ø225 × 99 mm Centrifugal ACDC Fan and Splash Proof Centrifugal ACDC Fan *San Ace 225AD* 9AD Type

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1. Introduction

In markets for heat exchangers, residential air ventilation systems, and renewable energy inverters, an increasing amount of heat is generated due to higher performance and functionality of these devices. As such, high airflow, high static pressure centrifugal fans are used in a growing number of cases.

These devices are often used outdoors or in environments where there is only AC power available, requiring AC-driven fans with waterproof performance. Another need is to lower fan power consumption for achieving energy savings for devices.

As such, by using an AC-powered DC motor circuit in a centrifugal fan, we developed the *San Ace 225AD* Splash Proof Centrifugal ACDC Fan which offers low power consumption and waterproof performance.

In parallel, we also developed the ø225 × 99 mm Centrifugal ACDC Fan, a non-waterproof model with better airflow vs. static pressure characteristics, for applications that do not require waterproofing.

This article will introduce the performance and features of the new models as well as key points of development.

2. Product Features

Figure 1 shows the appearance of the new models.

The only external differences between the waterproof and non-waterproof models are in their harness and nameplate.

The features of the new models are as follows:

(1) No DC power supply required
(2) PWM control function
(3) High airflow and high static pressure
(4) Low power consumption
(5) Low sound pressure level (SPL)
(6) Dustproof and waterproof performance with an IP56 ingress protection rating[Note]

Note: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 *San Ace 225AD*

3. Product Overview

3.1 Dimensions

Figure 2 shows the dimensions of the new models.

3.2 Specifications

3.2.1 General specifications

Tables 1 and 2 show the general specifications for the new models.

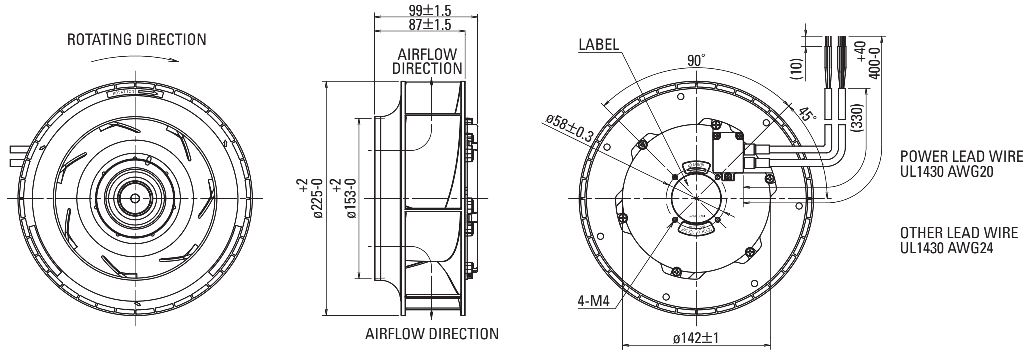


Fig. 2 Dimensions of the ø225 × 99 mm Centrifugal ACDC Fan (unit: mm)

Table 1 General specifications of the ø225 × 99 mm Centrifugal ACDC Fan

Model no.	Rated voltage [V]	Operating voltage range [V]	PWM duty cycle* [%]	Rated current [A]	Rated input [W]	Rated speed [min^{-1}]	Max. airflow		Max. static pressure		SPL [dB(A)]	Operating temperature range [°C]	Expected life [h]
							[m^3/min]	[CFM]	[Pa]	[inchH$_2$O]			
9ADTS11P0G001	115	90 to 132	100	3.6	155	3,200	23.0	812	815	3.27	74	-20 to +60	40,000/ 60°C
			20	0.3	10	1,000	7.1	252	80	0.32	50		
9ADTS11P0F001			100	1.6	70	2,450	17.6	621	480	1.93	68		
			20	0.3	10	1,000	7.1	252	80	0.32	50		
9ADTS23P0G001	230	180 to 264	100	2.0	155	3,200	23.0	812	815	3.27	74		
			20	0.2	10	1,000	7.1	252	80	0.32	50		
9ADTS23P0F001			100	0.9	70	2,450	17.6	621	480	1.93	68		
			20	0.2	10	1,000	7.1	252	80	0.32	50		

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

Table 2 General specifications of the ø225 × 99 mm Splash Proof Centrifugal ACDC Fan

