

Understanding TDK Today

Three Strategic Growth Fields: IT Home Electronic Appliances; High-Speed, Large-Capacity Networks; and Car Electronics

Three key markets—growth markets—will be the focus of TDK in the coming years. Advances in digital technologies and the wedding of various electronic devices spell growth for IT home electronics appliances. The same is true of high-speed, large-capacity networks that make the sending and receiving of video content not just a dream but a reality. And car electronics, increasingly used to enhance safety and link vehicles to data communication networks, are also expected to witness burgeoning demand.

Why is TDK focusing on these markets? Because they all use electronic components, many of which have at their nucleus distinctive TDK expertise—materials technology and process technologies. Such components include ferrite cores, capacitors, inductors, EMC components (“noise” reduction components), high-frequency components, sensors, magnets, transformers, power supplies, HDD heads, semiconductors and recording media—the list goes on and will become longer as TDK channels its energies into these growth fields.

IT Home Electronics Appliances

Growing Demand for Digital Household Appliances a Boon for Electronic Components

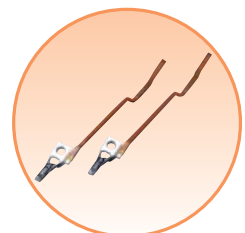
Recent technological advances have spurred the digitalization of home electronics appliances. One example is the traditional cathode ray tube (CRT), which is more and more playing second fiddle to plasma display panels (PDPs) and liquid crystal displays (LCDs). And video cassette recorders (VCRs) are giving way to DVD players/recorders, while 35mm film cameras are taking a back seat to digital still cameras (DSCs). Car navigation systems further demonstrate just how pervasive digital appliances have already become. More will follow.

Another trend looks set to redefine the shape of home appliances. They will be able to do more. Previously, most home appliances were designed only for a single function; they basically performed only one task. In the future, appliances will offer communications, including Internet connectivity; they will be able to use HDDs and other media to record large volumes of data, such as digital TV broadcasts; and they will function as computers. In short, look out for products bursting with functionality. Also predicted is the advent of home servers, allowing the integrated management of broadcasting, communications and computer data through one channel.

The four digital home appliances mentioned above—PDPs/LCDs, DVDs, DSCs and car navigation systems—now account for a considerably higher proportion of electronic device production in monetary terms than they did just a few years ago. More growth is forecast. Indeed, these appliances are expected to follow in the footsteps of PCs and mobile phones as huge growth markets.

TDK's Magnetic Heads—Key to Helping Make HDDs Ubiquitous

HDDs, with their ability to store large volumes of data, as well as the ability to record and retrieve data at high speed, have readily found a home in a broad range of external storage equipment for computers, ranging from large-scale units to PCs. Recently, HDDs have also been increasingly employed in non-PC applications, such as game consoles, video equipment and surveillance camera systems. But they will be asked to do more. Today, the need to record and retrieve large volumes of data, including movies, advances in computer software and the development of mobile devices are all placing new demands on HDDs. They will be required to store even more data, operate at higher speeds, and be more resistant to shocks. Technological innovation is the order



GMR heads



of the day. The rewards will be great too: The HDD market is expected to expand as these storage devices are used in all manner of electronic products in addition to PCs.

As a leading company in the development and mass production of HDD magnetic heads, TDK is well positioned to benefit from these trends. Based on its resources in core ferrite materials technology, TDK leverages ultra-thin-film formation process technology that is conducted on a nanometer level and ultra-fine-patterned lithographic technology to manufacture HDD magnetic heads. HDD heads float a mere 10 or so nanometers above a hard disk as it spins at high speed. To achieve this level of precision, TDK developed ceramic processing technology that provides the optimal conditions for controlling the floatation of the head. This technology takes many years to cultivate and is the result of both the development of ceramic materials and processes related to their use and manufacture. In the future, TDK is intent on leveraging its vast technical resources in this area to provide head products that will facilitate an even larger volume of data on HDDs.

Other innovations have been made possible through technological cooperation with Matsushita Electric Co., Ltd. These include the successful development of an HDD head that can withstand an impact, while operating, of 1000G*¹ or five times the current specified tolerance for existing products.*²

Until now, impact resistance has been a problem, however, this advance is expected greatly increase the potential of mobile devices with HDDs. The advent of HDD-equipped mobile devices will move the world closer to a ubiquitous information society.

*¹ 1000G during operation refers to the force of impact experienced when a small mobile device such as a mobile phone is dropped, while operating, from a height of about 1.5 meters onto a concrete surface.

*² As of September 27, 2002 (TDK survey).

