Technology Focus

High-Performance Magnets Play Key Role in Compact Motors

The Kyoto Protocol to the United Nations Framework Convention on Climate Change was adopted by COP3 in December 1997 and came into effect Feb. 16, 2005. In Japan, the discharge amount of greenhouse gasses from 2008 to 2012 must be reduced by 6 percent as compared with that in 1990. For greenhouse gas emissions in Japan, about 90 percent of the discharge amount are carbon dioxide originating from energy. Thus, it is an important theme to reduce the consumption amount of energy.

In the amended Energy Saving Law in 1998, a top runner system was introduced for the energy saving standard of home appliances and electronic office equipment and the fuel consumption standard of automobiles, and equipment with high energy consumption efficiency had to be developed. Special attention is given to motors. In home appliances, high efficiency is obtained by controlling the motor, in which a magnet is employed, using an inverter. In automobiles, energy consumption efficiency was improved by electronic control for which motor was incorporated, 30 to 100 compact and lightweight DC motors. In hybrid cars, a driving motor or generator was installed. Some of the high-performance magnets that are part of these efficient, compact, and lightweight motors and their application samples will be discussed in the following paragraphs.

Ferrite Magnet

A ferrite magnet is the oxide produced by molding and sintering powder materials that have an iron oxide as the chief ingredient. The ferrite magnet is widely used all over the world because it is excellent in cost performance, and chemical and magnetic stability. The ferrite magnet that is presently mass-produced is hexagonal ferrite that has an M-type crystal structure. Residual magnetic flux density (Br) is determined by the saturation magnetization (Js) from a crystal structure and the orientation or density of a magnet. Intrinsic coercive force (Hcj) is determined by the anisotropic magnetic field (HA) and ratio of single magnetic domain particles (Fig.1).

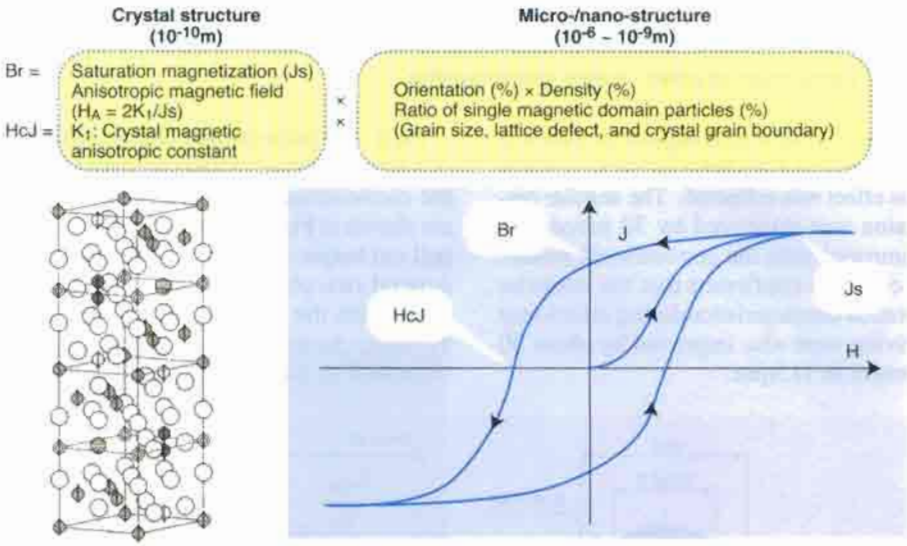


Fig. 1: Magnetic characteristics factor of ferrite magnet

TDK Corp. discovered the following items by containing a small quantity of lanthanum (La) and cobalt (Co) in strontium ferrite: First, improvement of 2 percent in saturation magnetization (Js) and improvement of 15 percent in crystal magnetic anisotropic constant (K_1) can be realized at the same time, and second, the temperature characteristics of intrinsic coercive force (Hcj) can also be improved remarkably. Production and sales began as La - Co ferrite magnet FB9 series in 1999.

For the magnetic characteristics shown in a map, FB9 series was improved in magnetic characteristics by three grades as compared with FB6 series. The temperature coefficient of intrinsic coercive force (Hcj) was also improved by about 40 percent. As a result, the material was especially strengthened for "low-temperature demagnetization" that is one of the weak points in a ferrite magnet (Fig. 2).

