High Airflow, Counter Rotating Fan "San Ace 80" 9CRB Type

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1. Introduction

In recent years, the information processing devices such as servers and storage equipment have increased in speed and capacity, which has resulted in devices having higher internal density and generating more heat. Sanyo Denki had already introduced the 80 mm sq. 80 mm thick high static pressure counter rotating fan "San Ace 80" 9CRA Type on the market, but there were an increasing number of cases where the desired cooling performance was not reached. Consequently, there is a growing need for a high airflow fan which can cool in a high-density environment while maintaining high static pressure. Moreover, the shift to high speed fans is creating the major issues of increased current and vibration.

In response to such needs, Sanyo Denki developed and commercialized the 80 mm sq. 80 mm thick high airflow counter rotating fan "San Ace 80" 9CRB Type (hereinafter "new model").

This document introduces the features and performances of the new model.

2. Product Features

Figure 1 shows a photograph of the new model.

Fig. 1: Photograph of the 80 mm sq. 80 mm thick "San Ace 80" 9CRB Type

The features of the new model are as follows:

(1) High airflow and high static pressure
(2) Optimal for a 2U size unit

3. Outline of the New Model

3.1 Dimensions

Figure 2 shows the dimensions of the new model.

3.2 Characteristics

3.2.1 General characteristics

Table 1 shows the general characteristics for the new model.

Rated voltage is 12 V DC only, while rated speed is 14,600 min^{-1} on the inlet side and 12,200 min^{-1} on the outlet side.

3.2.2 Airflow vs. static pressure characteristics

Figure 3 shows the airflow versus static pressure characteristics for the new model.

3.2.3 PWM control function

The new model has a PWM control function that controls the fan speed from an external source.

3.3 Expected life

The new model 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).

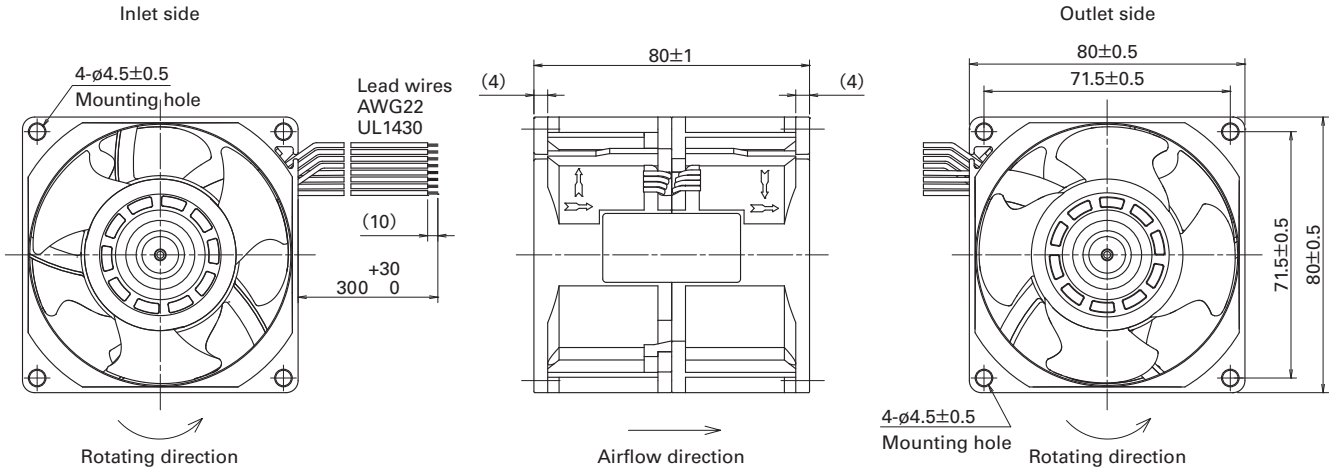


Fig. 2: Dimensions of the new model (unit: mm)

Table 1: General characteristics for the new model

Model No.	Rated voltage [V]	Operating voltage [V]	PWM duty cycle [%]	Rated current [A]	Rated input [W]	Rated speed [min^{-1}] Inlet side	Rated speed [min^{-1}] Outlet side	Max. airflow [m^3/min]	Max. airflow [CFM]	Max. static pressure [Pa]	Max. static pressure [inchH_2O]	SPL [dB(A)]	Operating temperature [°C]	Expected life [h]
9CRB0812P8G001	12	10.8 to 13.2	100	9.2	110.4	14,600	12,200	5.5	194	1,150	4.6	80	-20 to +70	40,000/60°C (70,000/40°C)
			20	0.17	2.04	2,000	1,670	0.7	24.7	21.6	0.09	24		

