High Air Flow Fan "San Ace 200" GV Type

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1. Introduction

In recent years, ICT devices have become faster with higher capacities, and as such, an even higher cooling performance is being demanded of the cooling fans adopted in these devices.

Also, from the aspect of energy conservation and environmental load reduction, there is a demand for even lower energy consumption in products with equivalent performance.

This document introduces the features and performance of the high air flow fan "San Ace 200" GV type (ϕ200 mm x 70 mm thick) that was developed to respond to these market demands.

2. Background of the Development

Sanyo Denki has produced and sold the "San Ace 200" E and EC types (ϕ 200 mm x 70 mm thick). However, to accompany the abovementioned demand for high capacity and high density in ICT devices, the demand for higher air flow in cooling fans grew stronger. Moreover, there was a limit to how much the air flow of conventional products could be increased in response to this demand. This was due to the restrictions in structural strength and heat generation of the motor and circuit. Hence, a demand grew for new products with further higher air flow.

We reviewed the overall structure and circuit design to develop a fan with the highest air flow for its size in the industry(*1) – the "San Ace 200" GV type (ϕ 200 mm x 70 mm thick).

3. Product Features

Fig. 1 shows a profile of the "San Ace 200" GV type fan (hereinafter referred to as the "new model").

The features of the developed product are as follows:

(1) High air flow
(2) Low power consumption
(3) PWM control

Compared with the conventional model, the new model has 70% higher air flow and about 15% lower power consumption.

Fig. 1: Appearance of the "San Ace 200" GV type

4. Product Overview

4.1 Dimensions

Fig. 2 shows the dimensions of the new model. The new model has the same outer dimensions as the conventional model (EC type) and therefore maintains mounting compatibility.

4.2 Characteristics

4.2.1 General characteristics

The rated voltage is 48 V DC, and the rated speed is 8,000 min^{-1}. Table 1 shows the general characteristics for the new model.

4.2.2 Air flow vs. static pressure characteristics

Fig. 3 shows the air flow versus static pressure characteristics for the new model.

4.2.3 PWM control function

Fig. 4 shows the air flow versus static pressure characteristics at individual PWM duty cycle of the new model.

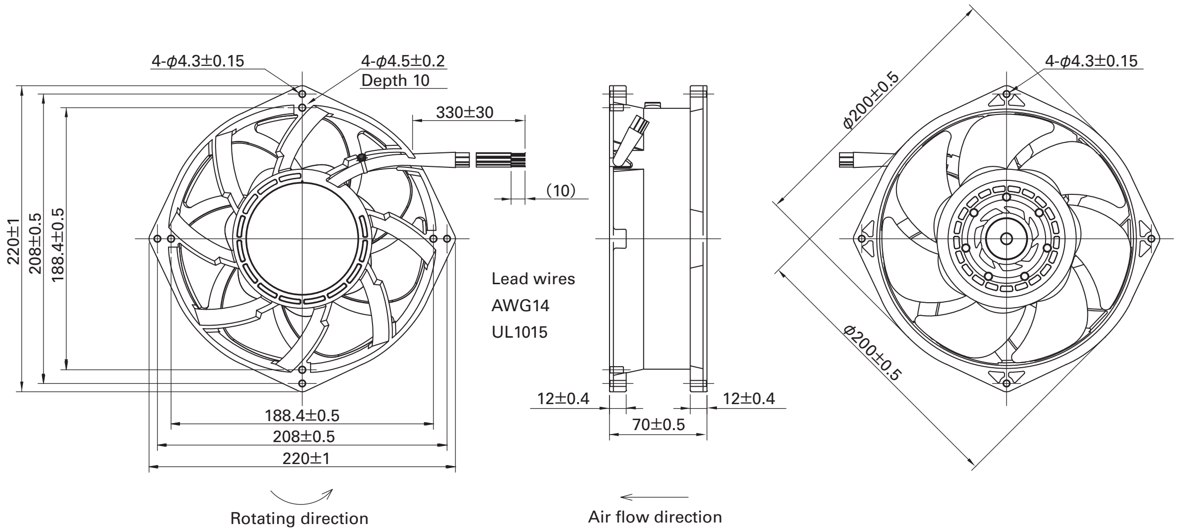

Fig. 2: Dimensions of the new model (unit: mm)

