Contribution to the world by technology

TDK Core Technologies Sustaining Innovation in Society

More than 80 years have passed since the magnetic material ferrite was first invented and put to use. The spirit of creating entirely new things of value by starting at the fundamental level of the material itself has defined TDK from the very beginning. Even today, it is still the trait that enables us to contribute to various facets of society through innovative and original products.



center

TDK's Core Technologies and Monozukuri Power Sustain a Society Inspired by Dreams

Cloud computing is the backbone of the smart society. The smart grid enables the realization of a cleaner future. TDK products play a vital role in many things surrounding us in our daily lives. By persistently pursuing a path of innovation for technologies and products geared to the needs of society, we help to build a world where dreams can come true.

MKK Power Capacitors

These film capacitors are used around the globe in low-loss. high-voltage DC power transmission systems. Advanced technologies such as film metallization and stacked winding have been harnessed to create capacitors that are compact. extremely reliable and can handle high energy levels.



Main Applications

Converters for power generation and power transmission systems, inverters for industrial equipment and railway traction systems, etc.

Opening up new possibilities for solving environmental problems Energy-related Market

TDK products play a role in the search for solutions to environmental issues such as global warming and dwindling energy resources. With the production of eco-friendly cars and renewable energy systems gaining momentum all over the world, TDK components contribute to better fuel economy and higher performance.



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Current sensors

Current sensors from TDK are used not only in hybrid electric and electric vehicles. our lineup also comprises products designed for torque control in servo motors, input/output control in switching power supplies, battery management and various other industrial equipment applications. Main applic HEV/EVs. industrial motors inverters, switching power supplies, etc

ind pow eneration

Large neodymium magnets

By harnessing proprietary low-oxygen

for HEV/EV and industrial

equipment

Main applicati

DC-DC converter for HEV/EVs These power supplies efficiently convert the high voltage of the main battery into the lower voltage required by the electric equipment of the car, and are also used for charging the auxiliary battery. High

power conversion efficiency helps to conserve energy.

[Main applications] HEV/EV/PHEV (plug-in hybrids) etc. Automotive-grade multilayer ceramic chip capacitors Advances such as the realization of a finer structure for the dielectric ceramics material have resulted in tiny (0.6 x 0.3 mm) capacitors that offer high reliability and can withstand the extreme temperatures in the engine room of a car. Main applicatio

(tire pressure monitoring systems), keyless entry systems, various other sensors

TPMS

HDD heads

Magnetic heads for hard disk drives are manufactured using highly sophisticated thin film process technology. The heads from TDK are industry-leading products in the drive towards higher recording density, enabling hard disk drives that are both smaller and also offer greater storage capacity.

[Main applications] Hard disk drives for PCs, HDD recorders, home servers, data centers, etc.

Next-generation Information and <u>Communications marke</u> The modern networked society is evolving and changing on a daily basis. The power of

craftsmanship which is a core strength of TDK also provides advantages when it comes to realizing goals such as making mobile devices more compact and versatile, or enabling data centers to store more data while consuming less energy.



Wireless power transmission coil

These coils are key elements of systems designed to allow wireless battery charging of smartphones and other mobile devices. The use of a proprietary flexible magnetic metal sheet from TDK enables a thinner profile



Wireless power transmission systems for smartphones digital cameras, Bluetooth headsets, etc. Based on TDK's SESUB technology (semiconductor embedded in substrate), this product is a world's first and features a multi-channel power supply management IC chip that is embedded directly into the multilaver substrate. It also includes surface-mounted capacitors and power inductors. The result is a highly integrated and extremely flat module Main applications Smartphones, mobile phones, tablet PCs, and other mobile devices

martphone

Thin film common mode filters Proprietary thin film patterning technology

enables the formation of smaller and more precise coil patterns. With cutoff frequencies as high as 10 GHz, these EMC countermeasure control products offer even more efficient suppression of radiated noise.

[Main applications] Notebook PCs,

high-speed interfaces, etc. computers, HDDs, SSDs,



Power Management Module



Lithium-ion battery

These rechargeable, high energy density batteries are extensively used in various kinds of mobile devices. Advanced TDK technology for key components, such as electrodes and separators, provides a decisive advantage.

Main applications

Smartphones, mobile phones, tablets, computers, and other mobile devices

Contribution to the world by technology

FY 2013 Activity Report

Setup for Inspiring **Technological Innovation**

TDK is a business centered on the core of magnetism-related materials technology. Since the development of these materials takes a long time, one cannot hope for significant innovations by means of a setup calling for short-term results. However, it is important to promote efficient development. The key point here is the selection of development themes.

At TDK we have introduced an original stagegate process as a development management system. Under this system, the theme-specific development period is divided into four stages. At the end of each stage, the state of progress and commercial feasibility are objectively evaluated, and a decision is made on whether or not to go ahead with development. Thus, it is possible to judge the pros and cons of the theme by the same criteria each time, even if the leader of the development team changes. This increases the understanding of the engineers and enhances their enthusiasm for the project. Their motivation is further boosted by linking this system to the personnel appraisals, so that engineers are personally rewarded for their efforts through careful evaluation at each of the seven stages.

