Low-Vibration Fan “San Ace 40”

Toshiyuki Nakamura　Toshiki Ogawara　Katsumichi Ishihara　Toshiki Kobayashi

1. Introduction

With telecommunication equipments such as servers, the trend to create smaller and higher performance devices means that the amount of heat produced has increased rapidly and higher performance cooling fans are required. The rotating speed for the fans becomes faster every year, this has resulted in an increasing number of cases where the vibrations become a problem. More specifically, this causes an increase in reading errors and similar problems on the hard disk built into the device. The manufacturers must take many steps to solve these problems, such as creating stronger devices, insulating against vibrations by using vibration-proof materials, or by controlling the speed of the cooling fan.

Against this background, our company has developed a product that reduces the load for the vibration proofing used on a device while achieving the same cooling performance as the conventional model.

Two types of low-vibration fans were developed: a 40 mm sq., 28 mm thick fan and a 40 mm sq., 56 mm thick counter rotating fan are suitable for mounting on a 1U server.

This document introduces the features and performance of the “San Ace 40” low-vibration fan (both the 40 mm sq., 28 mm thick GE type and the 40 mm sq., 56 mm thick CRE type).

2. Background to Development

In conventional products, the method for reducing vibrations on the fan has involved making the amount of unbalance on the rotating blades as small as possible. However, customers have begun demanding even lower vibrations, and it became apparent that the conventional method could not meet the low-vibration abilities demanded by the customers.

In order to vastly reduce vibrations while keeping large air flow and high static pressure characteristics, this fan was developed by using a variety of low-vibration methods such as reducing the unbalance even further, improving the motor driving circuit, and increasing the stiffness of the frame.

During the development, the conventional method of reducing the unbalance was still employed, but by increasing the precision used for machining and assembling the parts, the unbalance was able to be reduced even further.

By using a soft-switching drive for the circuit used within the fan motor, the motor vibrations could be reduced.

Furthermore, a variety of materials were selected to increase the frame stiffness, and each material was tested in order to compare the ability of the materials to lower the vibrations. As a result, aluminum was selected for overall excellence, including an improvement in productivity. In the conventional product, it was difficult to produce an aluminum frame for a 40 ㎜ sq. fan due to the small size, but during the development of this fan, changes to the shape of the frame and other such adjustments were made in order to make the frames easier to mass produce.

This newly developed product draws on these methods to reduce vibrations in order to reduce the exciting force that causes vibrations and prevent those vibrations from being transmitted externally. These successful improvements achieve a vast reduction in vibrations.

3. Features of the “San Ace 40” Low-Vibration Fan

Fig. 1 shows a photograph of the “San Ace 40” low-vibration fan (hereinafter referred to as “the developed product”).

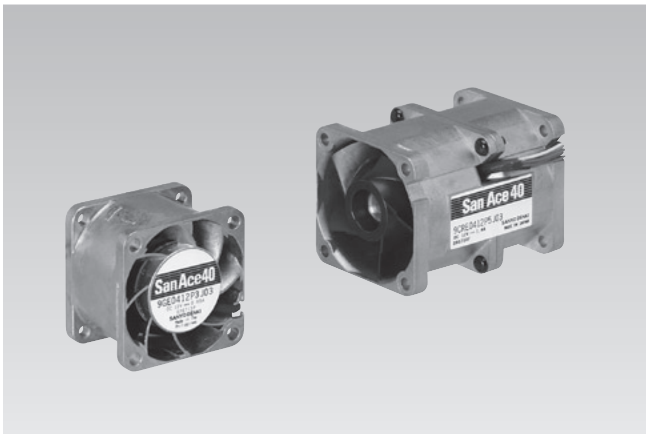

Fig. 1: Low-vibration fan “San Ace 40”
40 mm sq., 28 mm thick fan (left)
and 40 mm sq., 56 mm thick counter rotating fan (right)

The features of the developed product are as follows:

(1) Low-vibrations

(2) Large air flow and high static pressure

(3) PWM control function

The developed products (40 mm sq., 28 mm thick fan and 40 mm sq., 56 mm thick counter rotating fan) achieve 50% less vibration compared to conventional products (9GV0412J301, 9CRA0412J501) of the same size while achieving top class cooling performances. Also, the PWM control function supports speed control.

4. Product Overview

4.1 Dimensions

Fig. 2-1. shows the dimensions of the 40 mm sq., 28 mm thick GE type, while Fig. 2-2. shows the dimensions of the 40 mm sq., 56 mm thick CRE type.