Note 1: Input PWM frequency: 25 kHz
Note 2: Speed is 0 min^{-1} at 0% PWM duty cycle

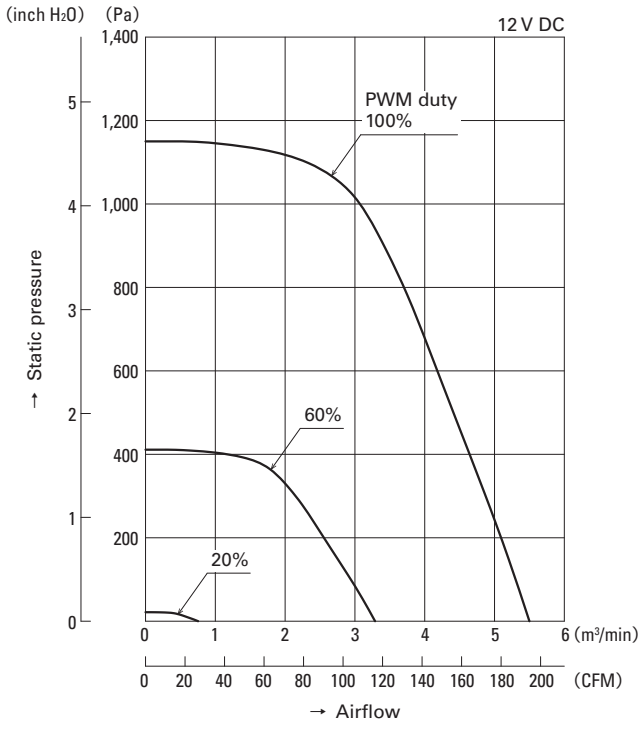


Fig. 3: Airflow vs. static pressure characteristic for the new model (example)

4. Development Points

On the new model, the impeller, frame, motor and circuit were all newly designed, in order to maintain the same static pressure as the conventional model, with an even higher airflow.

Below is an explanation of the differences between the new model and Sanyo Denki's conventional product, the "San Ace 80" 9CRA Type (hereinafter "conventional model").

4.1 Impeller design

In the case of counter rotating fans, the airflow versus static pressure characteristic changes significantly depending on the combination of impeller shape, mounting angle and speed of the respective inlet fan and outlet fan.

For the new model, we largely utilized fluid analysis and 3D printer molding to obtain the optimal combination of impeller shape and mounting angle. For the inlet fan, we focused the design on one which would achieve high airflow at the same time as minimizing power consumption and, as a result, incorporated a 3-impeller - a first in the history of Sanyo Denki. Furthermore, as a result of designing the outlet fan to achieve high static pressure, we succeeded

in maintaining high static pressure and realizing a high airflow.

Figure 4 shows an example of utilizing fluid analysis, while Figure 5 presents a comparison of the number and shape of impellers with the conventional model.

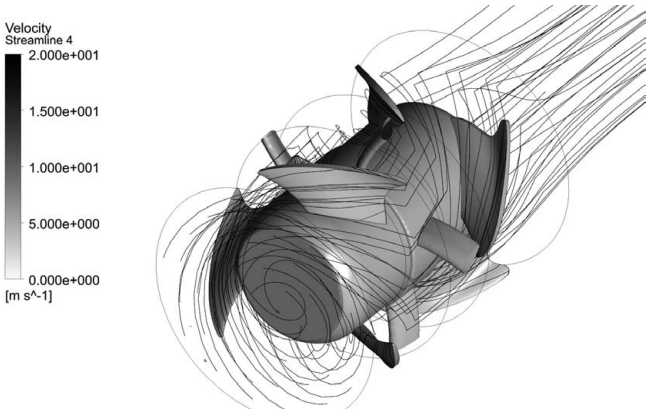
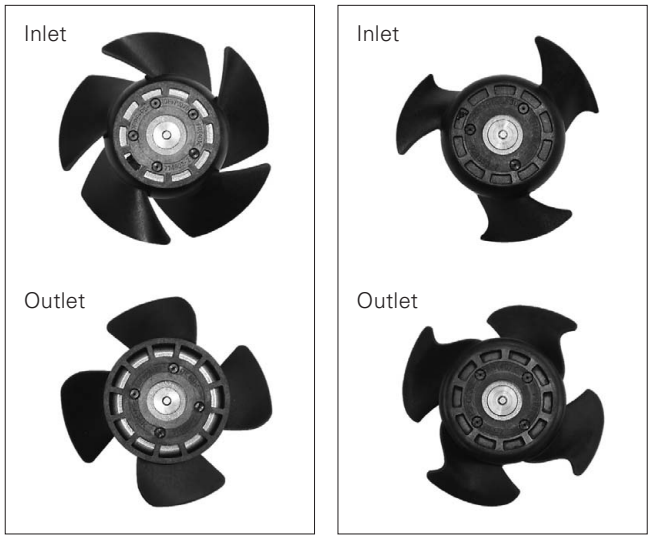


