High Airflow Splash Proof Centrifugal Fans *San Ace 225W* and *San Ace 221W*

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1. Introduction

In recent years, due to higher performance and functionality, there has been a constant increase in the amount of heat generated by outdoor equipment such as cellular base stations, ICT equipment, and PV inverters. Accordingly, greater demands have emerged for cooling fans that offer both water resistance and high airflow.

Moreover, there is an increasing demand for waterproof, high airflow fans for use in new applications such as large air conditioning equipment, commercial refrigerators, dust collectors, etc.

In response, SANYO DENKI has developed two high airflow Splash Proof Centrifugal Fans: *San Ace 225W* and *San Ace 221W*. This article will introduce the features and performance of the high airflow Splash Proof Centrifugal Fans *San Ace 225W* and *San Ace 221W* 9W2T type (hereinafter "new models").

2. Product Features

Figures 1 and 2 show the external views of the new models.

The features of the new models are as follows:

(1) High airflow
(2) Dustproof and waterproof performance with an IP56 ingress protection rating*
(3) PWM control function

* IP56 ingress protection rating
The degree of protection (IP code) is defined by IEC (International Electrotechnical Commission) 60529 "DEGREES OF PROTECTION PROVIDED BY ENCLOSURES (IP Code)" (IEC 60529:2001)

Fig. 1: ø225 × 99 mm *San Ace 225W* 9W2T type

Fig. 2: ø221 × 71 mm *San Ace 221W* 9W2T type

3. Product Overview

3.1 Dimensions

Figures 3 and 4 show the dimensions of the new models.

3.2 Specifications

3.2.1 General specifications

Tables 1 and 2 show the general specifications.

3.2.2 Airflow vs. static pressure characteristics

Figures 5 and 6 show the airflow vs. static pressure characteristics for the new models.

3.2.3 PWM control function

The new models have a PWM control function that enables external control of the 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.

3.3 Expected life

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

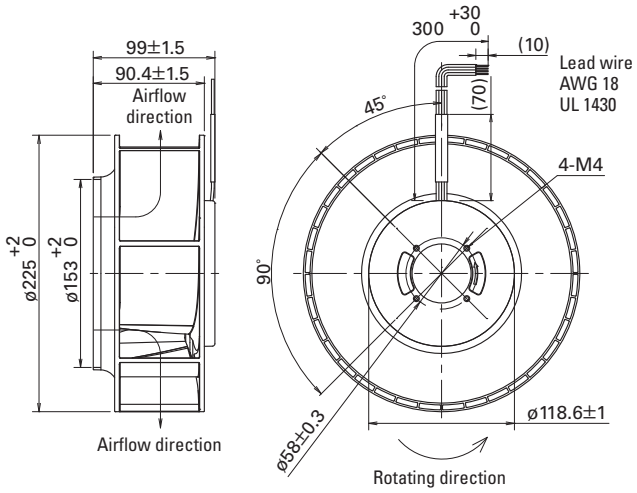

Fig. 3: Dimensions of the ø225 × 99 mm *San Ace 225W* 9W2T type (unit: mm)

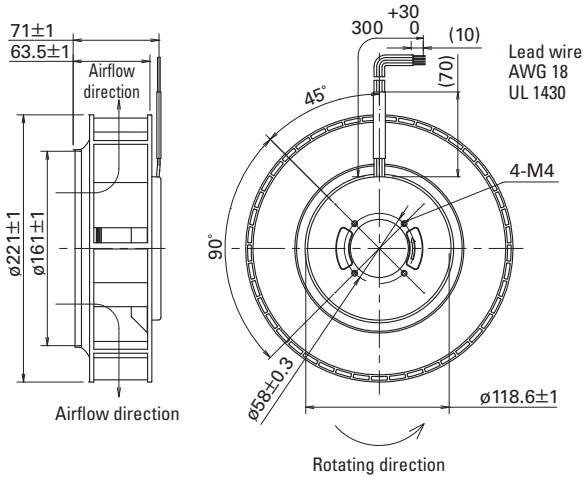

Fig. 4: Dimensions of the ø221 × 71 mm *San Ace 221W* 9W2T type (unit: mm)

