High Air Flow and High Static Pressure Counter Rotating Fan "San Ace 172" CR Type

Takashi Kawashima Izumi Onozawa Satoshi Fujimaki Toshiya Nishizawa

Yasuhiro Maruyama Atsushi Yanagisawa Hayato Murayama Yuusuke Okuda

1. Introduction

The rapid shift to an information-orientated society is accelerating the development of higher performance ICT devices. While these devices are energy-conserving, the downsizing of equipment leads to high density, therefore the power consumption and calorific value per unit of volume is increasing more and more. Therefore, higher cooling performance has been demanded from fans that are used for cooling.

Furthermore, interest has grown for global environmental protection, so various industries are attaching more importance to energy conservation. Even for cooling fans, low power consumption during operations has become important.

This document introduces the features and performance of the high air flow, high static pressure counter rotating fan "San Ace 172" CR type (ϕ172 x 150 x 102 mm thick) that was developed to respond to these market demands.

2. Background of the Development

Sanyo Denki has produced and sold a high air flow, high static pressure fan "San Ace 172" GV type (ϕ172 x 150 x 51 mm thick) and SG type product.

However, as information equipment and communications equipment became faster, with higher capacity and higher density as noted above, demand grew for cooling fans with high cooling performance in high static pressure ranges that could not be achieved with the conventional model.

There are many cases where two fans of this size are used in series to achieve high cooling performance. However, it is difficult to satisfy performance requirements using this method, therefore fan with further high performance in same room is necessary.

In response to this need, Sanyo Denki developed the first counter rotating fan of its size in the industry, the high air flow, high static pressure fan "San Ace 172" CR Type (ϕ172 x 150 x 102 mm thick).

3. Product Features

Fig. 1 shows a profile of the "San Ace 172" CR type fan (hereinafter referred to as the "new model").

The features of the developed product are as follows:

(1) High air flow
(2) High static pressure
(3) Low power consumption
(4) PWM control function

Fig. 1: "San Ace 172" CR type

4. Product Overview

4.1 Dimensions

Fig. 2 shows the dimensions of the new model.

4.2 Characteristics

4.2.1 General characteristics

Rated voltage is 48 V DC, rated speed is 7,300 min^{-1} (Inlet fan) and 6,400 min^{-1} (Outlet fan).

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.

4.3 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).

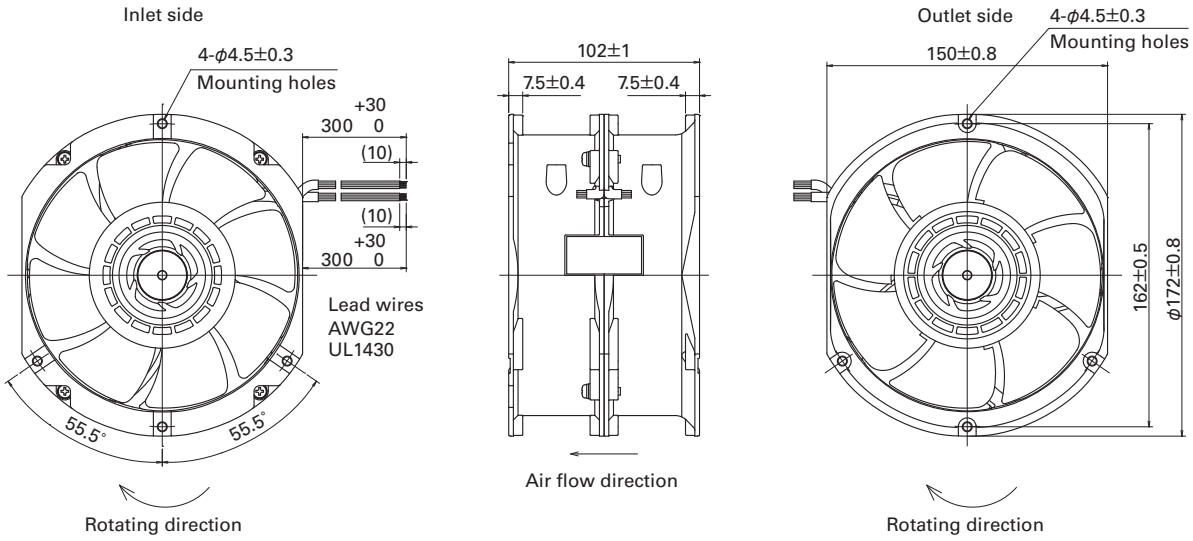


Fig. 2: Dimensions of the new model (unit: mm)

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}]		Max. air flow		Max. static pressure		SPL [dB(A)]	Operating temperature [°C]	Expected life [h]
						Inlet	Outlet	[m^3/min]	[CFM]	[Pa]	[inchH_2O]			
9CR5748P9G001	48	36 to 72	100	5.5	264	7300	6400	18	636	1400	5.62	83	-10 to +70°C	40,000
			0	0.5	24	2400	1900	5.5	194.3	152	0.61	54		