Fig. 4: Utilization of fluid analysis



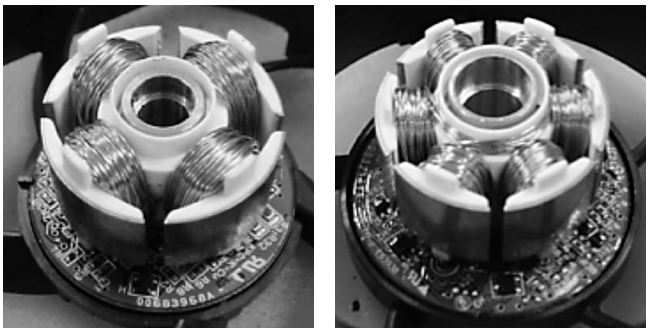
Conventional model　　New model

Fig. 5: Comparison of impeller shape between our conventional model and the new model

4.2 Motor and circuit design

In the design of the motor circuit, we newly fabricated the motor stator and changed the drive method from single to 3-phase, and optimized the motor drive control program in order to increase fan speed and current.

Figure 6 shows the motor portions of the conventional model and the new model.

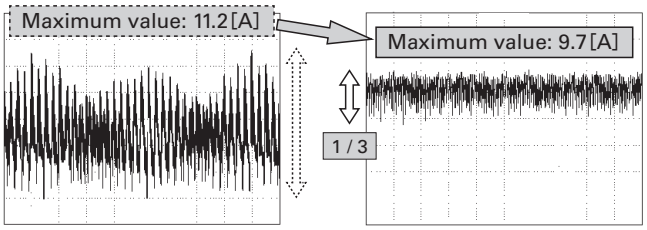


Conventional model (Single phase drive)　　New model (3-phase drive)

Fig. 6: Motors of the conventional model and the new model

The new model has higher power consumption than the conventional model due to the higher airflow, however the maximum value of the current waveform has been kept 13% lower through adoption of a 3-phase motor. The peak fluctuation of the current waveform was also reduced, and it was minimized to one-third of that of the conventional model.

Figure 7 is a comparison of current waveforms during normal operation.



Conventional model (Single phase drive)　　New model (3-phase drive)

Fig. 7: Example of current waveforms during normal operation (Comparison with the conventional model)

5. Comparison of the New Model and the Conventional Model

5.1 Comparison of airflow versus static pressure

The new model has maximum static pressure equivalent to that of the conventional model, but the maximum airflow is 1.22 times greater.

Figure 8 gives a comparison of the airflow versus static pressure characteristics for the conventional model and the new model.

Model No.	Max. airflow [m³/min]	Max. static pressure [Pa]
Conventional model: 9CRA0812P8G001	4.5	1,150
New model: 9CRB0812P8G001	5.5	1,150

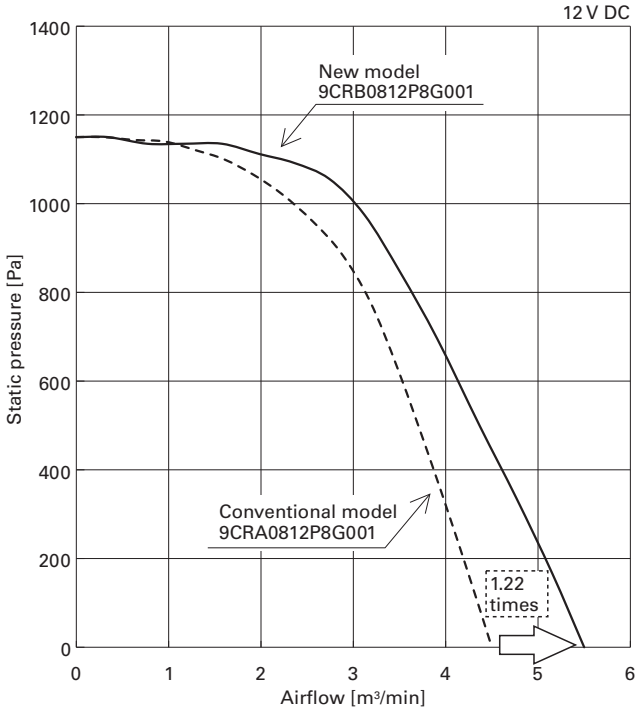


Fig. 8: Airflow vs. static pressure characteristic for the conventional and new model (example)

5.2 Power consumption comparison (when performance is equivalent to the conventional model)

Figure 9 shows a comparison of power consumption for the new model and conventional model with the same cooling performance.