Table 1: General specifications of the ø225 × 99 mm *San Ace 225W* 9W2T type

Model no.	Rated voltage [V]	Operating voltage range [V]	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]	SPL [dB(A)]	Operating temperature [°C]	Expected life [h]
9W2TS48P0S001	48	36 to 72	100	2.45	117.6	3,000	23.5	830	635	2.55	72.0	-25 to +70	40,000 at 60°C (70,000 at 40°C)
			15	0.24	11.5	1,000	7.83	276	70.6	0.28	52.5		

* Input PWM frequency: 25 kHz. Speed is 0 min^{-1} at 0% PWM duty cycle.
When equipped with our inlet nozzle [separately sold (model no.: 109-1134H)]

Table 2: General specifications of the ø221 × 71 mm *San Ace 221W* 9W2T type

Model no.	Rated voltage [V]	Operating voltage range [V]	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]	SPL [dB(A)]	Operating temperature [°C]	Expected life [h]
9W2TP24P0H001	24	16 to 36	100	3.35	80.4	3,050	17.6	621	530	2.13	71.5	-25 to +70	40,000 at 60°C (70,000 at 40°C)
			15	0.4	9.6	1,000	5.75	203	57.0	0.23	53.5		
9W2TP48P0S001	48	36 to 72	100	2.3	110.4	3,400	19.6	692	659	2.65	73.5		
			15	0.2	9.6	1,000	5.75	203	57.0	0.23	53.5		

* Input PWM frequency: 25 kHz. Speed is 0 min^{-1} at 0% PWM duty cycle.
When equipped with our inlet nozzle [separately sold (model no.: 109-1135H)]

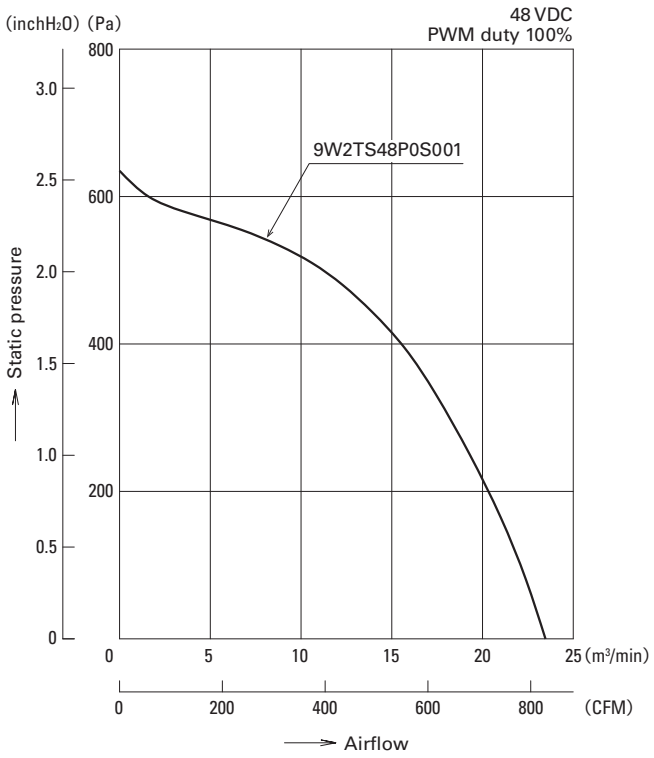

Fig. 5: Airflow vs. static pressure characteristics of the ø225 × 99 mm *San Ace 225W* 9W2T type