In the simulation for miniaturization of a car motor, it was calculated that the motor in which FB9H materials were used can be reduced in magnet volume by 25 percent and reduced in motor volume by 14 percent as compared with the motor in which the conventional FB6H materials were

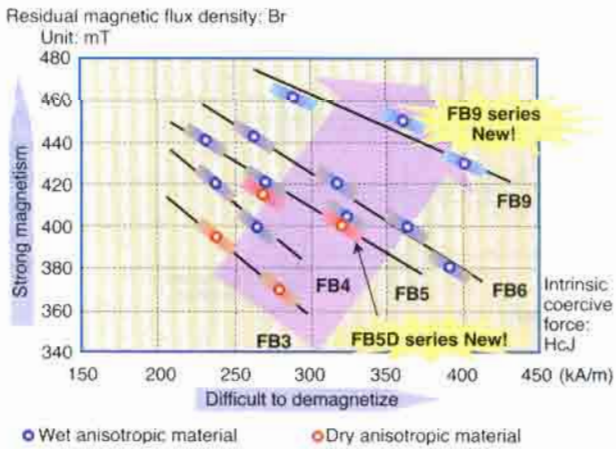


Fig. 2: Magnetic characteristic distribution drawing of TDK ferrite magnet

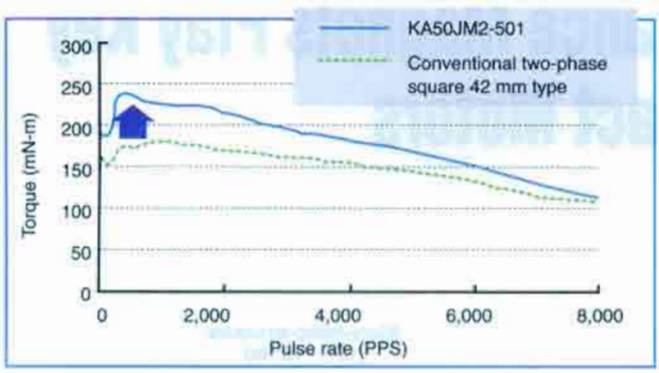


Fig. 5: Comparison of pulse - torque characteristics

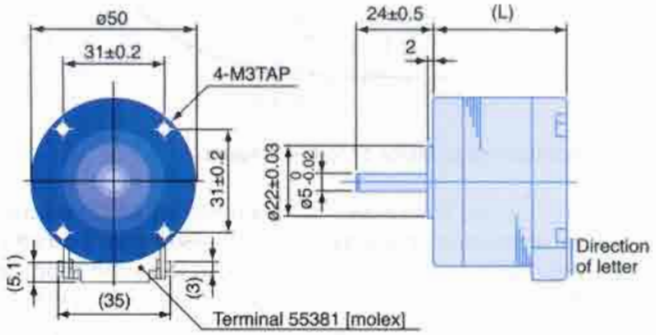
The comparison of angular precision is shown in Fig.4 as characteristics on which this effect was reflected. The angular precision was improved by 30 percent as compared with the conventional model. It could be confirmed that the irregular rotation characteristics during micro-step driving were also improved by about 30 percent in 115rpm.

Next, the pulse-torque characteristics of a representative model compared with the conventional model of Japan Servo are shown in Fig.5. The figure shows the pull-out torque characteristics during most general two-phase excitation. As compared with the conventional model, the dynamic characteristics of KA series are improved in torque by 30 percent for a low-speed area and improved in torque by 15 percent for a practical high-speed area of 4,000pps (1,200 rpm).

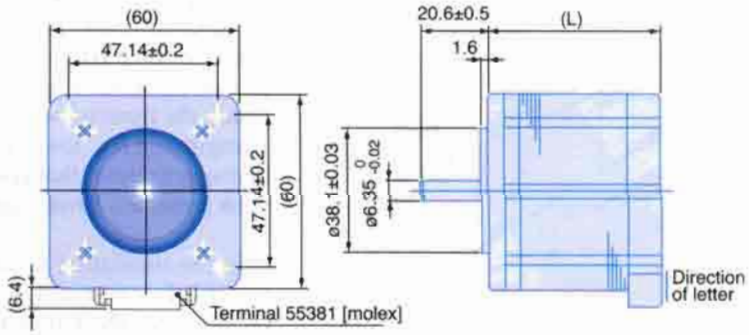
To satisfy the needs to a high-performance hybrid stepping motor, the KA series consists of products wherein the latest analytic tool was applied and for which the optimized magnetic circuit was pursued. The KA series corresponds to the advanced driving technology. It is expected to significantly contribute to the improvement in the performance of a device for which this motor was used.

The outside dimensions of a standard model from the KA series are shown in Fig.6. For KA50, compatibility is provided by making the installation engagement diameter and screw pitch the same as the conventional square 42mm series. For KA60, it is provided by making the installation engagement diameter and screw pitch the same as the conventional square 56mm series. As standard products, three kinds of motor thickness are set each in the KA50 and KA60, and four kinds of winding specifications are set in each thickness. The motor with the custom specifications specialized for characteristics required for each market is also provided in addition to a standard format.

In the future, Japan Servo will promote further the KA series in the office automation and its peripheral equipment market with the industrial machine in the center. The company will also promote the developed model tapping new markets with the KA series as basis.



Model	L
KA50HM2	34mm
KA50JM2	40mm
KA50KM2	54mm



Model	L
KA60JM2	44mm
KA60KM2	54mm
KA60LM2	65mm

Fig. 6: Outside dimensions

About This Article:

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