Table 1: General characteristics for the new model

Model No.	Rated voltage [V]	Operating voltage [V]	PWM duty cycle Note 1 [%]	Rated current [A]	Rated input [W]	Rated speed [min^{-1}]	Max. air flow [m^3/min]	Max. air flow [CFM]	Max. static pressure [Pa]	Max. static pressure [inchH$_2$O]	SPL [dB(A)]	Operating temperature [°C]	Expected life Note 2 [h]
9GV2048P0G201	48	36 to 72	100	12.5	600	8000	31.5	1112	1400	5.62	81	-10 to +70°C	40,000/60°C (70,000/40°C)

Note 1: Speed is 0 min^{-1} at 0% PWM duty cycle

Note 2: The expected life at 40°C is a reference value.

*Input PWM frequency: 1 kHz

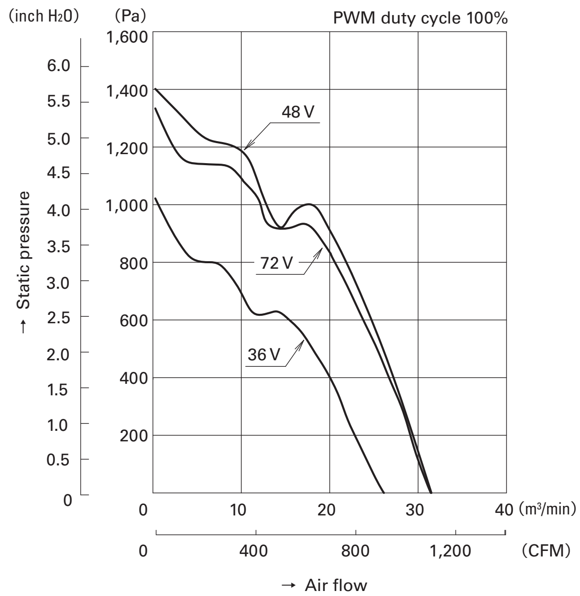

Fig. 3: Air flow vs. static pressure

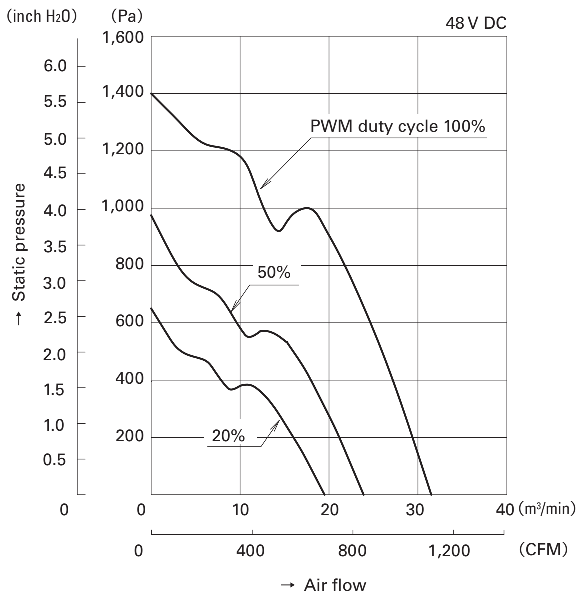

Fig. 4: Air flow vs. static pressure characteristics at individual PWM duty cycle

5. Comparisons with our Conventional Model

The following information introduces the characteristic differences between the new model and our conventional model.

5.1 Comparison of air flow versus static pressure

Table 2 shows the general characteristics of the new model and conventional model, while Fig. 5 shows air flow vs. static pressure.

