ϕ136 mm x 28 mm Thick Reversible Flow Fan "San Ace 136RF" 9RF Type

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1. Introduction

In recent years, cooling fans are increasingly used for purposes other than cooling. These applications require airflow, such as for household ventilation, beverage vending machines, food show cases and printing machines.

In regards to household ventilation, for example, there is the case of bringing external air into a room or the case of removing air inside a room in order to adjust the temperature of the room. In the past, for this type of case, it was necessary to install separate fans, one for intake and one for exhaust.

As such, a demand rose for a fan which could provide airflow in both directions to reduce equipment cost and installation space.

In order to meet this demand, Sanyo Denki developed and commercialized a new fan that can provide airflow in both directions, the ϕ136 mm x 28 mm thick reversible flow fan "San Ace 136RF" 9RF type.

This report introduces the features and performance of this product.

Fig. 1: ϕ136 mm x 28 mm thick "San Ace 136RF" 9RF type

2. Product Features

Figure 1 shows a photograph of the "San Ace 136RF" 9RF type fan (hereinafter referred to as the "new model").

The features of the new model are as follows.

(1) Virtually the same airflow vs. static pressure characteristic in both directions
(2) A function to switch airflow direction
(3) The same shaped mounting opening on both the impeller side and the label side

As the new model can direct airflow in both directions, the airflow directions are defined as follows;

· Forward: Brought in from the impeller side and directed to the label side
· Reverse: Brought in from the label side and directed to the impeller side

3. Outline of the New Models

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 models.

The new model is available with a rated voltage of 12 V DC or 24 V DC and both of these have a rated speed of 3,100 min^{-1}.

3.2.2 Airflow vs. static pressure characteristics

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

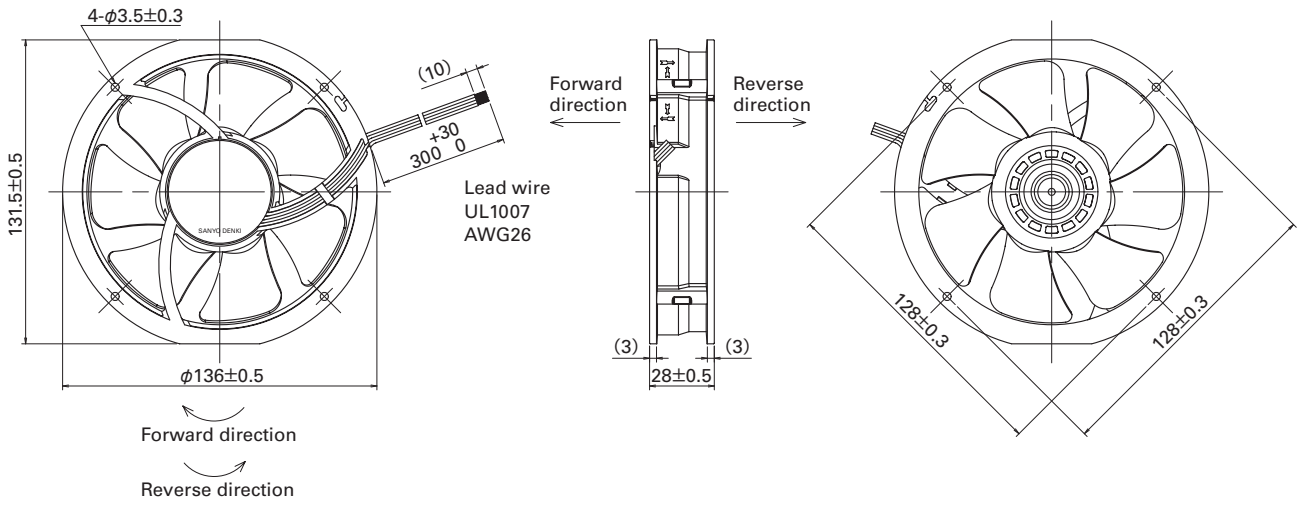

Fig. 2: Dimensions of the new model (unit: mm)

Table 1: General characteristics for the new model

Model No.	Airflow direction	Rated Voltage [V]	Operating voltage range [V]	PWM duty cycle [%]	Rated current [A]	Rated input [W]	Rated speed [min^{-1}]	Max. airflow [m³/min]	Max. airflow [CFM]	Max. static pressure [Pa]	Max. static pressure [inchH₂O]	SPL [dB(A)]	Operating temperature [°C]	Expected life [h]
9RF1312P3H001	Forward	12	10.2 to 13.8	100	0.15	1.8	3,100	2.00	70.7	102	0.410	35	-20 to +70	40,000/ 60°C
	Reverse			0	0.15	1.8	3,100	2.00	70.7	104	0.418	46		
9RF1324P3H001	Forward	24	20.4 to 27.6	100	0.09	2.2	3,100	2.00	70.7	102	0.410	35		
	Reverse			0	0.09	2.2	3,100	2.00	70.7	104	0.418	46		