EMC (Electro Magnetic Compatibility) Components—Rising in Importance With Digitalization of Electronic Devices

The digitalization of electronic devices offers many benefits to users. But this technology also has a drawback—noise. The consequence of impedance mismatching in circuits and unnecessary harmonics, noise inevitably accompanies all digital signal processing. There is one more issue that cannot be overlooked. The rising density of electronic circuit packaging is accompanying the miniaturization of electronic devices is progressively narrowing the spaces between electronic

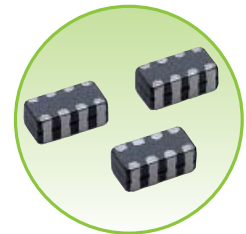
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components as well as signal paths. This proximity makes mutual interference among components and circuits increasingly likely. Moreover, the high-speed transmission of digital signals, examples of which include USB2.0 and Digital Visual Interface (DVI), has created a significant need to reduce noise in the line interface of electronic devices.

So while the digitalization, miniaturization and speeding up of electronic devices is benefiting users in the form of greater convenience, these advances are also causing noise, which in turn causes IC malfunctions and various other problems in electronic devices. EMC components are thus becoming increasingly important for holding noise below mandated levels.

Enter TDK's EMC products. These components, including common-mode filters and beads, are grounded on a fount of magnetic materials technology, notably ferrite, built up since TDK's founding. In fact, TDK can offer total EMC solutions, extending from radio wave absorbing materials, anechoic chambers and EMC testing systems. Underscoring TDK's expertise in EMC components are products like the industry's smallest* thin-film common-mode filter array that is compatible with high-speed differential signal transmission. This groundbreaking product was developed by applying fine-patterned conductor technology used in thin-film magnetic heads. Another example is highly reliable multilayer chip beads that are the smallest in the industry*. Both the reliability and small size were made possible by the use of an entirely monolithic structure produced by layering and sintering magnetic and conductive materials using control technology of the micron order.

*Source: As of March 31, 2003 (TDK survey)



Thin-film common-mode filter arrays

TDK's Low ESL Decoupling Capacitors Underpin the Latest CPUs

As CPUs operate at faster speeds and use higher frequencies, decoupling capacitors, which are used in peripheral circuitry, require a smaller ESL (Equivalent Series Inductance) to accommodate higher clock frequencies. Leveraging proprietary multilayering technology and technology for designing internal electrodes, TDK is able to supply low-ESL decoupling capacitors for the latest CPUs.





Blu-ray Disc

Blu-ray Disc—Next-Generation, High-Capacity Optical Media

TDK is well known for its ferrite materials and magnetic recording media, especially audiotapes and videotapes. But TDK has also spent many years developing optical recording media.

Presently, TDK is selling writable CDs and DVDs that are backed by many distinctive technologies. And a Blu-ray Disc has already been commercialized. Blu-ray Discs are widely seen as the next generation of optical media.

Moreover, TDK has won plaudits for its “Super Hard Coat DVDs.” Boasting a rugged recording surface along with superior lubricity and anti-static characteristics, these discs set TDK apart from the competition. And TDK isn’t just focusing on reliability. TDK is also working hard to commercialize environmentally friendly recording products.

High-Speed, Large-Capacity Networks

High-Speed, Large-Capacity Networks—Bringing a Ubiquitous Information Society Closer to Reality

xDSL, CATV and other services are propelling the Internet into a broadband age. The world is shifting from communication centered on voice, most notably the telephone, to communication that involves the swapping of video content and other data in large volumes. Concurrently, we are seeing the start of digital TV broadcasting and highly sophisticated mobile communications with the roll-out of third-generation (3G) systems. And gradually we are seeing broadcasting and communications converge as high-speed, large-capacity networks become more widespread.

These trends spell opportunities for TDK, too. Most obvious is rising demand for electronic components for mobile phones. Other attractive areas include DC-DC converters used in communications equipment for transmitting and receiving data; recording media; EMC components and xDSL filters for combating noise that interferes with the sending/reception of information.

Tape-Based Data Storage Media for Computers—Essential to the High-Capacity Data Era

The mushrooming of networks in recent years has brought about an explosion in the volume of data being shared, prompting demand for larger-volume, higher-speed recording media. That’s why TDK has applied itself to the development of tape-based data storage media for computers. These products tap TDK’s expertise in thin-film coating and vapor deposition technologies refined in the development of audiotapes, videotapes and other products for the consumer media field. LTO (Linear Tape-Open) Ultrium 2^{*1} tapes, one of the latest products on the market, has a capacity of 200GB^{*2} and can transfer data at 40MB^{*3} per second, making it ideal for the data storage needs of the new era. It is also alive with TDK technology. This product showcases TDK’s state-of-the-art magnetic materials and thin-layer coating technology, including specially designed Super Finavinx metallic magnetic particles and magnetic layers where the thickness is controlled to the nanometer order. By employing a high-precision cartridge mechanism, this tape is highly durable and highly reliable for use in LTO Ultrium 2 systems.