Table 2: General characteristics for the new model and the conventional model

	Max. air flow [m³/min]	Max. static pressure [Pa]	Power consumption [W]	SPL [dB(A)]
New model 9GV2048P0G201	31.5	1400	600	81
Conventional model 9EC2048P0J01	18.5	1000	211	75

The new model has 70% higher maximum air flow and 40% higher maximum static pressure compared to the conventional model, offering better cooling performance.

We made the below changes to achieve high air flow.

· Increased impeller size to expand ventilation area.

· Increased impeller (rotor) speed.

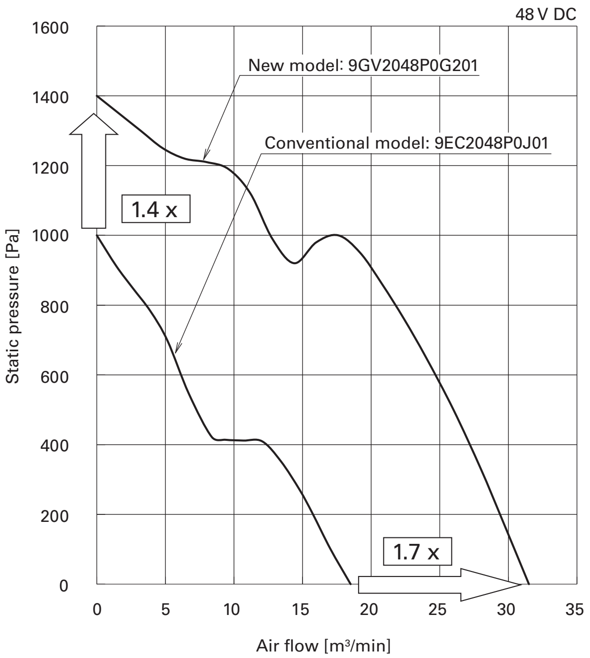

Fig. 5: Air flow vs. static pressure characteristics – Comparison between the new model and the conventional model

Fig. 6 shows the shape of the new model impeller.

Ventilation area was expanded by making the diameter of the rotor hub approximately 10% smaller than the conventional model.

Moreover, the new model is around 30% faster than the conventional model.

Fig. 6: Shape of the "San Ace 200" GV type impeller

5.2 Comparison of power consumption

Fig. 7 shows the air flow vs. static pressure at the expected operating point of the new model where performance would be equivalent to the conventional product, 9EC2048P0J01 (5300 min^{-1}). The individual power consumption are also shown.

Power consumption in the vicinity of the expected operating point on the expected system impedance curve was around 15% less than the conventional model.

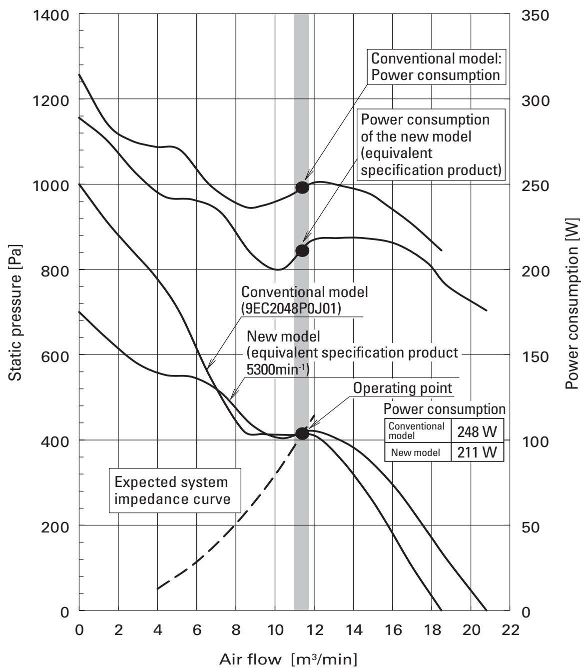

Fig. 7: Air flow vs. static pressure characteristics – Comparison between the conventional model and the equivalent specification model

5.3 Elements of the new development

[Frame]

Fig. 8 shows the aluminum frame of the new model. The structure is one where the frame hub is used as a heat sink in order to conduct the heat of the power semiconductor to the frame as much as possible.

