

## Creation of Environmental Measures in Products

The FDK Group is committed to developing and offering of eco-friendly products by paying efforts to eliminate hazardous chemical substances and reduce energy and resource consumption from the entire lifecycle of a product from development to disposal.

### Offering Super-Green Products with the Top Environmental Elements

The FDK Group conducts a 'Product Environmental Assessment' to understand how a product is friendly to the environment. In the Third Environmental Action Plan, the conventional concept of 'eco-friendly products' and 'green products (eco-friendly reinforced product)' was further reinforced, and development and provision of 'super-green products with top environmental elements' were promoted.

#### Targets of the Third Environmental Action Plan

##### Provision of Super-Green Products by the end of FY 2006

"Super Green Products" are the advanced form of green products incorporating such properties as energy saving, 3R (Reduce, Reuse, Recycle)-based design, and elimination of hazardous chemical substances. They are forerunners having the "world's first", "world's smallest", "nation's first", "industry's first", "nation's smallest" and "industry's smallest" characteristics, which are intended to be released by the end of FY 2006.

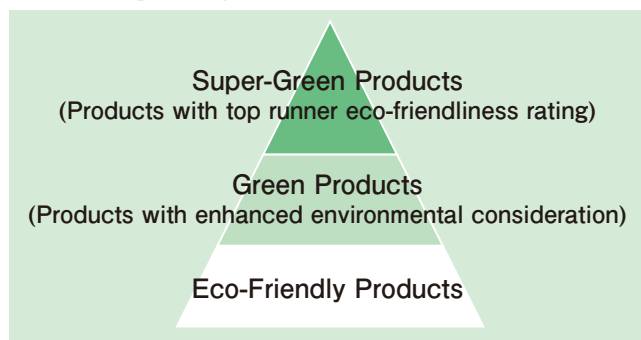
#### Super-Green Products

In FY2006, 8 themes were set to develop super-green products. As a result, RF multilayer chip inductors 'AMLO603E Series' were recognized as super-green products. Compared with other inductors, the Q-value is raised and hence, the electricity consumption under the high-frequency band is less by 20% to 30% than that of the conventional ones. The energy-saving performance is among the highest in the world. The RF multilayer chip inductors are the Group's second super-green products following to an ultra small multilayer power inductor 'MIPF 2520D Series' produced in FY2005.

#### Super-Green Products Available Now

FY2005	FY2006
	
<World's Smallest Product> Multilayer power inductor MIPF 2520D Series	<World's Highest Energy-Saving Product> RF multilayer chip inductor AMLO603E Series
※ Whether a product contains the top environmental elements or not, which is to say whether it is the world's smallest or the world's first product, is determined as of when the product is first released to the market.	

#### Positioning of Super-Green Products



#### Eco-Friendly Product Assessment Category (Large Category)

##### Products

- Hazardousness (including hazardous chemical substances)
- Resource-saving and recycle-oriented design
- Reusability as resources
- Easiness for decomposition
- Energy-saving
- Easiness for disposal by disassembly

##### Packaging Materials

- Resource-saving and recycle-oriented design
- Reusability
- Using materials

##### Others

- Disclosure of information
- Eco-friendliness

#### Future Actions

In the Fourth Environmental Action Plan, more super-green products will be released and development of eco-friendly products will be reinforced in order to raise the value of products manufactured by the FDK Group. A new indicator, i.e. Environmental Efficiency Factor, will be introduced to measure the environmental values of a product. More precisely, Environmental Efficiency Factor 2 products will be developed and released. Compared with the products in FY2005, an Environmental Efficiency 2 compliant product refers to a product that incorporates a half of environmental burdens compared to other products with the same product values (i.e. functionality and performances), or the one which product value is at least twice as large as those having the same degree of environmental burdens.

$$\text{Environmental Efficiency} = \frac{\text{Value of Products and Services}}{\text{Environmental Burdens incorporated in Products and Services}}$$

↑ Improved  
↓ Decreased

$$\text{Factor} = \frac{\text{Environmental efficiency of a target product}}{\text{Environmental efficiency of a product used as a standard}}$$

The ratio of environmental efficiency of a target product to that of a product used as a standard

#### Result of the Third Environmental Action Plan

■ Two super-green products were released.



# Production of Environmental Measures on Products

## Major Eco-Friendly Products Developed in FY2006

### RF Multilayer Chip Inductor AML0603E Series



#### Application

It is used as a part of, for example, a choke circuit for power line and an impedance matching circuit of signal lines for cellular phones and various high-frequency modules.

