DC-Resonance Powers Wireless Transfer

Through the electromagnetic resonance field, Murata Manufacturing has come up with the DC-resonance method to efficiently transfer power among wireless devices.

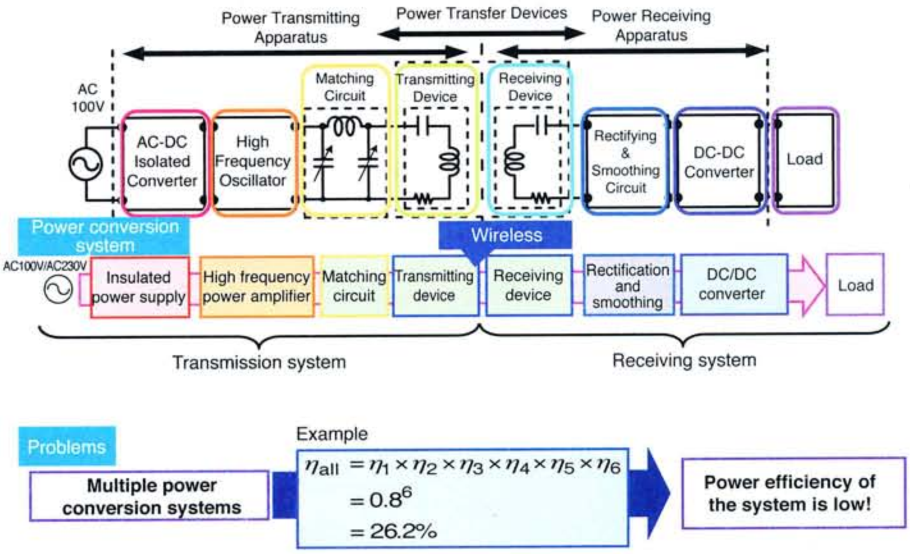

Fig. 2: Problems in the present system

Murata Manufacturing Co., Ltd. has developed the direct current (DC) resonance method as a new technique for wireless power transfer system. Fig. 1 shows the new DC-resonance-based system together with the present system for comparison.

The DC-resonance method is a new technique to convert DC electrical energy into electromagnetic field energy. It supplies electric power to a spatially remote place by utilizing a resonance of the electromagnetic field whose energy is taken from DC voltage. That is to say, it employs a novel physical phenomenon called electromagnetic resonance field, which utilizes the interaction of the electromagnetic field. The new technique generates a resonance field from a DC power source and obtains an electric power from the resonance field. In the process of the energy supply from the power source to the objective instruments, it can reduce the number of energy conversions and thus achieve simplification and high power efficiency of a system. Moreover, the resonance field can be enlarged by using the resonance apparatuses, and thus the technique is expected to be used for a vast range of applications for a variety of purposes.

By fusing many different techniques, such as electric power storage, radio communication, power electronics, and electromagnetic interference (EMI) technique, the DC-resonance technique will have a large potential to create novel technology, products, and value. This technique will make it possible to develop really valuable new products for users and offer new solutions in various areas where application of wireless power transfer is advantageous.

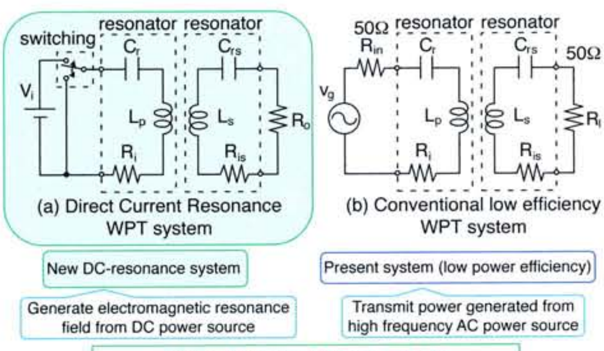

Fig. 1: Comparison between the new DC-resonance system and the present system

Murata has developed the magnetic field resonance technique for the first time in the world, and reported the achievement at the IEEE INTELEC in 1994. On the basis of this pioneering development, the company started a feasibility study aiming at its practical use around 2009, and succeeded in developing the DC-resonance system employing a new physical phenomenon called electromagnetic resonance field.