4.2 Characteristics

4.2.1 General characteristics

Both the 40 mm sq., 28 mm thick GE type and the 40 mm sq., 56 mm thick CRE type have a rated voltage of DC 12 V and a rated rotating speed of J speed, and both products also come with PWM control function.

Tables 1-1 and 1-2 show the general characteristics for the developed product. The characteristics tables show values when PWM control is using maximum speed (DUTY: 100%) and the minimum speed (DUTY: 0%).

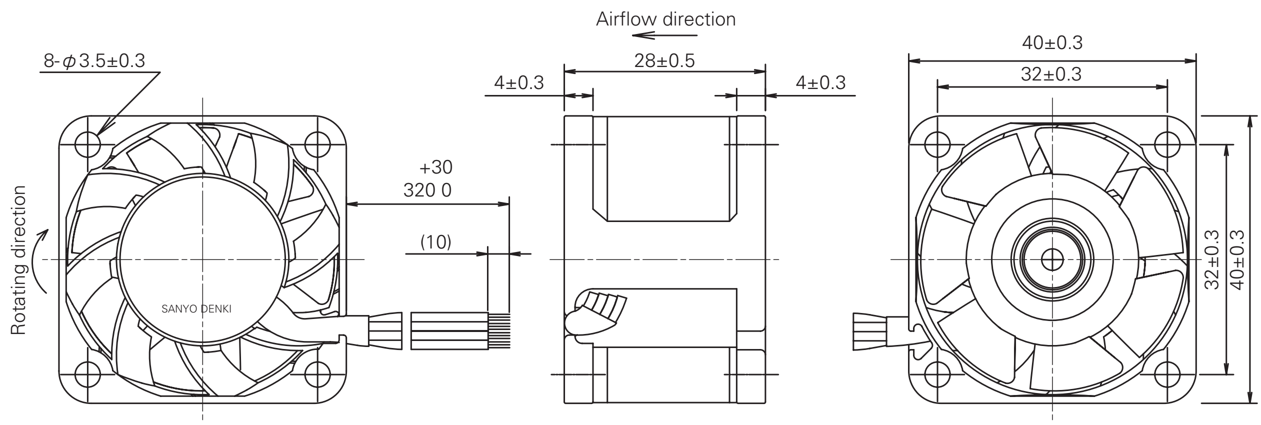

Fig. 2-1: 40 mm sq., 28 mm thick GE type dimensions (Units: mm)

Table 1-1: 40 mm sq., 28 mm thick GE type general characteristics

Model No.	Rated voltage [V]	Operating voltage range [V]	PWM duty cycle*1 [%]	Rated current [A]	Rated input [W]	Rated speed [min^{-1}]	Max. air flow [m^3/min]	[CFM]	Max. static pressure [Pa]	[inchH_2O]	Sound pressure level [dB(A)]
9GE0412P3J03	12	10.8～13.2	100	0.65	7.8	15,000	0.69	24.4	343	1.378	56
			0	0.05	0.6	2,650	0.12	4.2	10.7	0.042	14

*1 Input PWM frequency: 25 kHz

Table 1-2: 40 mm sq., 56 mm thick CRE type general characteristics

Model No.	Rated voltage [V]	Operating voltage range [V]	PWM duty cycle*1 [%]	Rated current [A]	Rated input [W]	Rated speed [min^{-1}]	Max. air flow [m^3/min]	[CFM]	Max. static pressure [Pa]	[inchH_2O]	Sound pressure level [dB(A)]
9CRE0412P5J03	12	10.8～13.2	100	1.4	16.8	15,800 / 12,200	0.9	31.8	570	2.29	62
			0	0.1	1.2	2,850 / 2,250	0.12	4.2	13.7	0.055	20.5