*Input PWM frequency: 25 kHz

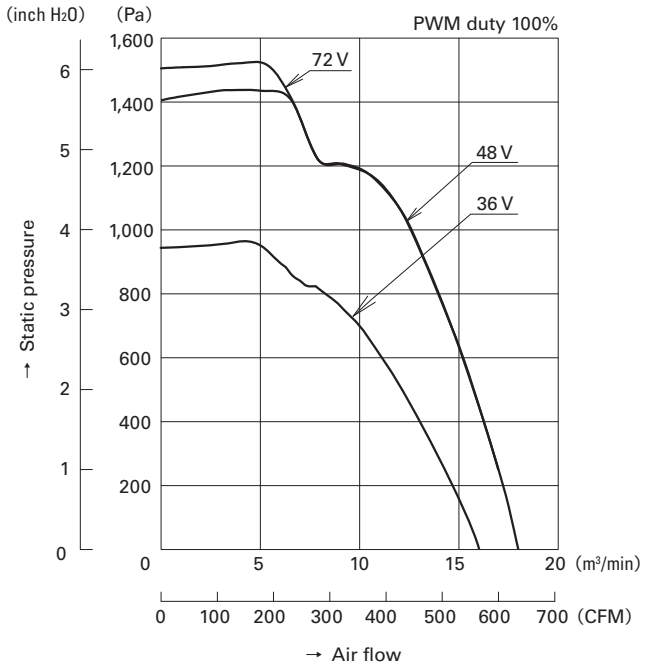


Fig. 3: Air flow vs. static pressure

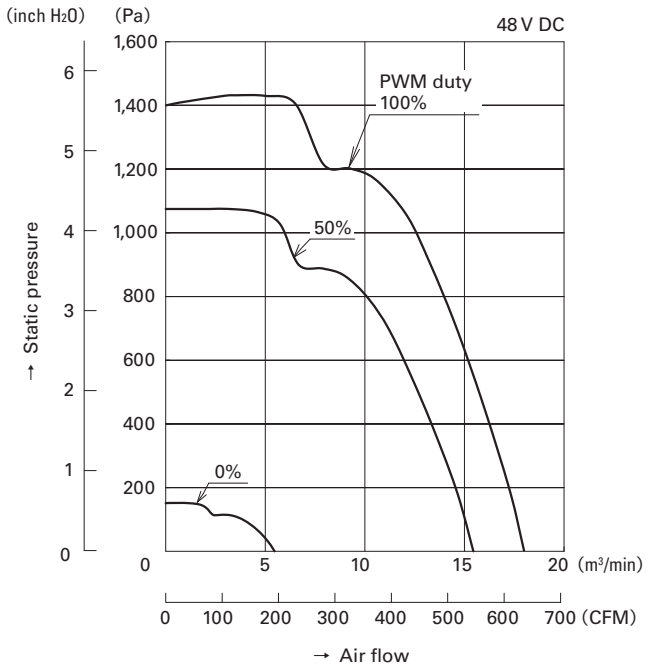


Fig. 4: Air flow vs static pressure characteristics at individual PWM duty cycle

5. Comparisons with our Conventional Model

Because the new model is the first counter rotating fan of its size, a high performance impeller and frame were newly designed.

As a result, high air flow and high static pressure were improved significantly even when compared with 2 of our highest air flow conventional models (9SG5748P9G001) used in series. Below is a comparison and introduction of features.

5.1 Comparison of air flow versus static pressure

Fig. 5 shows the air flow vs static pressure for the new model and when 2 conventional models are used in series.

With the expected system impedance, the new model achieves a cooling performance with an air flow improved by 22% and static pressure improved by 50%.

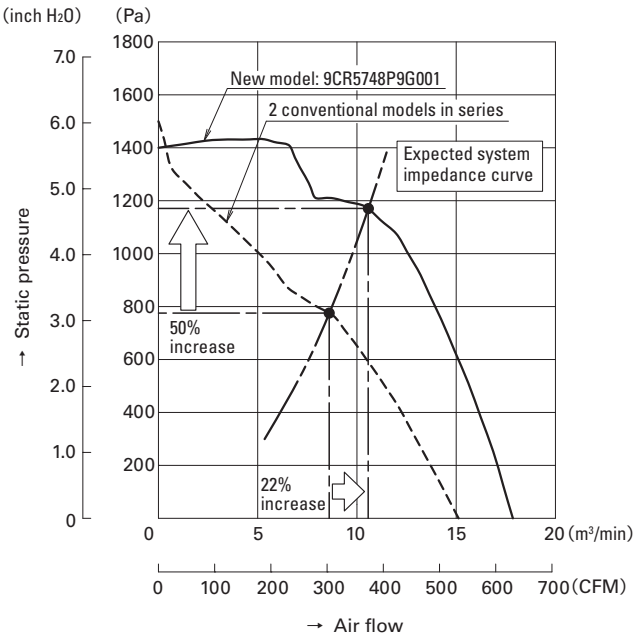


Fig. 5: Air flow vs static pressure characteristics (comparison between the conventional model and the new model)

5.2 Comparison of power consumption

Fig. 6 shows the air flow vs static pressure of the new model compared to 2 conventional models used in series, with the expected system impedance.