Merits of DC-Resonance System

A DC-resonance system is a wireless power transfer system converting DC voltage to electromagnetic field energy. Most of the electric power being consumed is taken from DC voltage. Commercially available AC voltage is mostly converted to DC voltage to be used, and most of electronic devices are usually operated by DC voltage. Therefore, wireless supply of DC electric power from a DC source to spatially remote apparatuses is extremely useful. Moreover, by improving the system efficiency, the amount of energy loss can be substantially reduced.

In a DC-resonance system, electric energy and electromagnetic field energy are converted directly. Most of the existing resonance type wireless power transfer systems developed so far needed power conversion of four to six times

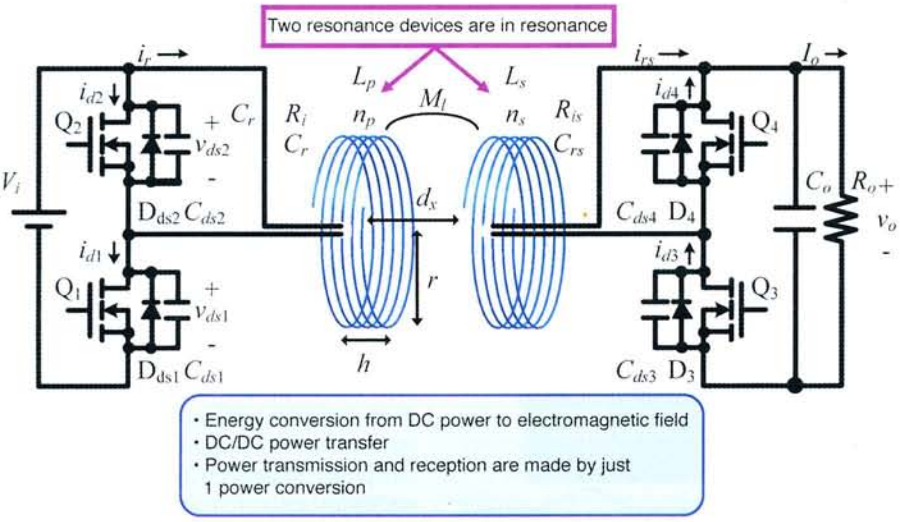

Fig. 3: An example of the basic structure of the DC-resonance system

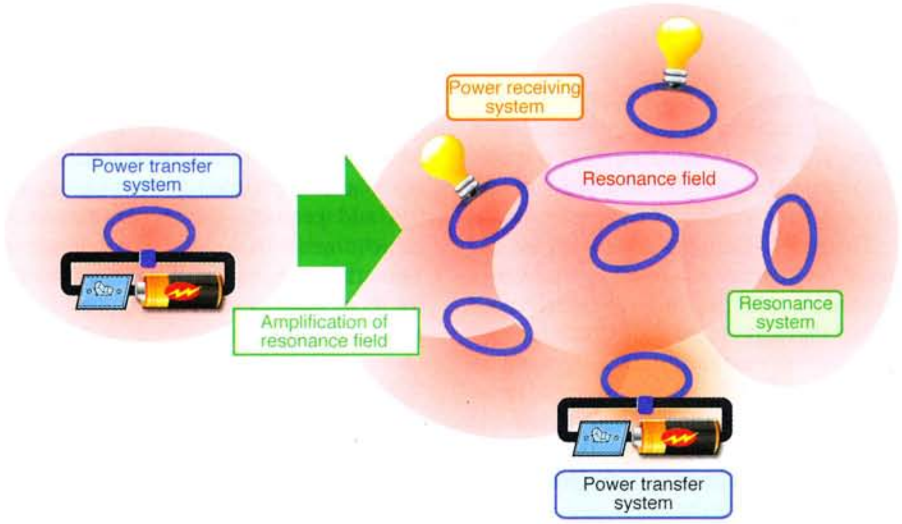

Fig. 4: Image of amplification of the resonance field

for power transfer. Problems of the present systems are shown in Fig. 2. On the other hand, a DC-resonance system performs direct energy conversion. Fig. 3 shows an example of the basic structure of a DC-resonance system. The realization of tremendous reduction of energy loss as well as the size and weight are expected to be great advantages.