*1 Input PWM frequency: 25 kHz

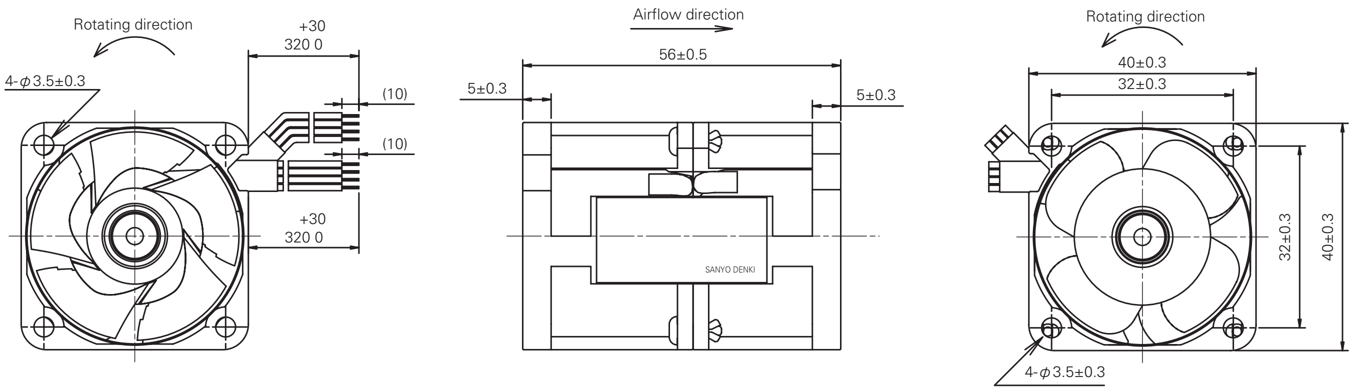

Fig. 2-2: 40 mm sq., 56 mm thick CRE type dimensions (Units: mm)

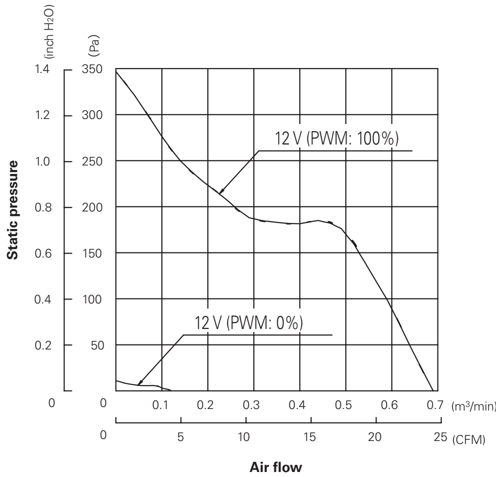

Fig. 3-1. Example of air flow vs. static pressure characteristic (40 mm sq., 28 mm thick GE type)

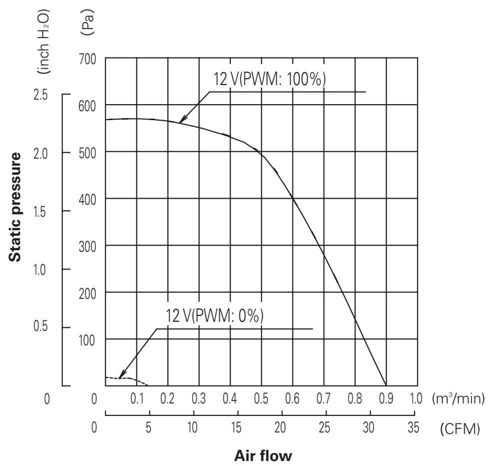

Fig. 3-2. Example of air flow vs. static pressure characteristic (40 mm sq., 56 mm thick CRE type)

4.2.2 Air flow vs. static pressure characteristics

Figs. 3-1 and 3-2 show the air flow versus static pressure characteristics for the developed product.

4.3 Life expectancy

The developed product has an expected life of 40,000 hours at 60° C (survival rate of 90% with continuous operation at the rated voltage under free air conditions and at normal humidity).

5. Functional Comparison with Conventional Models

The developed products achieve drastic reduction in the vibrations while retaining large air flow and high static pressure by reducing the unbalance in the blades, improving the motor driving circuit, and increasing the stiffness of the frame.

The following information introduces the differences between the conventional 40 mm sq., 28 mm thick fan (9GV0412J301) and 40 mm sq., 56 mm thick counter rotating fan (9CRA0412J501).

5.1 Low vibration

Fig. 4-1 shows examples of the rotating speed versus vibration characteristic for the 40 mm sq., 28 mm thick fan, while Fig. 4-2 shows examples of the rotating speed versus vibration characteristic for the 40 mm sq., 56 mm thick counter rotating fan (each compares the developed product to the conventional product).

Comparing the vibration acceleration for the developed product and the conventional product, when operating at the rated rotating speed, the vibration acceleration is 50% lower for the developed product compared to the conventional product. Also, the variation of the maximum and minimum values is about half compared to the conventional product.