#### Features

While suppressing the surge of direct current resistance to a minimum possible level, the Q factor is raised to 22 to 23, which is the world highest. Compared to the conventional products, the Q factor under high-frequency band has risen by 20 to 30%. In order to respond to the requirement of diversified application of the product, 20 types of inductors are available with the inductance value ranged from 2 to 12 nH.

#### Eco-Friendliness

Because the Q factor reached to the world highest level, the electricity consumption was successfully reduced to 20 to 30% for use under the high-frequency band, compared to conventional products. No lead is used in the inductors and hence they are European RoHS compliant. Due to having the world highest energy-saving performance, the products are recognized as 'super-green products' by the Fujitsu Group.

#### Comment from the implementer

How to suppress direct current resistance while raising the Q factor under the high-frequency band environment was the key to develop this product. Raising the Q factor makes the energy loss smaller and can contribute to saving electricity consumption. It is expected that more high functional but smaller in size cellular phones will appear in the future, and the demand for energy saving will be heightened. I am determined to continue development of eco-friendly products that match to the diversified requirements of the society.

**Tatsuji Kawai**  
Product Development Dept.  
Ceramic Component Div.

### Multilayer Chip Balun for WiMAX AMB1608C Series



#### Application

It is used for matching impedance between a balanced circuit and an unbalanced circuit in a RF circuit used for WiMAX, the next generation high speed wireless data communication system which is built into a cellular phone, a PDA and a car navigation system.

#### Features

This is a chip balun of the world smallest and world thinnest. With the development of low temperature firing materials and optimization of a multilayer pattern, the balun realized low insertion loss of 0.6 dB, one of the lowest in this class, under the 2.5 GHz and 3.6GHz bands.

#### Eco-Friendliness

The world smallest and world thinnest baluns can contribute to minimizing consumption of resources in manufacturing them. The low insertion loss, among the highest in this class also contributes to electricity saving. The product is European RoHS compliant.

#### Comment from the implementer

We were successful in shortening the development period and realization of small-in-size and low insertion loss in the products. For the former, our conventional technologies in fine ceramics materials and multilayer printing process greatly contributed to it. WiMAX is a large capacity high-speed wireless communication system that is capable of reaching to a remote place and high-speed mobile communication. I am expecting that the market for this product will expand in the future.

**Tatsuhiko Nawa**  
Product Development Dept.  
Ceramic Component Div.

### Stepper Motor LAH6-20 Series



#### Application

It is mainly used as a part of driving an autofocus lens and a zoom lens of a digital camera and a lens used for correcting aberrations of a Blu-ray disc.

#### Features

Utilizing our unique technologies of accurate shape design of yokes (thin sheet plate formed by drawing), designing coils and magnetic circuits, the stepper motor realized higher output by approx. 20% compared to a conventional motor of the same size. This stepper motor will pave the way for small-in-size, light-in-weight and electricity-saving performance of devices that the stepper motor is incorporated.

#### Eco-Friendliness

Electricity saving of approx. 20% is realized in this product compared to conventional ones (measured under the testing condition of the FDK Group, i.e. voltage between the two terminals as 2.9V and coil resistance as 20Ω under the two-phase excitation of 1,500pps). Solder used for the coil terminal to connect ultra-thin magnet wires is lead-free, and hence, the product is European RoHS compliant.

#### Comment from the implementer

While remaining the size and the appearance of this stepper motor the same as that of conventional products, this product realizes higher output performance due to the merger and arrangement of our technologies cultivated so far. Raising output level can reduce electricity consumption. Due to the product's high output level, it can contribute to decrease the volume of CO<sub>2</sub> emission causing of global warming. It is expected that use of chemical substances will be severely controlled and restricted. We are determined ourselves to develop eco-friendly and highly efficient small motors.

**Small Size Motor Team**  
SM Engineering Dept.  
FDK Mechatronics Co., Ltd.

### Stepper Motor SM3.7-20 Series



#### Application

Mainly used as a part to correct aberrations of a Blu-ray disc and to drive lenses for autofocusing and zooming.

#### Features

This is the world smallest stepper motor, with the size the same as that of a grain of rice. Though the diameter is as small as 3.7 mm, it is capable of making a fine positioning, i.e. 20 steps in one rotation. Decrease of the output torque due to the small-in-size is effectively controlled using a special strong magnet developed using new materials.