By using a resonance apparatus, electric power is transmitted after amplifying the resonance field. Depending on the application purposes, the resonance field is amplified by properly arranging the power transfer system, the power receiving system, and the resonance system. By designing the resonance field with original ideas, such as use of multiple power transfer and receiving systems, or power receiving at various locations, application and further development of the system will become possible in many new different areas. Fig. 4 shows the image of the amplification of the resonance field. Fig. 5 shows sample results of the analysis of the resonance field obtained by using a computer code named Femtet made by Murata Software Co., Ltd.

Comparison with Present System

For wireless power transfer, a well-balanced design is needed, taking account of supplying power, distance between the transmitting and receiving stations and their arrangement, as well as size and shape of the devices. Under the designed conditions, it is important to achieve high power efficiency of the system. Fig. 6 shows the merit of the DC-resonance system. In comparison to the magnetic field resonance technique, the system structure is simpler and the size is smaller and lighter. As a result, the power efficiency of the system is enormously enhanced.

In comparison to the electromagnetic induction method, the flexibility in the arrangements of the power transmitting and receiving devices is higher. It is no more necessary to use heavy magnetic materials (iron) or wire-windings with a large area and volume (copper), so that the system structure becomes simpler.

In comparison to the electric field-coupled technique, it is more advantageous when a long transfer distance is needed. Physical contacts between the power transmitting and receiving devices are not necessary.

In comparison to the wireless radio technique, it can make the supplied power very large for a limited system size. Complex power transmitting and receiving apparatuses are not necessary, so that the system can be simple, small and light.

Applications, Future Prospects

Murata Manufacturing will rapidly proceed to find a new market where the wireless power transfer is valuable. Priority for application is placed to areas where the external power supply has not been possible and batteries have been required, such as wireless power supply to small electronic circuits or communication cards, rather than smartphones and other mobile devices to which power can be supplied through cables. At present, the environment problem related to battery disposal is becoming more and more serious, and the maintenance of sensor