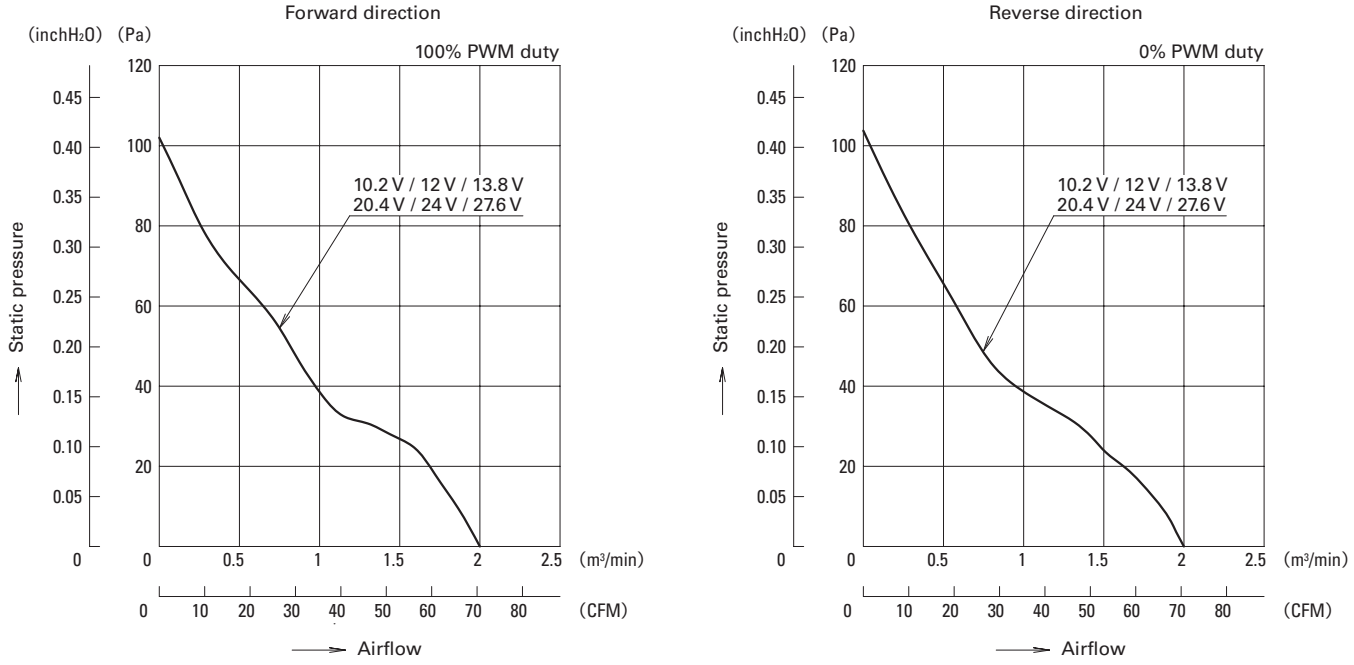

Fig. 3: Airflow vs. static pressure of the new model

3.2.3 Airflow direction switchover function

Figure 4 shows PWM duty versus rotating speed for the new model.

Maximum forward flow speed is reached when PWM duty cycle is at 100%, while maximum reverse flow speed is reached when PWM duty cycle is at 0%. The fan will stop when PWM duty cycle is at 50%.

Furthermore, if the control lead wire is connected to the minus power cable, maximum reverse flow speed will be obtained, and if it is not, maximum forward flow speed will be obtained.

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).

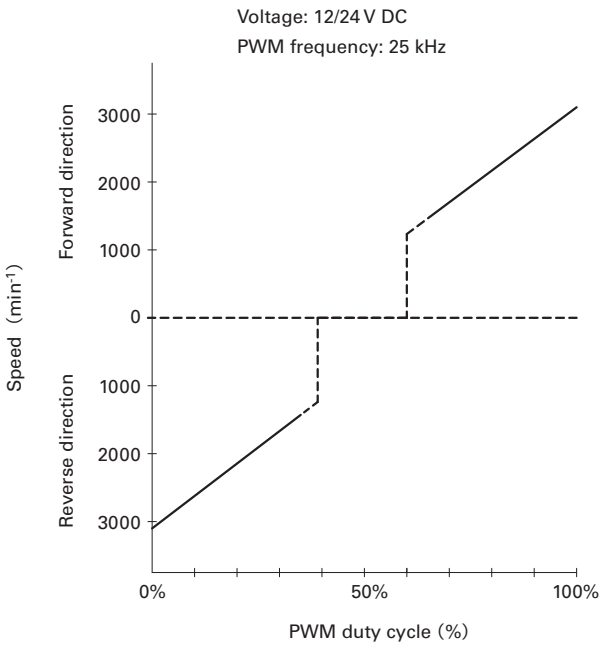

Fig. 4: An example of the new model's PWM duty speed characteristic

4. Development Point

The new model has a function to switch between airflow directions and was designed to make the airflow vs. static pressure characteristic of both directions as equal as possible.