#### Eco-Friendliness

Compared to an ultra-small stepper motor developed in June 2005, the mass and the volume of this product is lesser by approx. 30% and approx. 25% respectively. The lighter-in-weight and smaller-in-size motor contributes to reduce resource consumption and is European RoHS compliant.

#### Comment from the implementer

With the ongoing process of small-in-size and high-functional portable devices, a motor used to drive a camera lens also needs to be more small in size, more accurate, stronger in torque and highly energy saving. This year, we were successful in developing a small-in-size motor meeting these requirements using a special strong magnet and optimized magnetic circuits and other methods unique to us. In order to save the limited global resources, we will address development of more small and more light motors.

Small Size Motor Team  
SM Engineering Dept.  
FDK Mechatronics Co., Ltd.

### Isolated DC-DC Converters SENSEI Series



#### Application

This is used for supplying power to various electronic components such as servers.

#### Features

The SENSEI Series converters provide a 9.6V output (non-regulated) or 12V output (regulated) from an input voltage of 48V. Non-regulated type operates with an efficiency of up to 97%, with a power density of 300W/in<sup>3</sup>. It is realized higher thermal performance up to 85°C without heatsink. Using this product in combination with the SENPAI Series of non-isolated DC-DC converters results in exceptional electrical and thermal performance for Intermediate Bus Architecture and Distributed Power Architecture applications.

#### Eco-Friendliness

Power consumption is successfully reduced by achieving high efficiency. This product doesn't require a heatsink, further saving resources. It uses a halogen free PCB that doesn't emit any dioxins. It is in full compliance with RoHS directives that went into effect in Europe in July 2006.

#### Comment from the implementer

This is the first isolated DC-DC converter in the SENSEI Series. It is suitable for IBA and DPA applications that require high efficiency and high reliability in elevated temperature environments. The challenge in the development of this product was how to realize high efficiency and high performance within a limited space. We will continue to develop highly efficient products in order to contribute to energy saving.

Takafumi Hirai  
MS-FIRE Project  
Electronics Business Dept.

### Elements for Ultrasonic Motors



#### Application

It is used as a lens actuator of autofocusing system used in a camera.

Photo ( Larger one):  
conventional element  
Photo ( Smaller one):  
newly developed element

#### Features

Compared to an ordinary electrically driven motor, an ultrasonic motor works faster and smoother, has higher torque and emits lesser noises. This product is used as an element for driving an ultrasonic motor and realizes significantly smaller in size and higher torque in high and low speed ranges.

#### Eco-Friendliness

This product is significantly smaller by one-twentieth in volume than other conventional products. While saving resource consumption, energy saving in production is achieved. Its packaging materials are free from PVCs.

#### Comment from the implementer

As a digital camera is being widely used, a smooth and high speed autofocusing function conventionally used for high-end cameras is now gradually spread to low-end models. Under such a circumstance, the market requires more small-in-size and high torque products. We were successful in developing a manufacturing method suitable for making thinner products and as a result, a significantly small-in-size and high torque product has been successfully launched.

Tadashi Takeuchi and Masahiko Akagishi  
Product Development Dept.  
Ceramic Component Div.



## Production of Environmental Measures on Products

### Approaches to Totally Eliminate Hazardous Substances in Products

The FDK Group has been working for establishing a management system that ensures eliminating use of hazardous substances in its products, in order to comply with the EU RoHS Directive. In October 2004, the 'Committee for Products Containing Hazardous Chemical Substances' was set up and is in operation in order to totally eliminate using hazardous chemical substances included in the products.

#### Targets of the Third Environmental Action Plan

To eliminate the use of hazardous substances designated by Fujitsu Group in manufacturing products by the end of FY 2005, except for those designated by RoHS whose elimination target is the end of December 2004

■ Use of hazardous substances listed in 31 categories of Fujitsu Group's list will be totally eliminated by the end of FY 2005.

■ For products shipped to Europe and covered under the RoHS Directive, use of lead, cadmium, mercury, hexavalent chromium compounds, PBB and PBDE will be totally eliminated by the end of December 2004.

#### Elimination of Hazardous Chemical Substances and Confirmation Activities

In FY2005, all hazardous substances designated by Fujitsu Group were completely eliminated from the products manufactured by FDK. As to the chemical substances whose elimination was required by the RoHS Directives for all products shipped to customers, or which are to be shipped to Europe were successfully eliminated as per the request of our customers. For other prohibited chemical substances for which alternative items were not available and for which our customers requested us to continue searching, we followed customer specifications in dealing with the issue.

