High Performance Blower *San Ace B97* 9BMC Type

Munenori Takakuwa Toshiya Nishizawa Akira Nakayama

Koji Ono Hiromitsu Kuribayashi

1. Introduction

Thanks to its compact design and high static pressure, the 97 × 33 mm blower is used for air supply in printers and A/C units, as well as for cooling in servers and power sources. Its versatility allows it to be used in a wide range of markets and applications, including office equipment, industrial devices, and household appliances.

SANYO DENKI has developed and released the 97 × 33 mm blower *San Ace B97* 9BMB type (hereinafter "current model"). However, as its applications have become more compact while improving performance, blowers are also expected to increase performance.

In response, SANYO DENKI newly developed and released the 97 × 33 mm blower *San Ace B97* 9BMC type (hereinafter "new model") which achieves the highest cooling performance in the industry*.

This paper provides a detailed introduction of this new product.

2. Product Features

Figure 1 shows an external view of the new model.

Fig. 1: 97 × 33 mm
San Ace B97 9BMC type

The features of the new model are as follows:

(1) High static pressure
(2) High airflow
(3) PWM control function

3. Product Overview

3.1 Dimensions

Figure 2 shows the dimensions of the new model.

The new model has the same mounting dimensions as the current model, therefore compatibility is maintained.

3.2 Specifications

3.2.1 General specifications

Table 1 shows the general specifications.

3.2.2 Airflow vs. static pressure characteristics

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

3.2.3 PWM control function

Figure 4 shows an example of the airflow vs. static pressure characteristics for different values of PWM duty cycle. The new model has a PWM control function that enables external control of fan speed.

By controlling the fan's speed to suit the device's heat generation state rather than operating it at full speed constantly, both the overall device power consumption and noise can be reduced. Therefore, the demand for fans with a PWM speed control function has increased significantly in recent years.

3.3 Expected life

The new model has a expected life of 40,000 hours at 60°C (survival rate of 90%, run continuously at rated voltage in a free air state and at normal humidity).

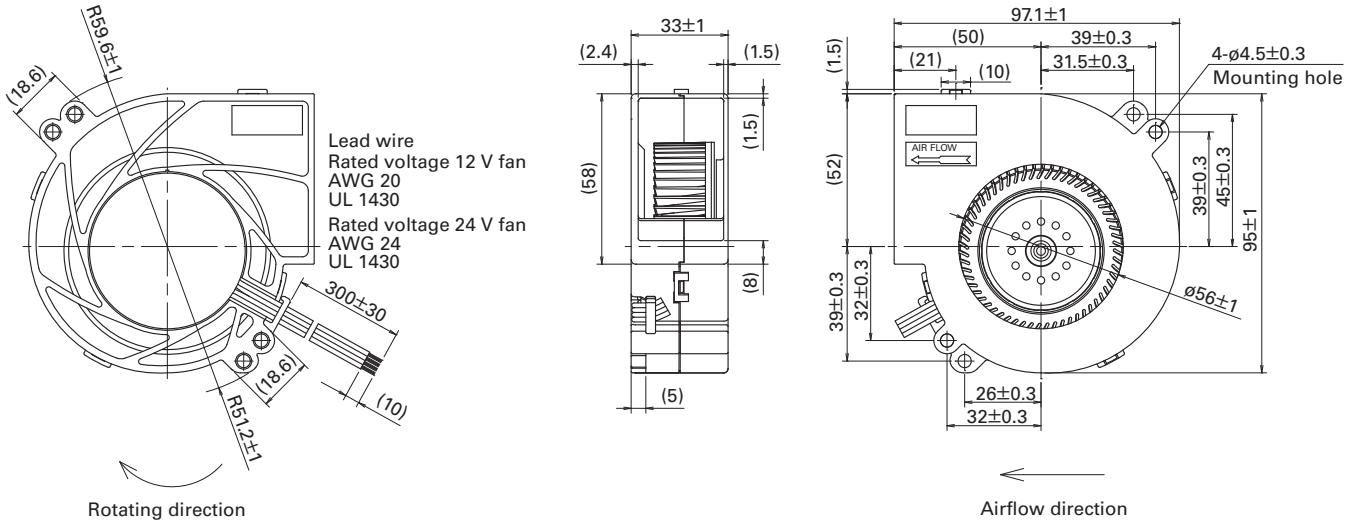


Fig. 2: Dimensions of the new model (unit: mm)

