Technology that Evolves in Line with Market Changes

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1. Introduction

In recent years, new products for global markets such as ICT devices, mobile terminals, home electric appliances, and automobiles, have featured many convenient new functions and the performance of products has improved dramatically compared to several years ago.

Products such as these with new functions and high performance are emerging on the market one after the other because they meet customers' expectations and offer new values.

Customers' expectations and desires, in other words, their "needs", are extremely diverse.

Even the needs of the same customer will change as time goes by and their environment changes.

It is natural for needs to change, and SANYO DENKI has repeated the cycle of new technology development, improvement, and innovation in order to satisfy such needs. In this way, we have achieved technology and production innovation and grown as a company.

From the time SANYO DENKI was established until present day, the Cooling Systems Division has engaged in product development with a focus on "products that achieve customer satisfaction".

We aim to swiftly provide our customers with products which

- have better cooling performance;
- are quieter;
- last longer; and
- are resistant to water and oil.

The AC fans, long life fans, splash-proof/oil-proof fans and CPU coolers we have produced to date are perfect examples of products that meet changing market needs. They have been well-received by many customers as the optimal solution.

However, the needs of the market have begun to change at a faster pace, therefore making it necessary to engage in product development in a timelier fashion than ever before.

This report introduces the technologies tirelessly developed by SANYO DENKI despite such market conditions in order to meet the changing needs of the market.

2. Technologies Created by Market Change

2.1 Changes in motor-related technologies

The motor-related technologies adopted in fans is changing in accordance with changing market needs.

When SANYO DENKI began developing DC fans, we initially adopted 2-phase motors.

These were advantageous from the perspective of design and production due to their simple circuit structure and minimal number of components.

Afterwards, demand for fans to have high cooling performance and low power consumption emerged; therefore, the adoption of single-phase motors became standard practice.

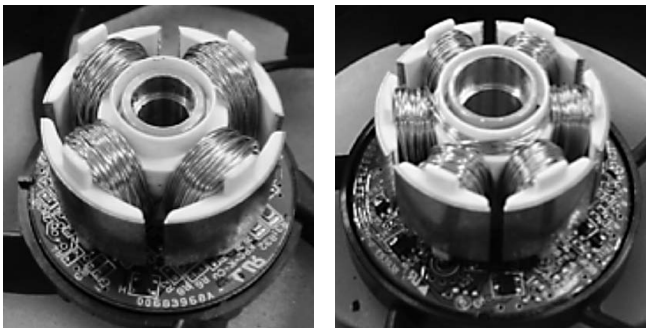
Single-phase motors have twice the amount of excitation windings for rotor rotation than the 2-phase motor; therefore, motor efficiency is higher and it is easier to achieve high-speed and low power consumption.

Recently, as a measure to prevent high-density data processing equipment from overheating fans are expected to have higher cooling performance and in order to realize this, fans must become even faster.

However, increasing fan speed has caused latent issues to surface, such as issues caused by fan vibration, malfunctions caused by sensor noise, and insufficient capacity of the power source for fan drive.

In order to clear these issues, SANYO DENKI developed a 3-phase motor and has achieved the following results.

Figure 1 shows a single-phase motor and a 3-phase motor.



Single-phase motor　　3-phase motor

Fig. 1: Motor appearance

2.1.1 Reduction of vibration acceleration

Figure 2 shows the vibration acceleration characteristics of the single-phase motor and the 3-phase motor, respectively.

Vibration caused by motor switching has been reduced by increasing the number of motor slots and increasing the switching count per revolution.

This has helped to reduce equipment noise and minimize HDD reading errors.

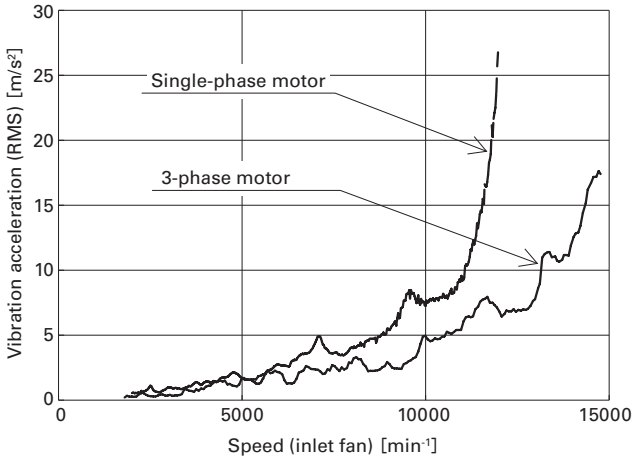


Fig. 2: Speed vs. vibration acceleration characteristics

2.1.2 Reduction of sensor noise

Figure 3 shows the pulse sensor waveforms of the single-phase and 3-phase motor respectively, while Figure 4 shows a steady-state current waveform and starting current waveform.