Fig. 8: “San Ace 200” GV frame shape

[Circuit]

A new low-loss power semiconductor was chosen and drive circuit using only Nch FET adopted to reduce circuit loss.

[Motor]

The diameter of the hub was made smaller to increase impeller size.

To accompany this, magnet and stator diameters were also made smaller, motor performance was further improved. Reviewing stator material and shape including multipolarity, magnet material and magnetization result in power reduction optimizing the motor.

[Coil]

Regarding multislot motor, wire connection of crossover part (between slots) is complicated. As for new model, wire connection process becomes effective by substituting for crossover with wire connection board between winding and circuit board.

[Input cables]

Conventionally, the fan power cable was connected directly to the circuit board by soldering, however due to high input current, there was a need to make the diameter of the power cable bigger.

Because a bigger power cable was adopted on the new model, it made soldering the cable directly onto the circuit board difficult. As a countermeasure, a terminal block was installed on the circuit board and the power cable was connected to this terminal block instead.

5.4 Comparison of sound pressure level (SPL)

Fig. 9 shows the SPL comparison of the conventional model versus the equivalent new model (5300 min^{-1}) from Fig. 7.

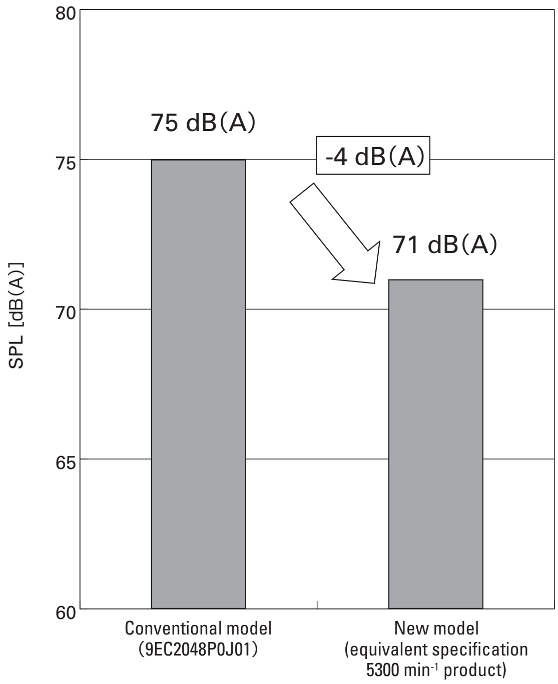

Fig. 9: Comparison of SPL between the conventional and an equivalent specification model

On the new model, SPL was 71 dB (A), which is a reduction of 4 dB (A) compared with the 75 dB (A) of the conventional model.

To reduce SPL, the shape and number of blades were optimized through the combined characteristics of guide vane (frame side) and moving blade (impeller side).

5.5 Expected life

The new model is approximately 30% faster than the conventional product, and at the same time, has an expected life (survival rate 90%, rated voltage continuous operation, free air state, normal humidity) of 40,000 hours at an ambient temperature of 60°C.

6. Conclusion

This document introduced some of the features and performances of the newly developed high air flow “San Ace 200” GV type fan.

The new model has significantly higher air flow keeping mounting compatibility with our conventional product (EC type). This contributes to reducing the number of fans used on equipment and equipment space.

Moreover, this product has achieved low power consumption, thereby it is thought to be able to greatly contribute to reducing the overall power consumption of equipment even when the same number of fans are used.

*1: As of October 16, 2012. As a same size industrial fan. Results from Sanyo Denki research.

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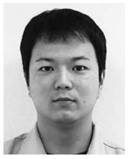

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