Model no.	Rated voltage [V]	Operating voltage range [V]	PWM duty cycle* [%]	Rated current [A]	Rated input [W]	Rated speed [min^{-1}]	Max. airflow		Max. static pressure		SPL [dB(A)]	Operating temperature range [°C]	Expected life [h]
							[m^3/min]	[CFM]	[Pa]	[inchH$_2$O]			
9ADW1TS11P0H001	115	90 to 132	100	2.9	140	3,100	22.3	787	760	3.05	73	-20 to +60	40,000/ 60°C
			20	0.3	11	1,000	7.1	252	80	0.32	50		
9ADW1TS11P0M001			100	1.4	61	2,350	16.9	597	440	1.77	67		
			20	0.3	11	1,000	7.1	252	80	0.32	50		
9ADW1TS23P0H001	230	180 to 264	100	1.9	140	3,100	22.3	787	760	3.05	73		
			20	0.2	11	1,000	7.1	252	80	0.32	50		
9ADW1TS23P0M001			100	0.8	61	2,350	16.9	597	440	1.77	67		
			20	0.2	11	1,000	7.1	252	80	0.32	50		

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

3.2.2 Airflow vs. static pressure characteristics

Figures 3 and 4 show the airflow vs. static pressure characteristics for the new models.

3.2.3 PWM control function

The new models have PWM control function and are capable of controlling fan speed.

3.3 Expected life

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

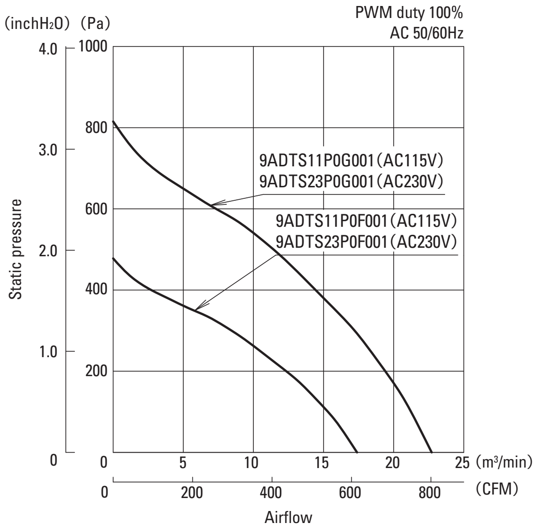


Fig. 3 Airflow vs. static pressure characteristics of the ø225 × 99 mm Centrifugal ACDC Fan

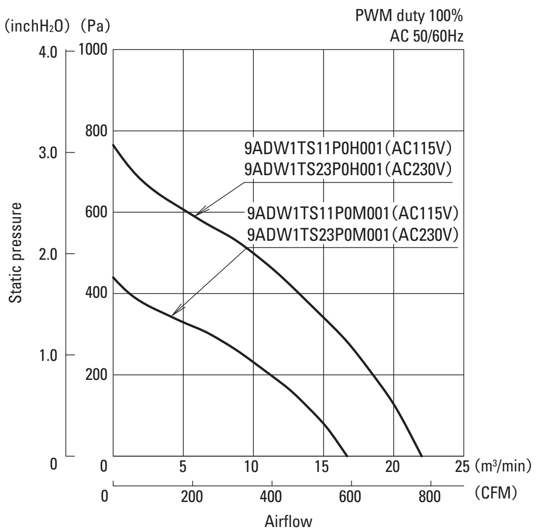


Fig. 4 Airflow vs. static pressure characteristics of the ø225 × 99 mm Splash Proof Centrifugal ACDC Fan

4. Key Points of Development

Even with an AC-DC converter installed, the new models have the same size as our current DC Centrifugal Fan and achieve high airflow and static pressure performance. Also, we successfully waterproofed the fan using a method different from our conventional method that covers live parts completely with epoxy resin.

The key points of development are explained as follows.

4.1 Waterproof design

The new models use an electrolytic capacitor in the AC-DC converter. As the pressure valve portion of the electrolytic capacitor must not be blocked, we couldn't use a waterproofing method that covers the capacitor completely with epoxy resin.

Consequently, we achieved waterproofing for the splash proof fan with a structure where only the motor portion is covered with epoxy resin while the circuit is enclosed in the space within the frame and top cover. Figure 5 shows the appearance of the live parts.

Moreover, we applied anti-corrosion coating for the aluminum frame and top cover, improving reliability.