The new model has 17% less power consumption with the expected system impedance.

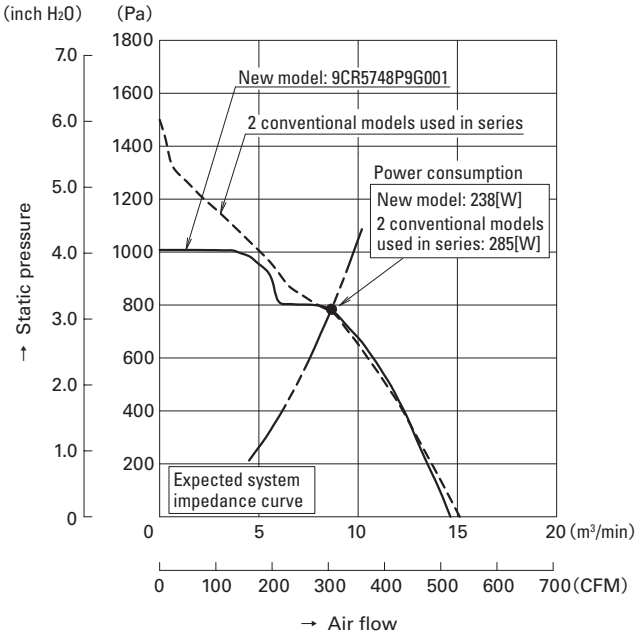


Fig. 6: Example of air flow vs static pressure with the expected system impedance

5.3 Improvements from the conventional model

The new model has a significantly higher air flow and static pressure compared with the conventional model. The frame and impeller shape were modified to achieve high performance and the temperature increase of the motor and electrical components was reduced.

6. Example of Adoption

This section introduces an adoption example of the new model. Table 2 shows one adoption example of this new model and Fig. 7 shows the customer's equipment. The new model was originally developed for cooling ICT devices, however due to its high air flow performance, it was adopted for the air-conditioning of a mouse cage for medical research. It is a new kind of adoption which demands higher performance than ever before.

Table 2: Adoption example of the new model

Field	Medical research equipment
Equipment overview	Mouse cage for medical research
Adopted model	9CR5748P9G001
Purpose of use	Air-conditioning for mouse cage
Customer's requirements	A fan with an extremely high air flow is required in order to distribute air evenly through the closely packed cages in the equipment.
Customer's evaluation	The new model matches the customer's purpose with its high air flow and high static pressure not seen in the conventional models.
Customer's merits	By using a fan with high air flow and high static pressure, the total number of fans used for the equipment is kept to a minimum, thereby saving space.

Fig. 7: View of customer's equipment

7. Conclusion

This document introduced some of the features and abilities of the newly developed high air flow, high static pressure counter rotating fan “San Ace 172” CR type fan.

The new model achieves dramatically higher air flow and static pressure compared to Sanyo Denki conventional model, and at the operation point at expected system impedance, it also realizes lower power consumption. Therefore, the new model can greatly contribute to handling higher heat and higher density that will likely continue to grow for equipment while also contributing to lower power consumption for the entire device.

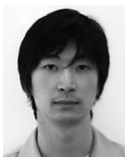
Takashi Kawashima
Joined Sanyo Denki in 2011.
Cooling Systems Division, Design Dept.
Worked on the development and design of cooling fans.

Izumi Onozawa
Joined Sanyo Denki in 2007.
Cooling Systems Division, Design Dept.
Worked on the development and design of cooling fans.

Satoshi Fujimaki
Joined Sanyo Denki in 1982.
Cooling Systems Division, Design Dept.
Worked on the development and design of cooling fans.

Toshiya Nishizawa
Joined Sanyo Denki in 1999.
Cooling Systems Division, Design Dept.
Worked on the development and design of cooling fans.

Yasuhiro Maruyama
Joined Sanyo Denki in 2001.
Cooling Systems Division, Design Dept.
Worked on the development and design of cooling fans.



Atsushi Yanagisawa
Joined Sanyo Denki in 2006.
Cooling Systems Division, Design Dept.
Worked on the development and design of cooling fans.

Hayato Murayama
Joined Sanyo Denki in 2006.
SANYO DENKI (Shenzhen) CO., LTD.
Worked on the development and design of cooling fans.

Yuusuke Okuda
Joined Sanyo Denki in 2010.
Cooling Systems Division, Design Dept.
Worked on the development and design of cooling fans.