*1: Linear Tape-Open, LTO, LTO logo, Ultrium and Ultrium logo are trademarks of HP, IBM and Seagate RSS in the U.S., other countries or both.

*2: Without compression

*3: Maximum without compression



LTO

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Innoveta Technologies, Inc. Acquired to Beef up Development of DC-DC Converters

TDK's recent acquisition of Innoveta Technologies, Inc., a U.S.-based manufacturer of power supplies, has bolstered TDK's ability to develop a full lineup of DC-DC converters for the communications market. Innoveta Technologies has won applause from the marketplace for developing DC-DC converters for wireless, communications, recording and data network applications. By combining Innoveta Technologies' converter design technologies with its materials and ferrite components technologies, TDK is applying itself to the development of new DC-DC converters for distributed power supply systems used in servers and for third-generation mobile phone communications infrastructure. The acquisition of Innoveta Technologies will also allow TDK to offer a broader range of AC-DC, insulated DC-DC and non-insulated DC-DC converters to meet customer needs.



Quarter-brick type
DC-DC converter

Car Electronics

Electronic Devices—On the Move

For some time now, electronics have been used in cars for engine and driving control. Recently, electronics have found wider application in automobiles to enhance safety and comfort. Growth has been rapid. What's more, electronics may play an even greater part in the prevention of global warming by enhancing fuel efficiency and helping to reduce the weight of cars.

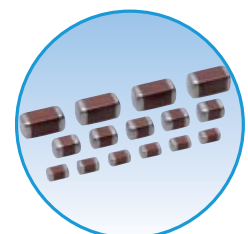
Hybrid Electric Vehicles (HEVs), Fuel Cell Electric Vehicles (FCEVs) and other developments are expected to spur even greater use of electronics in automobiles. Naturally, this will fuel growth in demand for automotive electronics.

Since people depend so heavily on cars, these electronics have to meet the strictest quality and reliability standards. TDK has proven that it can meet these exacting demands, having supplied components to carmakers and automotive electronic devices manufacturers for the best part of three decades.

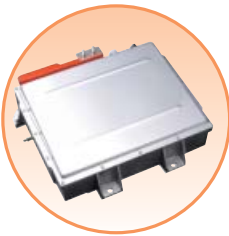
Automotive Electronics—In Greater Demand

Automobiles today are equipped with more than just engine control systems that regulate timing and fuel injection based on information from sensors. They also have electronic control units (ECUs) that regulate electronics for gauges, air conditioning and other systems. ECUs transmit and control information via automobile local area networks (LANs) such as CAN (Control Area Network)-BUS. The greater use of electronics in automobiles, however, creates "noise" in various forms, raising the need to prevent malfunctioning of on-board electronics. This is absolutely vital for cars that are unequivocally safe and reliable. In collaboration with manufacturers of ICs for automobile LANs, TDK stole a march on rivals by developing common-mode filters that are effective in suppressing noise.

Car electronics must naturally possess certain electrical characteristics. But they must also be highly reliable, heat resistant, shock-proof and non-corrosive. And, they must also be lighter and smaller to help reduce the weight of cars. There is also another trend—moving ECUs to the engine compartment to raise fuel efficiency by making the wire harness, the transmission line connecting the engine and ECU, shorter and lighter. Responding to this trend, TDK developed the X8R capacitor, which can withstand heat of up to 150 degrees Celsius. The use of motors in cars is also on the rise for everything from windows to mirrors, creating further demand for TDK's ferrite magnets and EMC components.



X8R capacitors



DC-DC converter for
HEV

Next-Generation Motor Vehicles

HEVs and FCEVs require specialized DC-DC converters to handle voltages of at least 200V. Beating out other companies, TDK was first to market with a DC-DC converter for HEVs. This converter showcases many of the technologies for which TDK is renowned—low-loss ferrite for greater efficiency, circuit technology to make smaller converters, and technology to optimize magnetic circuitry.

e-material solution provider—Leveraging Materials and Process Technologies

Materials and process technologies define TDK today. Ferrite has been one of TDK's defining technologies since the company was established in 1935. But TDK hasn't stopped there. It has developed dielectric, semiconductor, piezoelectric and other materials. All have been a driving force behind the development of smaller, lighter, thinner and higher performing electronic devices. TDK has also unlocked the potential of electronic materials with process technologies of the nanometer order, all developed with a fervent desire to satisfy customer needs.

Several trends promise to widen the applications for passive components, the company's main business line. As the use of ICs and other active components rises—fueled by digitalization, the need to operate at higher frequencies and higher electric currents, demand for larger storage capacity, and increasing use of car electronics—the need for passive components will almost certainly increase as a direct result. The consummate e-material solution provider, TDK is concentrating on the three key markets—growth fields—to deliver the best possible products that dovetail with emerging customer needs. This will be achieved by accurately identifying what customers want and refining core materials and process technologies—a TDK hallmark throughout the years.