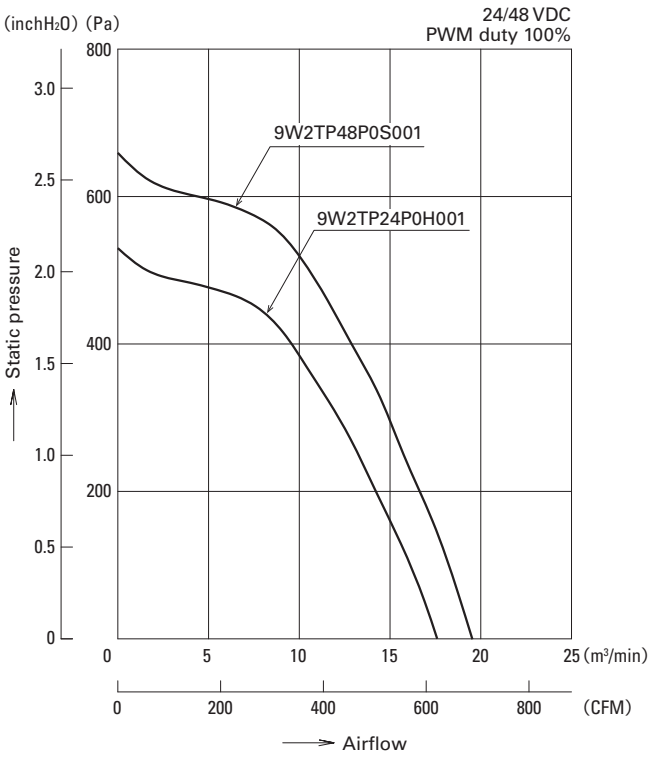

Fig. 6: Airflow vs. static pressure characteristics of the ø221 × 71 mm *San Ace 221W* 9W2T type

4. Key Points of Development

Based on the performance and structural components of our current High Airflow Centrifugal Fans *San Ace C225* and *San Ace C221*, the new models have adopted a structure never seen in our current Splash Proof Fans to achieve higher airflow.

The key points of development are explained below.

4.1 Waterproof design

Our current Splash Proof Fans are available in two types of structure. The first type covers the live parts (PCB, control circuit, motor) completely with epoxy resin, and the second type has a waterproof labyrinth structure to contain the live parts in its internal space.

The new models are large fans with high currents, therefore an electrolytic capacitor is used. As the pressure valve portion of the electrolytic capacitor must not be blocked, we couldn't employ the complete coverage with epoxy resin.

Due to the high current and high-heat generating control circuit components, we originally considered adopting a labyrinth sealing structure which allows enough space around the control circuit components for air ventilation as an alternative to covering the electrolytic capacitor in epoxy resin, etc. Studying various structures, we had a hard time achieving both internal air ventilation and waterproof performance because securing ventilation air space around the components always led to water ingress.

Consequently, we adopted a new structure where only the motor portion is covered in epoxy resin and the PCB and control circuit are contained in the space within the frame and top cover.

Figure 7 shows an external view of the live parts of the new models.

The frame and top cover are aluminum and painted for increased corrosion-resistance, improving reliability.

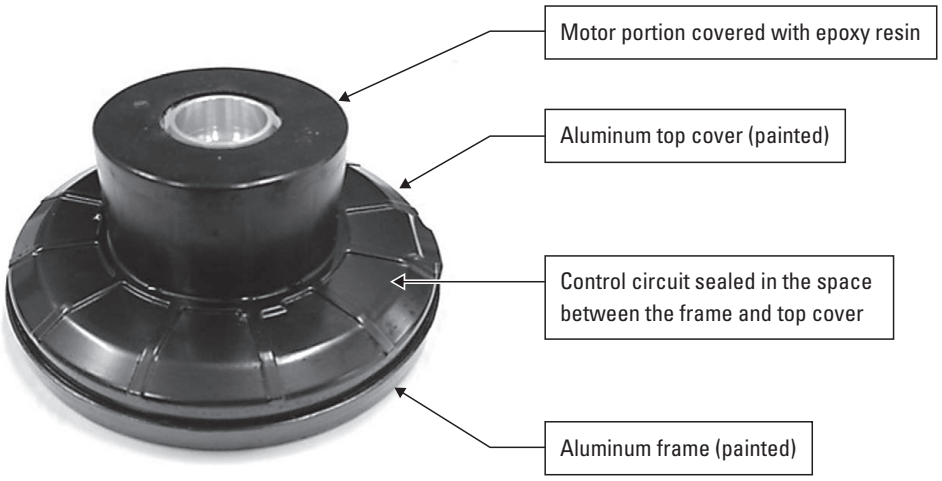

Fig. 7: External view of the live parts of the new models

4.2 Heat dissipation design to improve motor efficiency

Because the control circuit components of the new models are contained in a narrow space, the components cannot be directly air-cooled. It could shorten the life of the electrolytic capacitor if the temperatures of the control circuit components and the surrounding air rise. Therefore there is a need to reduce the temperature rise in a way other than air-cooling.