The progress of complying with the RoHS Directive has been uploaded to the FDK website and made accessible to our customers as well as our employees, since FY2005. The website lists RoHS compliant products as well as those items not to be complied with the Directive. Critical substances relating to the RoHS are examined in-house using an 'X-ray fluorescent spectrometer' and ICP analysis.

#### Establishment of a System to Control Hazardous Chemical Substances

With the idea that any product containing hazardous substances is a defect, the FDK Group has been operating a hazardous chemical substances control system, set up at all of its production sites, as a part of its quality assurance system (ISO9001 compliant) since FY2005.

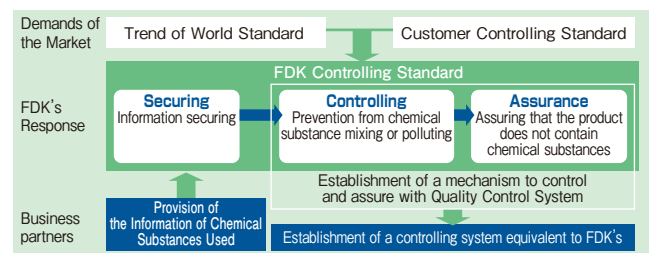
In FY2006, an audit on the hazardous chemical substances control system was made by members of the 'Committee for Products Containing Hazardous Chemical Substances.' The audit's purpose was to confirm a system of avoiding inclusion of hazardous chemical substances in products, as well as how that system was maintained, as objectively as possible, in order to extract and remedy problems found, if any.

After extracting problems and measures taken, in December 2006, a system capable of controlling hazardous chemical substances as targeted was established at all of FDK's production sites. An 'X-ray fluorescent spectrometer' was newly introduced to 2 overseas sites in FY2006. Now 6 major sites in total, in and out of Japan, use a spectrometer. Due to the introduction of the unit, acceptance tests and process controls can now be smoothly operated at each site.

#### Hazardous Substances Designated by the Fujitsu Group

Banned Substances: Substances prohibited for use in products (27)	
<ul style="list-style-type: none"> <li>• Polychlorinated biphenyls (PCBs)</li> <li>• Polychlorinated naphthalenes (with 3 or more chlorine atoms)</li> <li>• Asbestoses</li> <li>• CFCs</li> <li>• Specified halons</li> <li>• Carbon tetrachloride</li> <li>• 1,1,1-Trichloroethane</li> <li>• Bromochloromethane</li> <li>• Methyl bromide</li> <li>• HBFsCs</li> <li>• Polybrominated biphenyls (PBBs)</li> <li>• Polybrominated diphenyl ethers (PBDEs)</li> <li>• Short-chained chlorinated paraffins (carbon chain length 10-13)</li> <li>• Bis (tri-n-butyltin) oxide (TBTO)</li> <li>• Tributyl tins (TBTs), Triphenyl tins (TPTs)</li> </ul>	<ul style="list-style-type: none"> <li>• Specified amines (Those which contact to skin directly and for a long time only)</li> <li>• Azo dyes and azo pigments that generate specified amines (Those which contact to skin directly and for a long time only)</li> <li>• Chlorodanes</li> <li>• DDT</li> <li>• Aldrin</li> <li>• Endrin</li> <li>• Dieldrin</li> <li>• Hexachlorobenzene</li> <li>• N,N'-ditolyl-p-phenylenediamine, N-tolyl-N'-xylyl-p-phenylenediamine and N,N'-dixylyl-p-phenylenediamine</li> <li>• 2,4,6-tri-tert-butylphenol</li> <li>• Toxaphene</li> <li>• Mirex</li> </ul>
<b>Ozone depleting substances</b>	
Substances to be totally abolished: Substances banned for use in products (4)	
<ul style="list-style-type: none"> <li>• Cadmium and its compounds</li> <li>• Hexavalent chromium compounds</li> </ul>	<ul style="list-style-type: none"> <li>• Lead and its compounds</li> <li>• Mercury and its compounds</li> </ul>

#### Control Process for Banned Substances



#### Future Actions

We will continue improvement of our efforts in eliminating hazardous chemical substances from our products along with the ISO9001 Quality Management System based on the FDK Group's hazardous chemical substances control system established so far.

#### Results of the Third Environmental Action Plan

■ All products were successfully free of hazardous chemical substances as required by our customers. For other products that our customers required us for continued examination for searching for alternative substances, actions have been taken in accordance to the customer specifications.