120 × 120 × 25 mm *San Ace 120AD* 9AD Type ACDC Fan

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1. Introduction

In recent years, the accelerating trend to a low-carbon society to combat global warming has led to greater demand for cooling fans with low power consumption and long service life. In addition, cooling fans are required to have PWM control to adjust the fan speed in response to the operating conditions of equipment as well as a wide input voltage range for use in various countries.

Since our conventional AC Fans had become unable to meet these requirements, we have developed and expanded the lineup of our ACDC Fan, which has a built-in AC-DC conversion circuit to drive a DC motor.

Furthermore, for today's smaller, more advanced control panels and industrial equipment, there is an increasing demand for thin-profile cooling fans, including ACDC fans, to fit in the reduced and confined spaces. To meet these requirements, we have developed our slimmest 25 mm ACDC Fan. This article introduces the performance and features of the new product, as well as the key points of development.

2. Product Features

Figure 1 shows its appearance.

Its product features are as follows:

(1) Energy savings
(2) Long service life
(3) Wide operating temperature range
(4) High static pressure and high airflow
(5) PWM-based fan speed control

Fig.1 120 × 120 × 25 mm *San Ace 120AD* 9AD type fan

3. Product Overview

3.1 Dimensions

Figure 2 shows the dimensions of the new 120 × 120 × 25 mm *San Ace 120AD* 9AD type.

3.2 Specifications

3.2.1 General specifications

Table 1 shows the general specifications of the new product.

The lineup of the product is available in: a high-speed model with PWM control, constant high-speed model, medium-speed model, and low-speed model.

With an operating voltage range of 90 to 264 VAC, they can be used both with 100 and 200 VAC systems.

3.2.2 Airflow vs. static pressure characteristics

Figure 3 shows the airflow vs. static pressure characteristics of the high-speed, PWM-control model, 9AD1201P4H001. Figure 4 shows the airflow vs. static pressure characteristics of the high-speed 9AD1201H4002, medium-speed 9AD1201M4002, and low-speed 9AD1201L4002 models. The airflow vs. static pressure characteristics of all new models remain the same over their input voltage range from 100 to 240 V.

3.2.3 PWM control

The 9AD1201P4H001 model comes with PWM control for controlling the fan speed.

3.3 Expected life

The new product has an expected life of 60,000 hours at 60°C (survival rate of 90%, run continuously at rated voltage and normal humidity in free air).

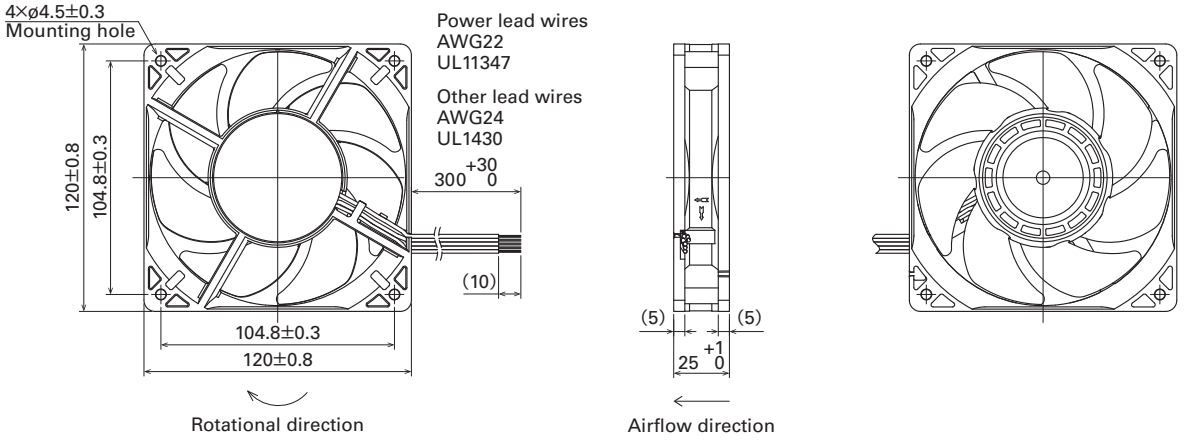

Fig. 2 Dimensions of 120 × 120 × 25 mm *San Ace 120AD* 9AD type fan (Unit: mm)