Table 1: General characteristics of the *San Ace B97* 9BMC type

Model No.	Rated voltage [V]	Operating voltage range [V]	PWM duty cycle Note 1,2 [%]	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]	SPL [dB (A)]	Operating temperature [°C]	Expected life [h]
9BMC12P2G001	12	10.8 to 13.2	100	6.2	74.4	8,200	1.85	65.3	1,950	7.83	69	-20 to +70	40,000 at 60°C (70,000 at 40°C)
			20	0.38	4.56	2,800	0.58	20.4	121.0	0.48	44		
9BMC24P2G001	24	21.6 to 26.4	100	3.1	74.4	8,200	1.85	65.3	1,950	7.83	69		
			20	0.19	4.56	2,800	0.58	20.4	121.0	0.48	44		

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

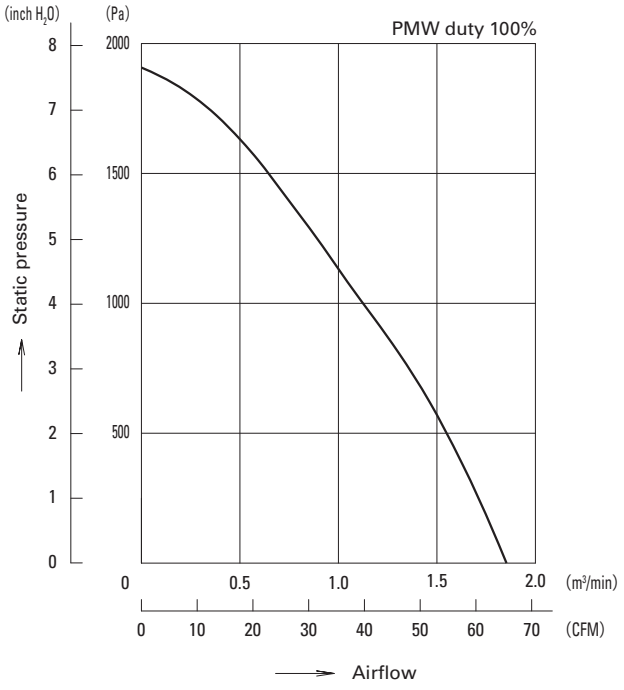


Fig. 3: Airflow vs. static pressure characteristics of new model

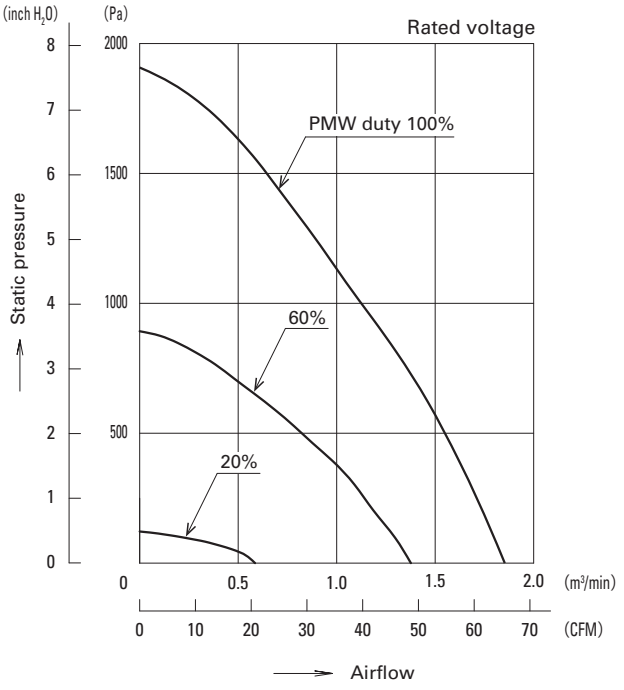


Fig. 4: Example of the airflow vs. static pressure characteristics for different values of PWM duty cycle.

4. Key Points of Development

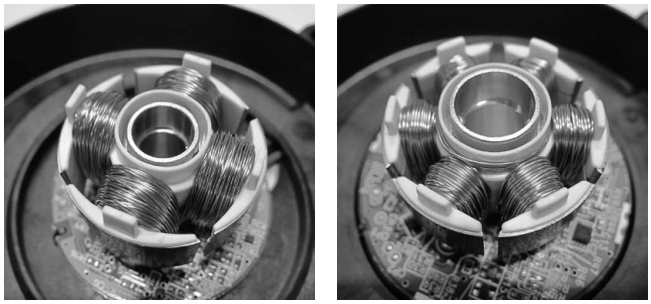
The new model achieves high static pressure and high airflow by adopting a large 3-phase motor and a newly-designed impeller, and higher rotational speed compared to the current model.