Below we introduce the development points which enabled the various features of the new model to be achieved.

4.1 Impeller and frame shape

So that the airflow vs. static pressure could be kept as equal as possible in both airflow directions, we adopted an impeller shape not used on the conventional model and optimized the angle, quantity and so forth.

Moreover, airflow efficiency declines in the reverse direction due to the frame spokes interfering, however by changing the shape of the blades and frame inner diameter we were able to achieve virtually equal airflow vs. static pressure in both airflow directions.

As a result, we believe it has become easier to visualize airflow control when customers design their equipment.

4.2 Motor and circuit

In regards to the motor and circuit, we revised the drive circuit so that the single phase drive motor which only rotates in one direction can rotate in two directions and achieved a control method which could switch between forward and reverse airflow by an external PWM signal.

Moreover, we have made it possible to switch rotational directions without the PWM signal as maximum reverse speed is obtained by connecting the control lead wire to the minus power cable, while maximum forward speed is achieved by not doing so.

As shown in Figure 4, the new model features a PWM speed control function to enable adjustment to the appropriate speed and this is believed to contribute to the reduction of sound pressure level (SPL) and power consumption of our customers' equipment on the whole.

4.3 Shape of the fan mounting opening

With the intention of simplifying equipment design and sheet metal machining for our customers, we redesigned the fan mounting opening into a simple circular shape and made the impeller and label sides the same shape.

Figure 5 shows reference dimensions for the mounting opening on the new model, while Figure 6 shows an example of mounting to the new model's sheet metal.

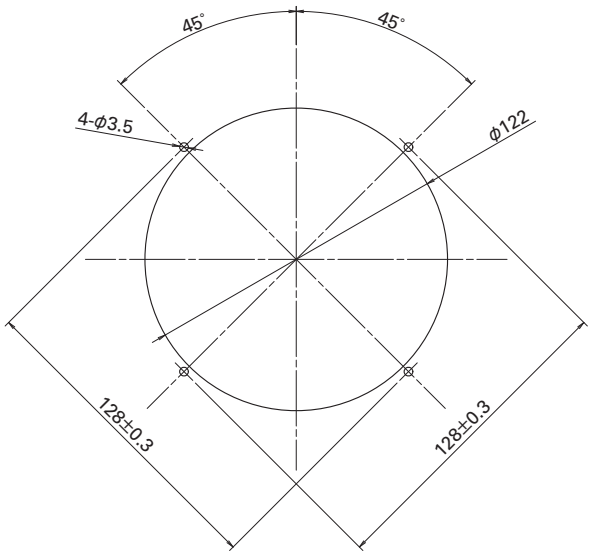

Fig. 5: Reference dimensions of the mounting opening for the new model

Fig. 6: Example of mounting on the new model's sheet metal

5. Comparison of New Models and Conventional Models

5.1 Space-saving through reducing fan number

In the case of household ventilation, etc. there is the case of bringing external air into a room or the case of removing air inside a room. In the past, this kind of situation required at least one intake fan and one exhaust fan.

The new model is capable of directing airflow in both directions singlehandedly, therefore comparing the fan size with a conventional model that has the same impeller size as the new model (120 mm sq., 25mm thick 9G type), it is possible to reduce space by approximately half when installing one new model compared to when two conventional models are used

Figure 7 shows a comparison of the fan size of one new model and that of two conventional models.

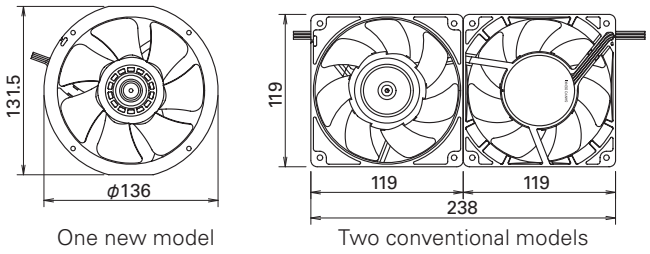

Fig. 7: Comparison of fan size for one new model and two conventional models

5.2 Comparison of airflow vs. static pressure characteristic, power consumption and SPL

Figure 8 gives a comparison of the forward airflow of the new model 9RF1312P3H001 and the airflow vs. static pressure characteristic of the conventional model 9G1212H401. Figure 9 gives a comparison of the reverse airflow of the new model and the airflow vs. static pressure characteristic of the conventional model 9G1212H401. Tables 2 and 3 show comparisons of power consumption and SPL at this time, making each intersecting point based on the presumed system impedance the operating points.