Furthermore, as well as personnel evaluation, in order to cultivate the "human strength" that is essential for business development, at TDK we endeavor to foster an open environment that promotes exchange beyond the limits of each department and specialty across the globe, and to develop human resources with a broad vision. Below, we feature reports from two employees who have taken part in training experiences unique to TDK. Firstly, we hear from an employee who took part in our Technology Exchange Meeting (TEM), which began in 2011 with the aim of creating a group-wide synergy through technical exchanges between engineers from around the world. Secondly, we hear from a new recruit who took part in a unique training experience for new TDK employees. We hope that both experiences introduced below demonstrate our efforts to build a working environment in which engineers can fully display their capabilities without fear of making mistakes.

nent by TEM Participant) Creating Synergies by Pooling the TDK Group's Collective Strength

Dr. Christian Hoffmann Senior Chief Researcher, Technology & Intellectual Properties Strategy Group, echnology HQ. TDK Corporation

Our training for new employees included a unique program in which we were divided into teams of three and given the task of producing an original bamboo dragonfly. Our assignment was not merely to produce a bamboo dragonfly but to create a product that would sell by taking quality, cost, delivery, and market value into consideration. We were therefore able to experience the whole process of manufacturing from original idea through to sale. The team members came from various departments, such as development, planning, and marketing. Faced with this mammoth assignment, at first we were

With keynote speeches by top management and group sessions in key areas the Technology Exchange Meeting (TEM) provides a top-down view and a bottom-up view of our capabilities at the same time. Bringing together technology experts from all parts of our company helps us to think out-of-the-box and develop advanced technologies.

Thanks to the TEM, I have been able to establish and maintain a network with engineers outside my usual field of expertise, and this has proved useful in many situations. In addition to a excellent and extensive technology base, one of the major strengths of the TDK Group is its extremely broad knowledge base, which is reflected in the large variety in its product portfolio.

I want to create new technologies and materials that will enable new products for a sustainable society. By observing my surroundings I try to identify circumstances which can be improved by my knowledge and experience and then act accordingly.

Unique Training for New Employees Stimulates the Imagination

baffled. But as we put our ideas into words, concepts and designs began to take shape. I felt a great sense of fulfillment when our dragonfly was finally completed.

I realized that it was precisely because of our different backgrounds and different strengths that we were able to broaden our vision and find better solutions. I also understood that good communication is essential for making good products. I want to put what I learned in this training to use in my daily work and connect it to greater job satisfaction, better productivity, and innovation.



Akiko Arai Planning Section, Planning and Coordination Departm Production Engineering Group, TDK

Nobuhiko Karashima Process Development Section, Advanced Technology Development Center, Technology HQ, TDK

Hironori Yoshimura MLCC Production Technology Division 1 Group 3, Ceramic Capacitors Business Group, TDK-EPC

Aiming to Become the World's Most Powerful Technology Development Group

TDK has positioned "contribution to the world by technology" as a key action item under from CSR perspective. Kaoru Matsuoka, General Manager of the Technology HQ, explains the concept as follows, noting that it is closely linked to TDK's corporate motto of "contribute to culture and industry through creativity."

Revolutionize and challenge through technology

Since our company's initial foundation on the basis of realizing the potential of ferrite, TDK has consistently advanced the progress of magnetics technology, and it still makes up part of the DNA of this company. Evolving further into microfabrication, powder and thin-film formation, sintering, coating, and other advanced processes, we have developed and expanded our core technological competence. As a result, we are able to supply the industry with materials, components, devices, and modules reflecting these core technologies, centered on the Next-generation Information and Communications and Energy-related sectors.

Our Mid Term Plan - adopted in fiscal 2013 - aims to "sharpen TDK's core technologies and contribute to the evolution of new social infrastructures." The motto for our technological development is therefore, "Change the paradigm of technology, challenge and revolutionize!" In other words, we want to change the world through technology.

To take an example, permanent magnets from TDK are used in motors and other similar products. Since it is said



Kaoru Matsuoka Senior Vice President. General Manager of Technology HQ and General Manager of Advanced Technology Development Center of Technology HQ, TDK Corporation

that electric motors account for about 60% of the energy consumed by society as a whole, contributing to the higher efficiency of motors is an area where TDK can make a significant contribution. If higher efficiency can be realized, drastic savings in energy consumption will be the result. Another area where we can make an important difference is in the field of rare earth materials - currently used for the permanent magnets of electric motors. Since these materials are both costly and rare, the protection of scarce resources is an important consideration with regard to their use. TDK is therefore making intense efforts to develop permanent magnets that do not require rare earth materials. Once realized, this will bring about a revolutionary change in the world of permanent magnets. The widespread use of electric motors that combine both low cost and high efficiency will be extremely beneficial in the drive to reduce the load on the environment.