The new models achieved higher motor efficiency and reduced heat generation by revising the motor height, magnet height, and magnet material of the development base high airflow Centrifugal Fan. Moreover, by using a bigger PCB with no change in fan dimensions and optimizing the arrangement of the high-heat generating components, we could reduce the temperature rise, achieving high airflow and waterproof performance.

Table 3 compares motor efficiency of the current model and new model.

Table 3: Motor efficiency comparison

	Motor efficiency [%]	
	Base fan	New model
At minimum load (at maximum static pressure)	76	77
At maximum load	75	78

5. Comparison with our Current Model

Figure 8 compares the airflow vs. static pressure characteristics of 9W2TS48P0S001 (ø225 × 99 mm), the highest-airflow model among the new models and 9W1TG48P0H61 (ø175 × 69 mm), the highest-airflow model among our current Splash Proof Centrifugal Fans.

The new model features significantly improved 2.6 times higher maximum airflow and 1.7 times higher maximum static pressure.

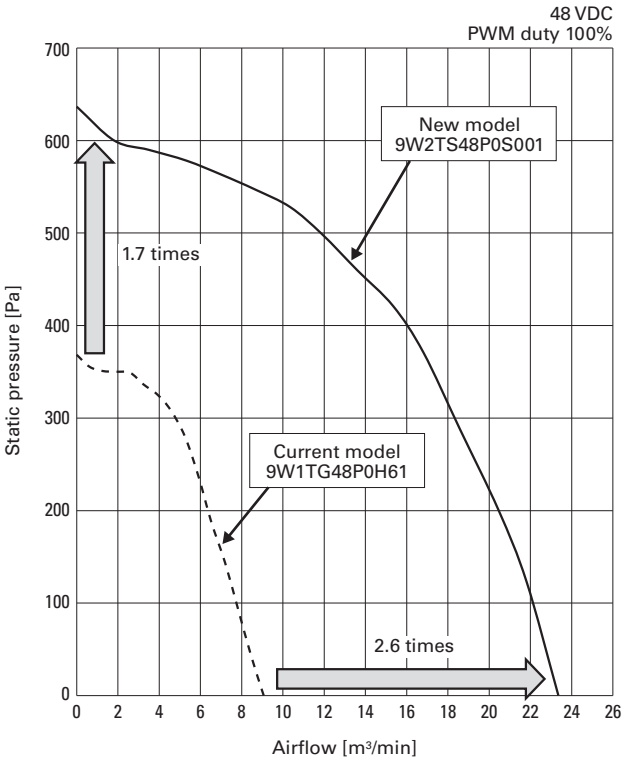

Fig. 8: Airflow vs. static pressure characteristics

6. Conclusion

This article has presented some of the features and performance of the high airflow Splash Proof Centrifugal Fans *San Ace 225W* and *San Ace 221W* 9W2T type we developed.

The new models achieved high airflow and an IP56 dust/waterproof rating by adopting a new water-resistant structure, improving motor efficiency, and optimizing the arrangement of high-heat generating components.

The ø225 × 99 mm sized fan has achieved the industry's highest* airflow as a splash proof centrifugal fan. The *San Ace 221W* 9W2T type fan is the first splash proof centrifugal fan of its size in the industry.*

It is predicted that outdoor equipment will be generating more and more heat and the demand for fans offering both high airflow and waterproof capability will continue to grow. It is also predicted that the demand for splash proof centrifugal fans will continue to grow for new applications such as air conditioning units and dust collectors.

By achieving both high airflow and dust/waterproof performance, we believe that the new models can help solve the issues our customers face.

SANYO DENKI will continue to stay ahead of the diversifying market and develop products that create value for our customers.

* Based on our own research as of July 3, 2017.

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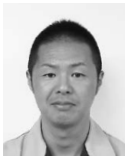

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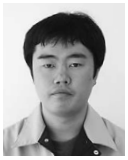

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