The key points of development are explained as follows.

4.1 Motor design

When rotational speed is increased, the motor generates more heat. In other words, in order to increase rotational speed, the motor must have high efficiency to minimize its heat generation. The current model adopts a 4-slot, single-phase motor; however, the new model adopts a higher-efficiency, large 6-slot, 3-phase motor to keep heat generation to a minimum and enable higher rotational speed.

Figure 5 shows the motor portion of the current model and new model.



Current model　　New model

Fig. 5: Motor of the current model and new model

4.2 Impeller design

A high static pressure can be obtained by increasing blower rotational speed. However, higher rotational speed also results in increased sound pressure level (SPL). We engineered the shape of the bottom of the impeller to facilitate smoother airflow. As a result, we achieved higher rotational speed while suppressing the increase in SPL as much as possible.

Moreover, to achieve high-speed rotation, we had to improve the rigidity of the impeller to withstand centrifugal force at high rotation. By creatively designing the shape of the guide at the top of the impeller, we have increased rigidity and made impeller diameter even wider. We used a 3D printer during design verification and repeatedly measured the model to find the optimal blade shape and achieve high static pressure and high airflow.

Figure 6 shows the shape of the impeller for both the new and current models.

Current model　　New model

Fig. 6: Impeller shape of current model and new model

5. Comparison with the Current Model

The newly designed impeller and large 3-phase motor of the new model result in higher rotational speed and significantly improved static pressure and airflow over the current model.

The following is a comparison of the characteristics of the new and current models.

5.1 Comparison of airflow vs. static pressure characteristics

Figure 7 gives a comparison of the airflow vs. static pressure characteristics for the new model 9BMC12P2G001 and 9BMB12P2K01, a current model of the same size. Both the static pressure and airflow have been significantly increased, with maximum static pressure 1.5 times greater and maximum airflow 1.15 times greater.

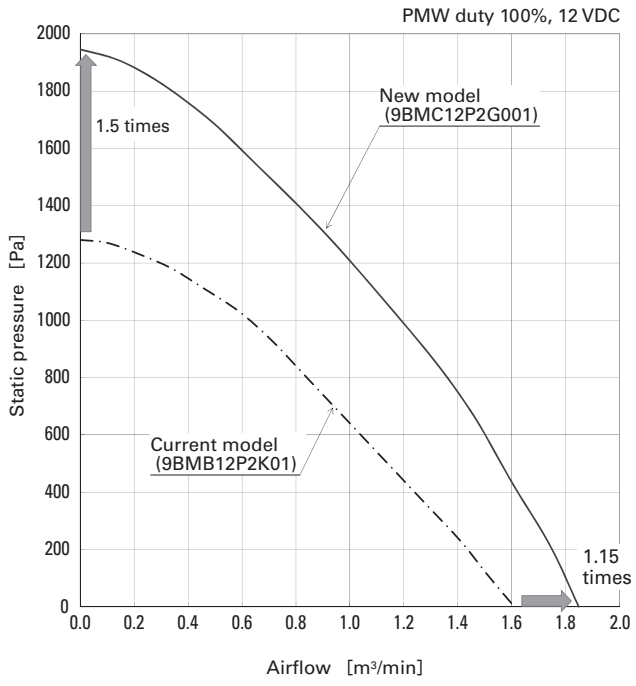


Fig. 7: Airflow vs. static pressure characteristics

5.2 Comparison at assumed system impedance

Figure 8 shows a comparison of the "airflow vs. static pressure and SPL characteristics" of the new model 9BMC12P2G001 and current model 9BMB12P2K01 as well as the assumed system impedance curve. System impedance indicates the aerodynamic load specific to a piece of equipment. Therefore, the point where the system impedance curve and airflow vs. static pressure characteristic curve intersect indicates the operating point of the blower used in the target equipment. The new model achieves higher rotational speed with high static pressure and high airflow. As such, the new model has an SPL of 69 dB(A) in a free air state which is 3 dB(A) higher than the current model's SPL of 66 dB(A).

However, the difference in SPL becomes even smaller depending on the system impedance of the equipment on which the blower is used. Figure 9 shows the airflow at the operating point of the assumed system impedance shown in Figure. 8.

At the operating point with this assumed system impedance, the SPL of the current model and the new model was the same at 66 dB(A); however, the operating airflow of the current model is 1.18 m^3/min compared to 1.45 m^3/min of the new model. The new model achieves 23% higher airflow than the current model while maintaining the same SPL.