At the operating points on the presumed system impedance, the new model consumes around 19% less power than the conventional model for both the forward and reverse directions. Meanwhile, the SPL of the new model is equal to the conventional model in the reverse direction, however 4 dB (A) less in the forward direction.

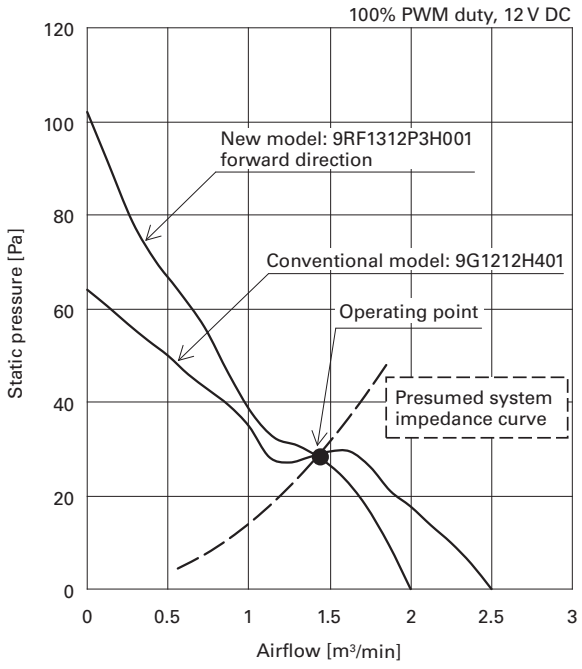

Fig. 8: Airflow vs. static pressure (Comparison of the new model forward direction and the conventional model)

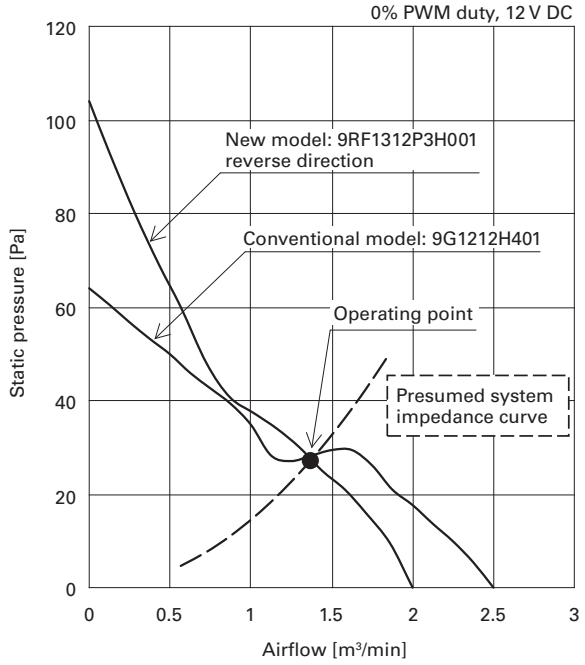

Fig. 9: Airflow vs. static pressure
(Comparison of the new model's reverse direction and conventional model)

Table 2: Comparison of power consumption and SPL at the operating points on the presumed system impedance (Comparison of the new model forward direction and the conventional model)

	Power consumption [W]	SPL* [dB(A)]
New model 9RF1312P3H001 forward direction	2.6	40
Conventional model 9G1212H401	3.2	44

* Value at 1 m from inlet side

Table 3: Comparison of power consumption and SPL at the operating points on the presumed system impedance (Comparison of the new model reverse direction and the conventional model)

	Power consumption [W]	SPL* [dB(A)]
New model 9RF1312P3H001 reverse direction	2.6	46
Conventional model 9G1212H401	3.2	46

* Value at 1 m from inlet side

6. Conclusion

This report has introduced some of the features and performance of the ϕ136 mm x 28 mm thick reversible flow fan "San Ace 136RF" 9RF type, the first product of this type for Sanyo Denki.

The new model has a function to switch between airflow directions and is a fan with virtually equal airflow vs. static pressure characteristic in both directions. In other words, this product alone can satisfy the needs of equipment which conventionally used multiple fans to direct air in two directions.

In this way, we can expect the new model to help our customers reduce their equipment cost and installation space as well as greatly contribute to new fields and markets other than cooling.

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