When the speed of the new model is lowered with PWM control and compared with the conventional model at equivalent cooling performance in a presumed operation point, the new model has 6% less power consumption than the conventional model.

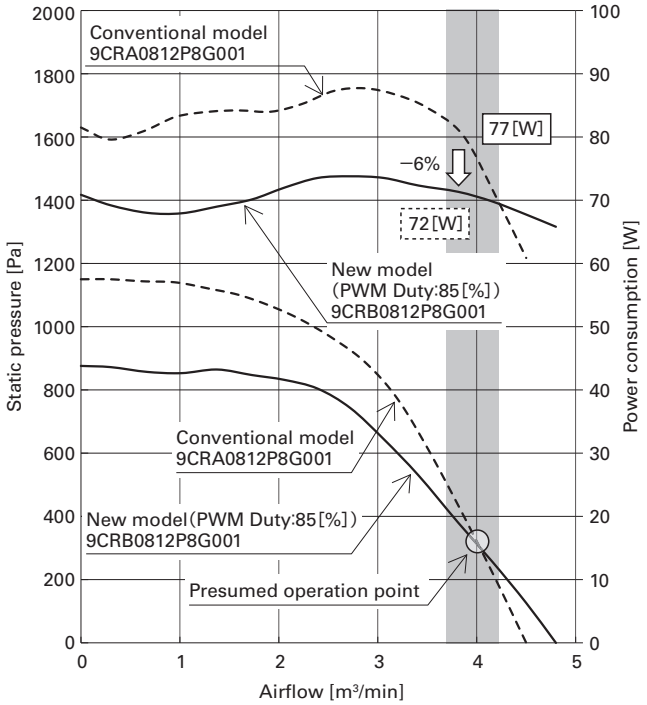


Fig. 9: Airflow vs static pressure characteristics (comparison with the conventional model)

5.3 Comparison of vibration characteristics

The new model was designed with a focus on minimizing vibration increase caused by higher speed, and low vibration compared to the conventional mode was achieved through strengthening the frame and improving the motor.

Figure 10 shows a comparison of the speed versus vibration acceleration for the new model and conventional model.

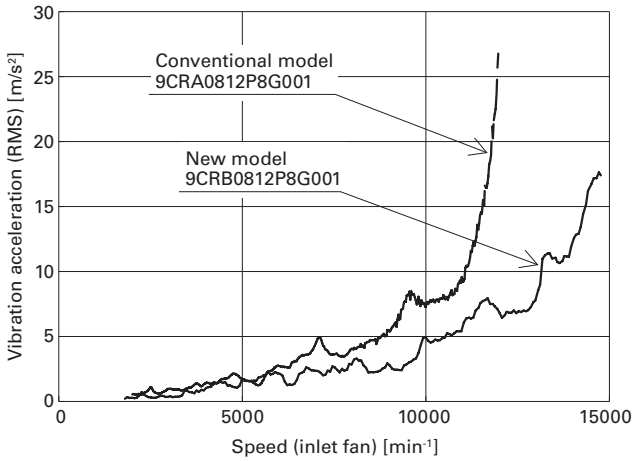


Fig. 10: Speed vs. vibration acceleration characteristic (comparison with the conventional model)

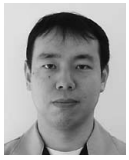
6. Conclusion

This document has introduced some of the features and performances of the 80 mm sq. 80 mm thick high static pressure counter rotating fan “San Ace 80” 9CRB Type developed by Sanyo Denki.

The new model maintains the same high static pressure as our conventional model at the same time as boasting significantly higher airflow and minimizing the rise in current and vibration associated with fans of higher speed.

We believe this will largely contribute to the cooling of equipment which is generating a higher amount of heat and are of higher density.

We will continue to quickly develop products to meet the market demands and provide devices that that fulfill our customers’ needs.



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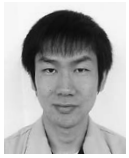

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