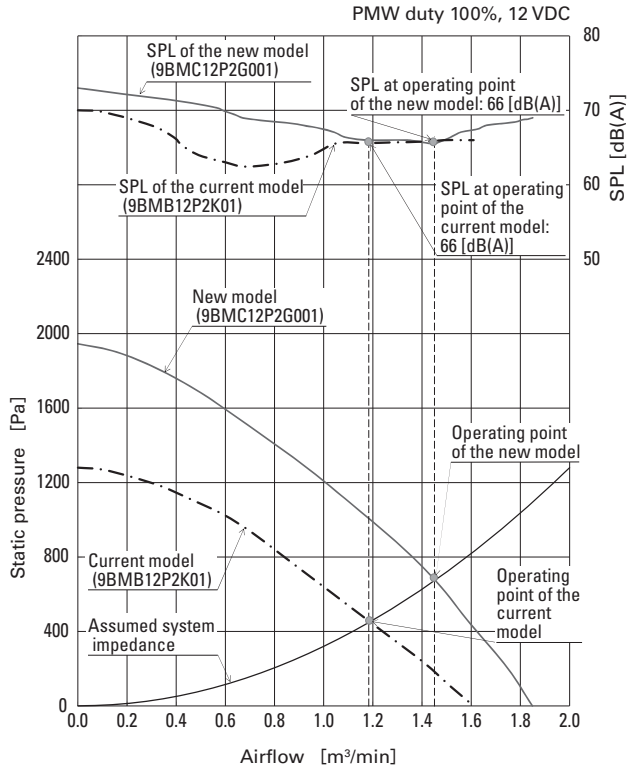


Fig. 8: Airflow vs. static pressure vs. SPL characteristics example

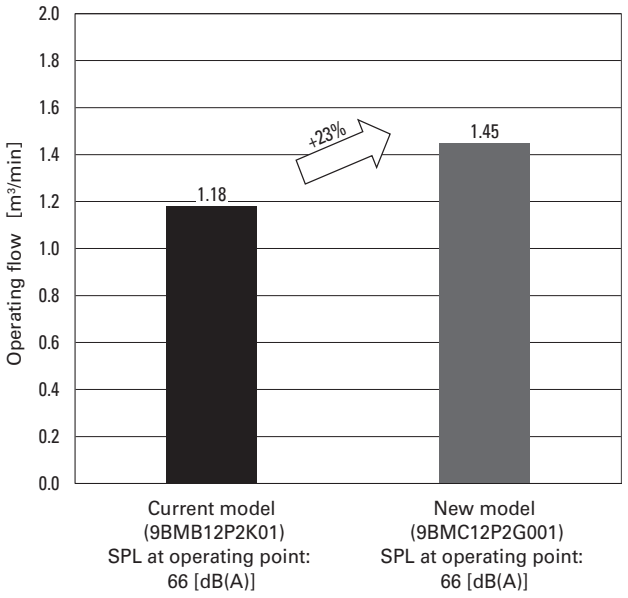


Fig. 9: Comparison of operating flow at the operating point with the assumed system impedance

6. Conclusion

This article has presented some of the features and performance of the high performance 97 × 33 mm blower *San Ace B97* 9BMC type developed by SANYO DENKI.

The new model has increased rotational speed and achieves significantly higher static pressure and higher airflow than the current model by adopting a large 3-phase motor and a newly-designed impeller.

The 97 × 33 mm blower has been used in a variety of applications thanks to its compact design and high static pressure performance, making it ideal for cooling and air supply applications in small spaces. By achieving even higher static pressure and airflow on the new model, SANYO DENKI offers new value for existing equipment, such as high performance and space efficiency. We also believe this product can offer value for equipment in new fields.

* As of May 25, 2017. Compared with blowers of equivalent size. Investigated by SANYO DENKI.

Munenori Takakuwa
Joined SANYO DENKI in 1998.
Cooling Systems Div., Design Dept.
Works on the development and design of cooling fans.

Toshiya Nishizawa
Joined SANYO DENKI in 1999.
Cooling Systems Div., Design Dept.
Works on the development and design of cooling fans.

Akira Nakayama
Joined SANYO DENKI in 2005.
SANYO DENKI PHILIPPINES, INC., Design Dept.
Works on the development and design of cooling fans.

Koji Ono
Joined SANYO DENKI in 2015.
Cooling Systems Div., Design Dept.
Works on the development and design of cooling fans.

Hiromitsu Kuribayashi
Joined SANYO DENKI in 1996.
Cooling Systems Div., Design Dept.
Works on the development and design of cooling fans.