Table 1 General specifications of 120 × 120 × 25 mm *San Ace 120AD* 9AD type fan

Model no.	Rated voltage [V]	Operating voltage range [V]	Frequency [Hz]	PWM duty cycle* [%]	Rated current [A]	Rated input [W]	Rated speed [min^{-1}]	Max. airflow [m^3/min]	Max. airflow [CFM]	Max. static pressure [Pa]	Max. static pressure [inchH$_2$O]	Sound pressure level [dB(A)]	Operating temperature range [°C]	Expected life [h]
9AD1201P4H001	100 to 240	90 to 264	50/60	100	0.06	3.4	3000	2.35	83	62	0.249	40	-20 to +70	60000 at 60°C (90000 at 40°C)
				30	0.02	0.7	900	0.7	24.7	6.6	0.03	14		
9AD1201H4002				—	0.06	3.4	3000	2.35	83	62	0.249	40		
9AD1201M4002				—	0.04	1.6	2250	1.76	62	35	0.140	34		
9AD1201L4002				—	0.03	1.1	1800	1.41	49	22	0.088	26		

* Input PWM frequency: 25 kHz. Speed is 0 min^{-1} at 0% PWM duty cycle.
Note: The expected life at an ambient temperature of 40°C is for reference purposes only.

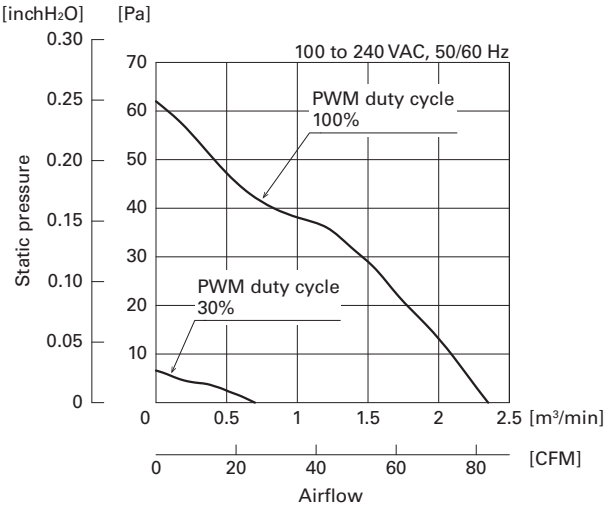

Fig. 3 Airflow vs. static pressure characteristics of 9AD1201P4H001

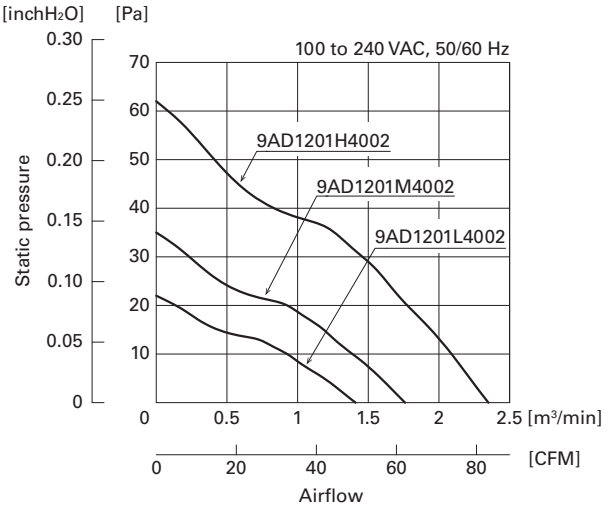

Fig. 4 Airflow vs. static pressure characteristics of new 9AD1201H4002, 9AD1201M4002, and 9AD1201M4002 models

4. Key Points of Development

The new product achieves lower power consumption, longer service life, higher static pressure, and higher airflow while maintaining the same size as our current AC Fan.

The key points of development are as follows.

4.1 Design techniques that achieved a 25 mm thin-profile frame

ACDC fans need to incorporate a large high-capacitance capacitor and, reactor to convert AC input power into low-voltage DC power. Figure 5 shows the cross-sectional views of new and current ACDC Fans.

