary tremendously based on the technique used. Typically, the battery will receive 45% – 55% of the DC input power fed to the transmitter in an LTC4120-based system. Transmitter options and efficiency measurements can be found in AN138: Wireless Power User Guide (<http://www.linear.com/docs/43968>).

Q. How do you calculate efficiency?

A. Efficiency is calculated as battery charge power divided by transmitter DC input power at rated load.

Q. What is the size of your system?

A. The largest components in the demo system are the 50mm diameter transmit coil and the 25mm diameter receive coil. There are three transmitter options available, ranging from a basic transmitter design, to a one-to-one Proxi-Point transmitter, to an advanced one-to-many Proxi-2D Transmitter (available early 2014). The dimensions of the transmitter systems are:

Basic: 50mm diameter transmit coil plus 540 mm² of single-sided circuitry

Proxi-Point: 70mm x 66mm x 11mm

Proxi-2D: 170mm x 147mm x 16mm

The LTC4120 and supporting circuitry are 460 mm² (single-sided) in addition to a 25mm diameter receive coil. Proxi-Point and Proxi-2D transmitters are fully enclosed, off-the-shelf solutions ready to use or incorporate directly into a product.

Q. Is the LTC4120-based wireless power system compliant with Qi?

A. The LTC4120-based system is currently not compliant with the Qi standard. This is because, unlike consumer-oriented solutions following the Qi standard, the LTC4120-based solution addresses the needs of high reliability industrial, military and medical applications. PowerbyProxi's underlying technology and wireless power architecture allow the LTC4120-based system to operate at a greater power transmission distance with more tolerance for misalignment. This is achieved efficiently so that the receiver does not experience thermal problems. In addition, most industrial, military and medical applications would prefer not to be interoperable with consumer-grade products.

In summary, LTC determined that Qi systems do not offer the performance or flexibility that is available by using Proxi's patented DHC technology. We chose

what we believe is the best technology available to meet the needs of our customers.

PowerbyProxi has recently joined the Wireless Power Consortium (WPC), owner of the Qi specification, with the express purpose of working towards integration of DHC and Proxi technology into the next release of the Qi product specification. Depending on the outcome of that effort, certain LTC solutions may be Qi compliant in the future.

Q. Can power be transmitted across a gap larger than 1.2cm?

A. The existing LTC4120-based systems are designed to transmit up to 2W across a gap up to 1.2cm. However, if lower power levels are acceptable, it is possible to transmit at distances greater than 1.2cm. Please contact Linear Technology for additional information.

Q. Where do I buy receive coils? Will receive coil X work?

A. AN138: Wireless Power User Guide (<http://www.linear.com/docs/43968>) discusses specific components in detail. However, component vendors are developing new products for wireless power applications every day. Please contact Linear Technology or PowerbyProxi for up-to-date specifics not covered in the LTC4120 datasheet or AN138.

Q. Where do I buy transmit coils? Will transmit coil X work?

A. Proxi-Point™ and Proxi-2D™ include integrated transmit coils. AN138: Wireless Power User Guide (<http://www.linear.com/docs/43968>) discusses specific components of the basic transmitter in detail. However, component vendors are developing new products for wireless power applications every day. Please contact Linear Technology or PowerbyProxi for up-to-date specifics not covered in the LTC4120 datasheet or AN138.

Q. Are there any health risks associated with this technology?

A. PowerbyProxi has conducted studies at leading medical universities and found no adverse health effects as a result of their wireless power technology. Each Proxi transmitter system has been tested against international standards that dictate maximum magnetic field exposure levels, and all have produced results well below the allowable limits.