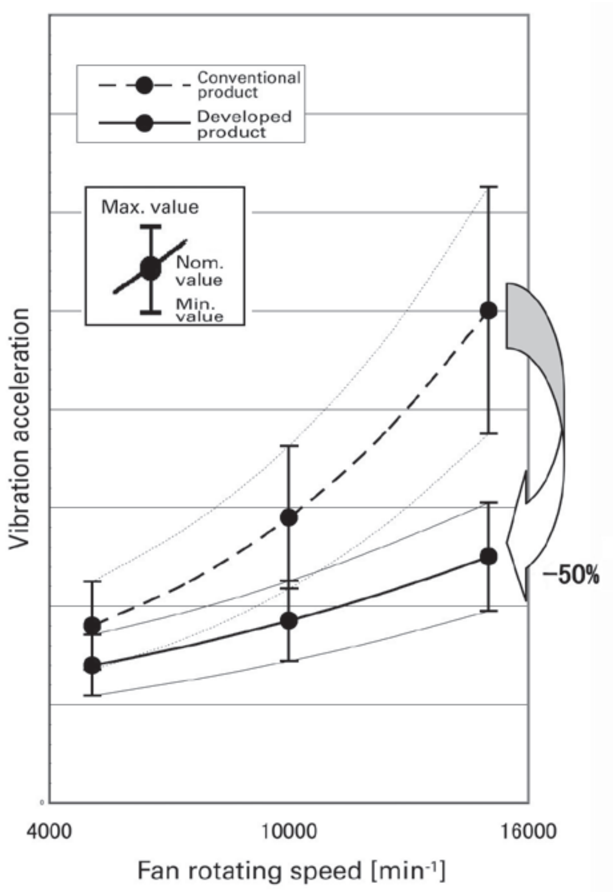

Fig. 4-1: Example of rotating speed vs. vibration characteristic (40 mm sq., 28 mm thick fan)

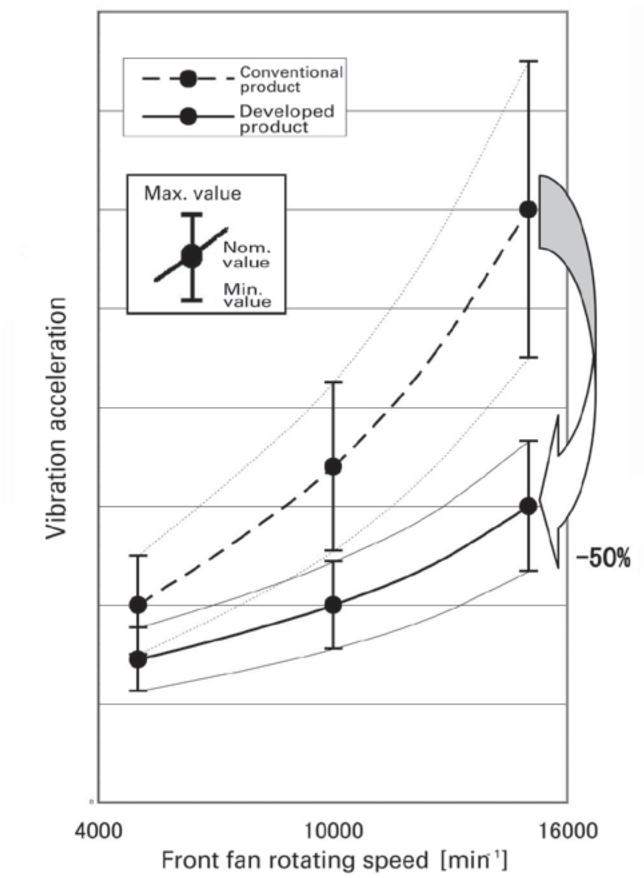

Fig. 4-2: Example of rotating speed vs. vibration characteristic (40 mm sq., 56 mm thick counter rotating fan)

6. Conclusion

This document introduced some of the features and abilities of the newly developed "San Ace 40" low-vibration fan.

This developed product has drastically reduced vibrations compared to the conventional products (9GV0412J301, 9CRA0412J501) while maintaining large air flow and high static pressure. By providing large air flow and high static pressure as well as the low-vibration characteristics, this product can reduce customers' load in terms of vibration proofing for equipment such as 1U server devices with high packing density. These developments should make a large contribution to low vibration on other electronic equipments.

Toshiyuki Nakamura
Joined Sanyo Denki in 1999.
Cooling Systems Division, Design Dept.
Worked on the development and design of fan motors.

Toshiki Ogawara
Joined Sanyo Denki in 1984.
Cooling Systems Division, Design Dept.
Worked on the development and design of fan motors.

Katsumichi Ishihara
Joined Sanyo Denki in 2001.
Cooling Systems Division, Design Dept.
Worked on the development and design of fan motors.

Toshiki Kobayashi
Joined Sanyo Denki in 2005.
Cooling Systems Division, Design Dept.
Worked on the development and design of fan motors.