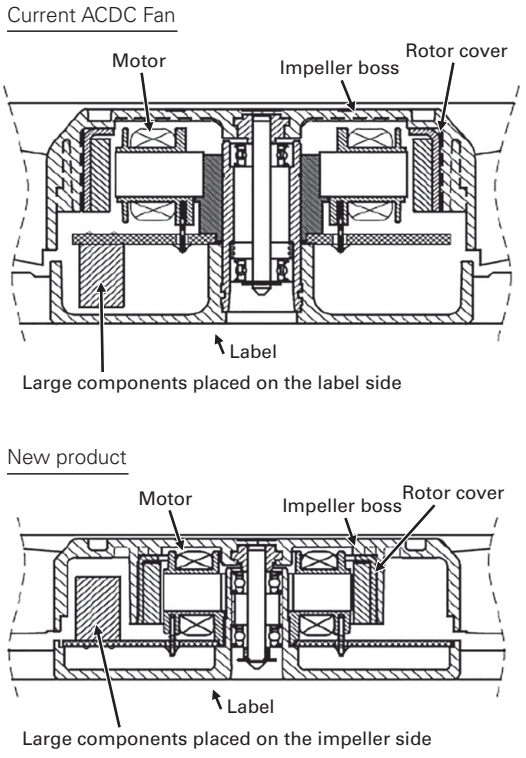

Fig. 5 Cross-sectional views of new and conventional ACDC Fans

With our conventional ACDC fans, these large components were mounted on the label side, which created unused space inside, leaving little room for downsizing. To address this, the new product uses a relatively compact motor for a 120 mm sq. fan, securing space for large components between the inner surface of the impeller boss and the rotor cover. This design has helped achieve a thickness of 25 mm, making it the slimmest among all of our ACDC Fans.

4.2 Impeller and frame design

The motor needed to be downsized to achieve a thickness of 25 mm. In general, however, reducing the motor size makes it more difficult to improve the airflow vs. static pressure characteristics while also suppressing power consumption and heat generation. We addressed this issue by testing various combinations of parameters such as the number, length, angle, and shape of impeller blades as well as the frame shape through simulations and evaluations on actual equipment to determine the optimal design for excellent airflow efficiency.

4.3 Low power consumption and long service life

The new product internally converts AC power into DC power to drive a DC motor, improving motor efficiency and reducing losses compared to AC motors. With the reduced power losses and high-efficiency impeller and frame designs reducing the temperature rise of the motor and bearings, the new product achieves improved airflow vs. static pressure characteristics, lower power consumption, and longer service life compared to our current AC Fans.

Compared to the current product, power consumption has been reduced by 72% from 12 W to 3.4 W.

The expected life (at 60°C, survival rate of 90%, run continuously at rated voltage and normal humidity in free air) of the new product is 60,000 hours, 2.4-times longer than the 25,000 hours of the current product.

5. Comparison of New and Current Products

5.1 Comparison of airflow vs. static pressure characteristics

Figure 6 compares the airflow vs. static pressure characteristics of the new 9AD1201P4H001 and the current product. Compared to the current product, the maximum airflow and maximum static pressure have been improved by 2% and 19%, respectively. In addition, the operating airflow has been improved in the actual operating zone.

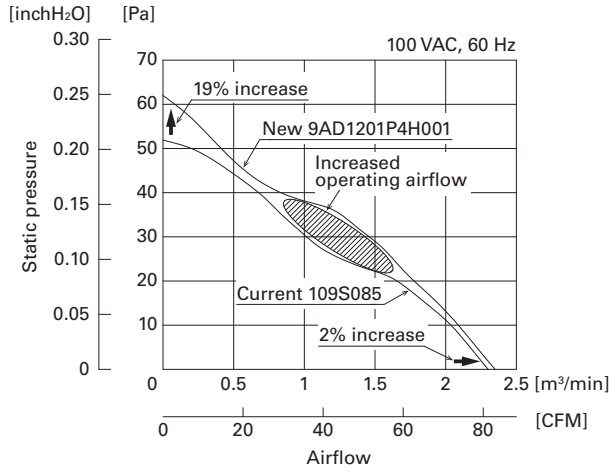

Fig. 6 Airflow vs. static pressure characteristics of the new and current products

5.2 Power consumption comparison with the current product at equivalent performance

Figures 7 and 8 compare power consumption for the current and new products at equivalent cooling performance.

These figures show that, when the fan speed of the new product is reduced through PWM control to match the cooling performance of the current product, power consumption at the estimated operating point has been reduced by 76% at 60 Hz and 81% at 50 Hz.