The noise observed on the pulse sensor waveforms is caused by motor switching.

This noise is more likely to occur when there is a high current flow and the current ripples are large, as is the case with the current waveform of the single-phase motor.

For our 3-phase motor, we were able to significantly improve the ripples of the steady-state current waveform, thus significantly reducing the noise generated on the sensor.

This has made it possible to minimize abnormal fan speed detection when 3-phase motors are installed in a device.

Moreover, because 3-phase motors enable lower peak value and RMS of steady-state current, and lower peak value of starting current, it is possible to reduce the necessary power capacity to run the fan and thus help reduce equipment footprints and costs.

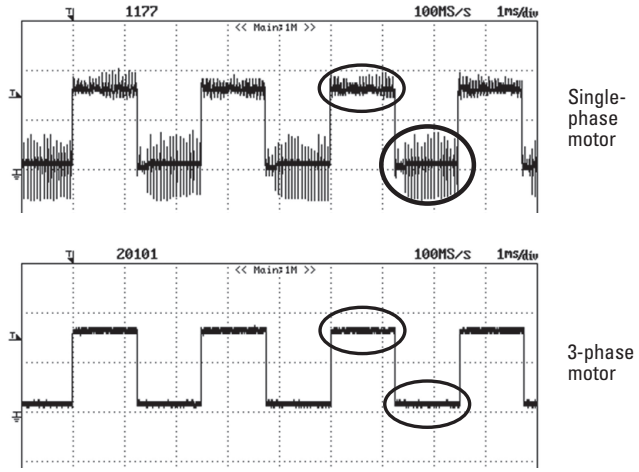


Fig. 3: Pulse sensor waveform

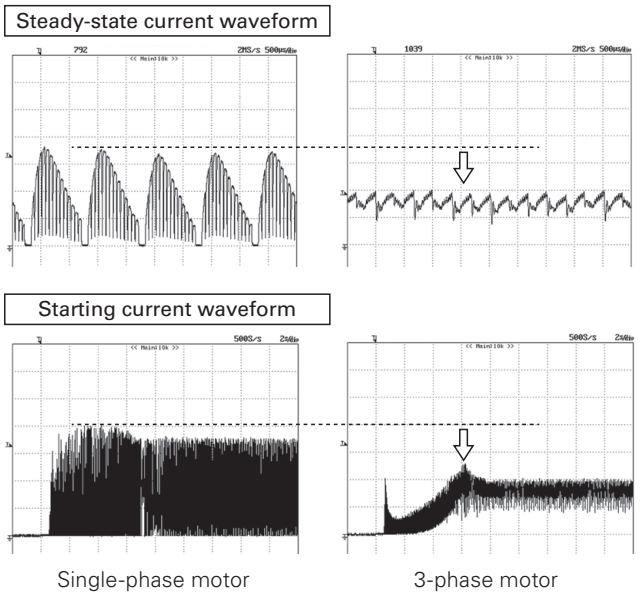


Fig. 4: Steady-state/starting current waveforms

2.2 Changes in ventilation technology

In recent years, fans have started being used for purposes other than cooling, such as for ventilation in households, beverage vending machines, food showcases, and printers.

In the case of household ventilation, for example, there is a need to alternate between taking in outside air and discharging indoor air in order to adjust room temperature.

Conventionally it was necessary to install two separate fans (one for intake and one for exhaust), however in order to reduce equipment costs and footprints, there is an increasing demand for fans capable of airflow in both directions.

The following section provides an overview of the technologies adopted in the fan developed by SANYO DENKI to solve this demand for bidirectional flow – the ø136 mm x 28 mm Reversible Flow Fan.

2.2.1 Motor and circuit

Figure 5 provides the PWM duty vs. speed characteristics of the ø136 mm x 28 mm Reversible Flow Fan.

In regards to the motor and circuit portion, based on single-phase motors which normally only rotate unidirectionally, we used multiple hall sensors and added special control with a microcontroller to newly design a drive circuit able to achieve bidirectional rotation.

We have realized a control method able to switch between forward rotation and reverse rotation by using an external PWM duty signal.

Moreover, we have adopted a control method able to switch between rotational directions even if a PWM duty signal is not used by connecting the control lead wires openly or to ground (-).