In this way, TDK refuses to think that something is "impossible." Rather, we want to challenge various aspects of established technology, with the aim of bringing about a revolution. As a business that is a public entity and has the responsibility to contribute to society, TDK pursues technology that helps society to evolve in a positive direction. The most important resource that allows us to pursue this aim is "people." This of course applies not only to us, but can be said of all industrial activities. Strengthening human resources is always a key factor. TDK wants to give its junior staff a broad range of opportunities to gather experience and to learn. We therefore implement a strong program of staff rotation. This involves pursuing the initial stages of technology development within the Technology HQ, but then transferring the engineers, alongside his/her project, on to the business groups that operate in the intended field of application. In this way, development can continue in closer proximity to the actual markets. The engineers take responsibility all the way through to mass production in the respective business groups. We believe that this market-oriented approach has the potential to trigger technological revolutions. By fostering staff with a high level of technological knowledge, TDK wants to become the world's most powerful technology development aroup.

In order to contribute to the evolvement of the social infrastructure, we will hone our core technology skills in the field of magnetics to the utmost, under the motto of "Change the paradigm of technology, challenge and revolutionize!"

Contribute to resolving social problems through business activities

The TDK Group is responding swiftly to the advanced sophistication and diversification of the electronics sector. We do this by always operating at the cutting edge, introducing new products that utilize proprietary materials technology and design technology, and by developing new technologies. Key areas are products related to next-generation recording technology, microelectronics modules for mobile communications, and environmentally-oriented and energysaving devices for the automotive sector and for nextgeneration infrastructure applications.

Technological resources are being allocated to vital markets including the Energy-related and Next-generation Information and Communications markets, to realize efficient, solutionoriented research and development.

Passive components segment

In the passive components segment, we have harnessed core technologies for the development of next-generation multilayer ceramic chip capacitors and inductors, EMC filters, and compound sheet type flexible magnetic shields and RF absorbers for anechoic chambers. As a result, we introduced various EMC countermeasure products to the market and advanced the performance of anechoic chamber facilities. Activities related to the implementation of RF modules and other module products were also strengthened.

Magnetic application products segment

In the magnetic application products segment, the development of market-ready rare-earth-free magnets and next-generation ferrite magnets is progressing, along with the development of next-generation high-density recording heads. The development of devices for hybrid vehicles and electric

vehicles is also being strengthened. As energy saving measures have become a major concern for society, the development of highly efficient power supplies is one way in which we are responding to such needs. In view of fluctuations in the price and supply situation of rare earth materials - due to the difficult international situation in the production areas - we are aiming to significantly reduce the use of rare earth elements (or even eliminate them altogether) in new types of magnets.

Film application products segment

In the film application products segment, the development of next-generation, lightweight, environment-friendly, lithium battery materials as well as of films with new properties and functions is progressing.

TDK's Research & Development framework

In Japan, the Advanced Technology Development Center within the Technology HQ is pursuing the development of advanced materials technology, process technology, and new devices as a corporate R&D activity. In addition, sector specific products and technologies are being developed through technology development sections within the respective business groups.

On the global stage, TDK promotes research and development in conjunction with major universities in the U.S. and Europe, and we are making increased use of local expertise and technological resources through R&D subsidiaries in various countries. In China, where we intend to strengthen our base and pursue an expansion of activities in future, we are carrying out research related to electronic component materials.

With regard to R&D at consolidated subsidiaries, we are continuing to intensively pursue the development of next-generation HDD heads at Headway Technologies, Inc. in the U.S.

53,943 million yen

Percentage of R&D vs. net sales



TEM (Technology Exchange Meeting)

The TEM is a forum for technology exchange aimed at dismantling global barriers and promoting faster group-wide integrated development. TDK Group engineers from different countries, with specialization backgrounds across various fields, come together for two days to discuss and explore a number of topics in depth.

After a preparatory meeting in Munich in 2011, the fourth fully-fledged TEM was held in November 2012. A total of 155 engineers from the TDK Group have so far participated in the meetings. Through such initiatives, we aim to promote not only a cross-fertilization of ideas but also the exchange of human resources, in order to build a more organic R&D framework.



TDK Named as one of the "Top 100 Most Innovative Organizations" by Thomson Reuters in 2012

In January 2013, TDK Corporation was selected as one of the "Top 100 Global Innovators for 2012" by Thomson Reuters (headquartered in New York). This award honors corporations and research organizations with notable inventions, judged not only on the basis of

patent applications but also in terms of global impact. Criteria for selection includes the number of patents, the success rate, the global reach of patent portfolio, and the influence of patents in citations. TDK received an especially high rating for its number of patents, along with high ratings in the other three categories.



Trophy engraved with the TDK name