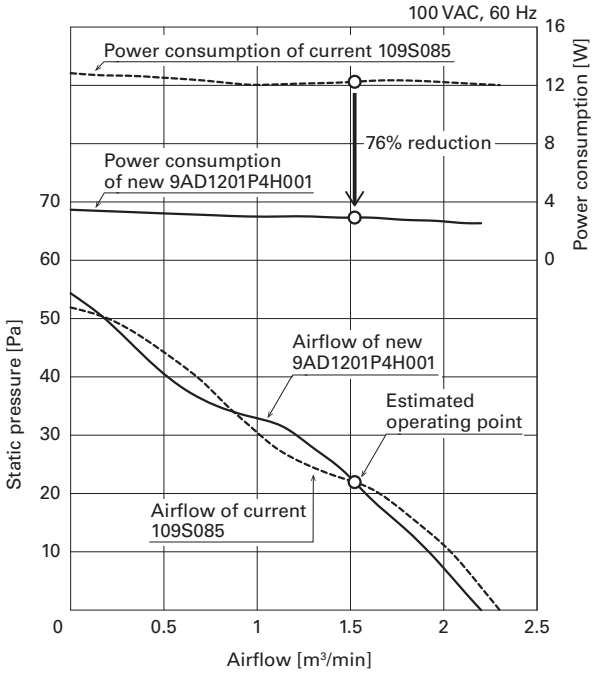

Fig. 7 Airflow vs. power consumption characteristics of the new and current products (60 Hz)

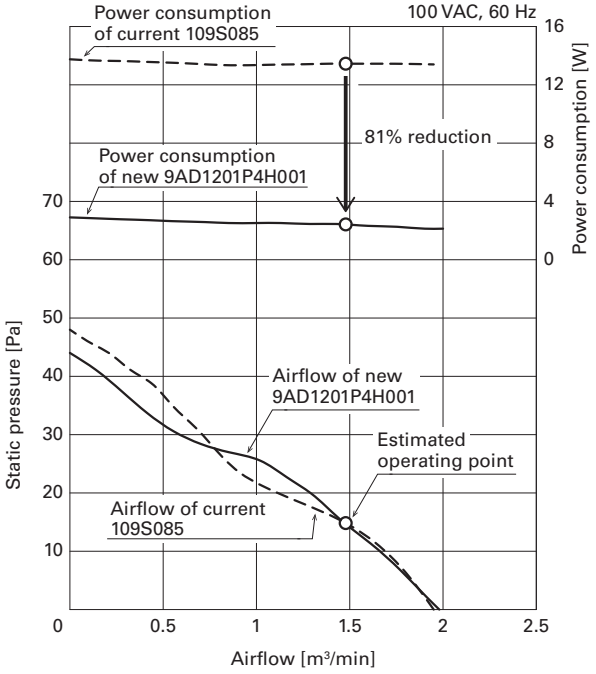

Fig. 8 Airflow vs. power consumption characteristics of the new and current products (50 Hz)

5.3 Environmental impact comparison

Figure 9 compares the CO_2 emissions of the new and current products over their life cycles.

The new product produces 77% less CO_2 emissions over its product life cycle compared to the current product thanks to its greatly reduced power consumption.

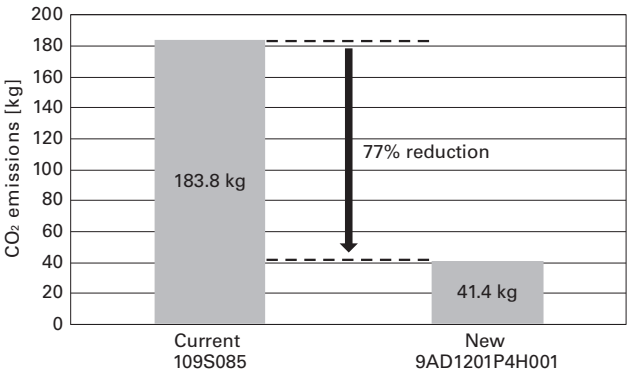

Fig. 9 CO_2 emissions comparison using our LCA calculation software (operated continuously for 25,000 hours in free air)

6. Conclusion

This article has introduced the features and performance of our new 120 × 120 × 25 mm *San Ace 120AD* 9AD type ACDC Fan equipped with an AC-DC conversion circuit. The new product has a built-in AC-DC conversion circuit and its impeller, frame shape, motor, and circuit are designed for high efficiency. This realized higher airflow, higher static pressure, lower power consumption, longer service life, PWM control, and a wider input voltage range than our current product.

With the trend toward a low-carbon society accelerating, the demand for products with low power consumption and long service life will continue to increase.

We will continue to help our customers create new value by providing products that address changing market demands.

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