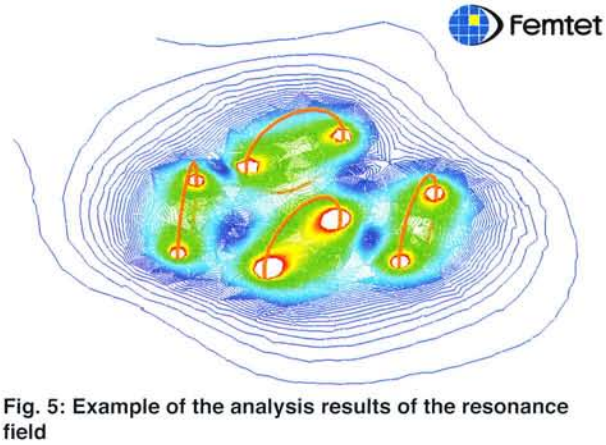

Fig. 5: Example of the analysis results of the resonance field

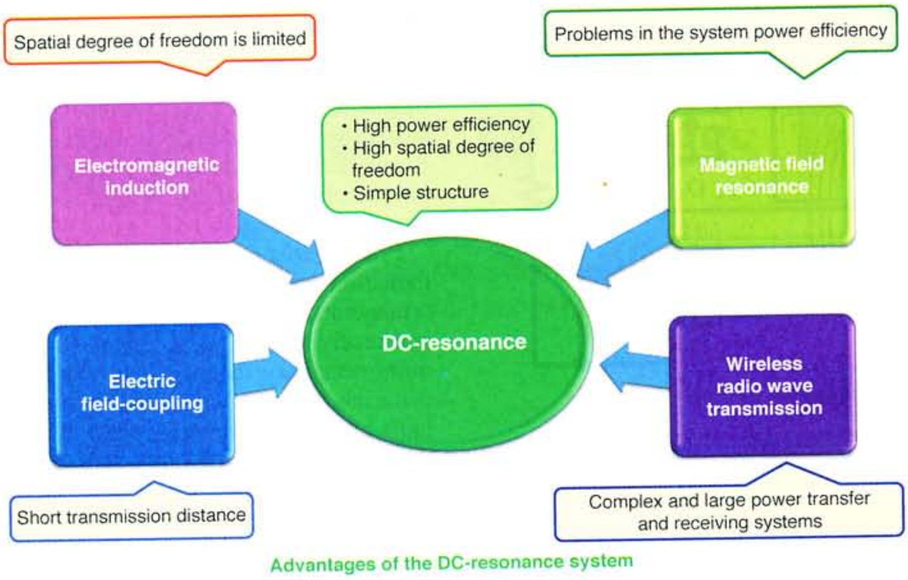

Fig. 6: Merit of DC-resonance system

Fig. 7: Scene of proving experiments of the wireless power transfer system using the DC-resonance method

networks, including exchange of batteries of many sensors requires a lot of labor. The use of wireless power transfer can create new values as it reduces the environment load and saves labor.

The new system can cope with the application in areas where a large power is needed by enlarging its scale size. In such areas, there is a great deal of demand from customers and markets as well as many promising applications. Therefore, Murata Manufacturing is considering offering the technology, license, and know-how individually through open innovation. As for the industrial machines, driving mechanisms in electric vehicles and so forth, the company is considering cooperation with other organizations, based on the technical achievement that it has accumulated.

Fig. 7 depicts the proving experiments of the novel DC-resonance wireless power transfer system. An electromagnetic resonance field is generated from DC power produced by a solar cell, lighting up multiple light-emitting diodes (LEDs). This demonstrates new innovative technologies, such as (1) DC/DC power transfer, (2) power transfer to multiple loads, (3) amplification of the electromagnetic resonance field, and (4) power transfer to various directions. The new system is widely expected to be used for industrial applications.

Aiming at creating new values and contributing to the society in the present world full of electronics, Murata Manufacturing will further develop science and technology, activate industry, and promote the dissemination of achievements in technical development. Thus the company will endeavor to offer its customers with highly marketable products soon.

About This Article:

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TDK Beefs up MLCC Business for Cars

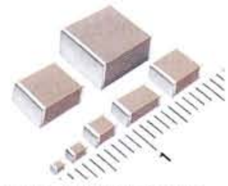
TDK Corporation has been further stepping up its efforts in the automotive field in its multilayer ceramic capacitor (MLCC) business. Sales of MLCCs for automotive applications have already reached around 50 percent, making it the company's mainstay business field. TDK has newly developed automotive-grade MLCCs featuring C0G temperature characteristics and rated voltages from 100 to 630V.

TDK has developed the new products eyeing adoption in engine control units (ECUs) and keyless entry systems in cars, as well as inverters and DC/DC converters in electric vehicles (EVs) and hybrid electric vehicles (HEVs).

A wide product lineup with high reliability have been achieved through the combination of technologies for finer dielectric powder manufacturing, high-dispersion processing, as well as thin and multilayer technology for the dielectric ceramic layer.

Broad Product Range

The new products come in sizes from 1005 to 5750 and in seven shapes. In terms of rated voltage, types rated for 450V have been added for the 2012-size and larger sizes, as opposed to the previous lineup rated for up to 250V. Furthermore, the 5750-size Series has been newly added. In terms of performance, they feature C0G temperature characteristics, the highest levels of performance with temperature range from -55 to +125°C, and temperature coefficient of 0 to ±30ppm/°C. Thus, they are free from DC bias characteristics and temperature- or time-dependent fluctuations of capacitance, ensuring that circuits consistently achieve the output that they are designed for. Upon request, temperature ratings of up to 150°C can be met. The MLCCs are qualified to AEC-Q200 standard established by the Automotive Electronics Council (AEC) targeted at passive components.



TDK's MLCCs featuring C0G temperature characteristics and rated voltages from 100 to 630V

Achieving high voltage ratings of up to 630V, TDK anticipates that the new MLCCs will replace existing film capacitors. ❑