2.2.2 Impeller and frame shape

Figure 6 shows the airflow vs. static pressure characteristics of the ø136 mm x 28 mm Reversible Flow Fan while Figure 7 shows a comparison of impeller shape with the conventional fan.

Since the fan rotates in both directions, in order to achieve almost same airflow and static pressure in both directions, we have adopted a special impeller shape whereby the blade cross-section is bisymmetrical and the angle and number (of blades) have been optimized.

Moreover, when the fan rotates in reverse, the frame spokes cause interference, reducing airflow efficiency. Therefore, by optimizing spoke shape and using an innovative frame internal shape, we were able to achieve virtually equal airflow vs. static pressure characteristics for both directions.

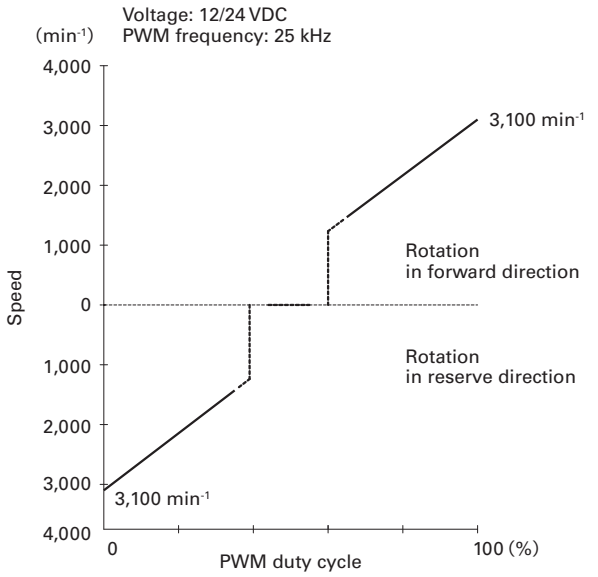


Fig. 5: PWM duty vs. speed characteristics

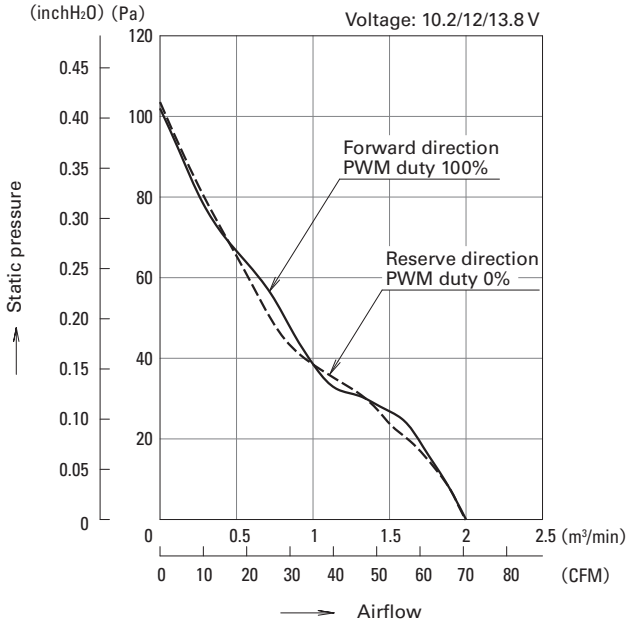


Fig. 6: Airflow vs. static pressure characteristics

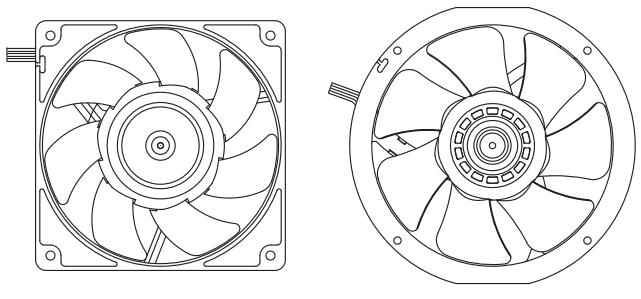


Fig. 7: Impeller shape

3. Conclusion

These technologies developed by SANYO DENKI in response to changing market needs are utilized in products as the optimal solutions to issues faced by our customers, and in turn, these products are enjoying immense popularity.

Because we foresee the needs of the market will begin to change at an even faster pace, we believe it is necessary to provide products in a timelier fashion than ever before.

In order to achieve product development that satisfies rapidly changing needs, we wish to ascertain our customers' needs and issues early on, improve our technological capability, such as core and design technology, and build a framework enabling us to provide "new value" in the form of products, etc., in a timely manner.

Reference

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