4.2 PCB design

The new models are larger than our current models of 9AD type (92 × 92 mm, 120 × 120 mm). So, using the same circuit configuration as these would result in insufficient circuit capacity to operate the motor. To tackle this issue, we focused on the following: choosing components which can withstand high power levels, optimizing the circuit configuration, and re-examining the thermal distribution method for high heat emitting components. Through these improvements, we were successfully able to drive a motor that requires 30 times more power than conventional models.

Also, the new models are AC-input fans and need a high-voltage input. As such, they require more space between components than DC fans that only require a low-voltage input. But this allowed us to place fewer components on a PCB, making our PCB layout design difficult. Moreover, large components must be used to support high power. In the early stages of development, we placed a drive control circuit and AC-DC converter on two separate PCBs, causing an issue of increased frame volume.

As a solution to this issue, we placed the electrolytic capacitor on a spacer. Figure 6 shows how components are mounted with a spacer. Using a spacer enabled components to be placed even under the electrolytic capacitor, allowing both the drive control circuit and AC-DC converter laid out on a PCB. This solved the issue of increased frame volume.

4.3 Impeller design

The new models have an AC-DC converter and circuit configuration supporting high power, resulting in increased volume of the circuit and motor portion than our DC Centrifugal Fan of equal size. Figure 7 shows a comparison of the impellers. The new models have a smaller ventilation area than the DC Centrifugal Fan, therefore are disadvantaged performance-wise. As such, we carefully adjusted the impeller shape to obtain the maximum static pressure and airflow as possible with a limited ventilation area.

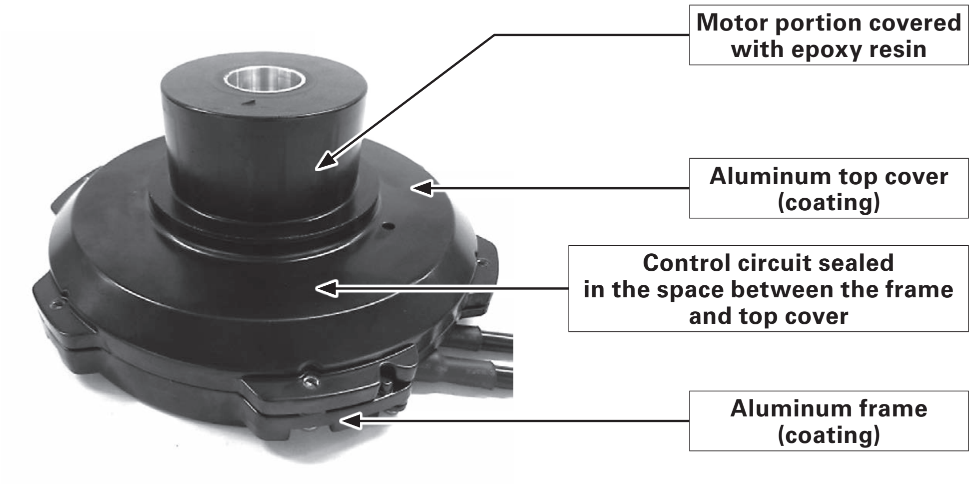


Fig. 5 Appearance of the live parts

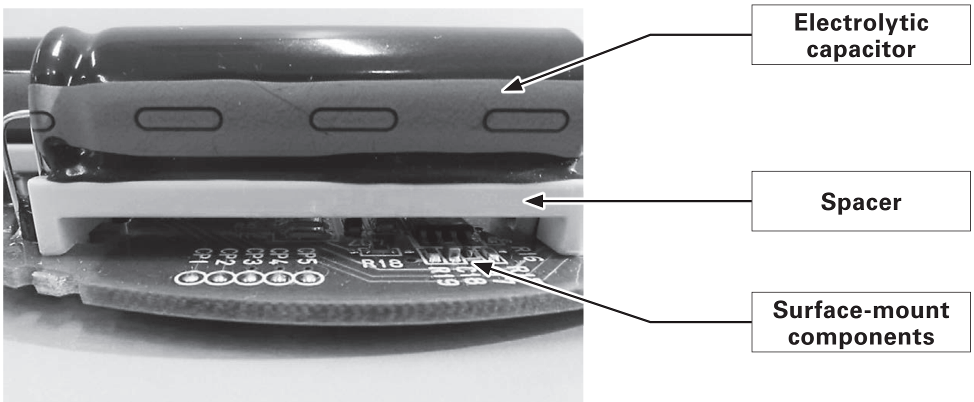
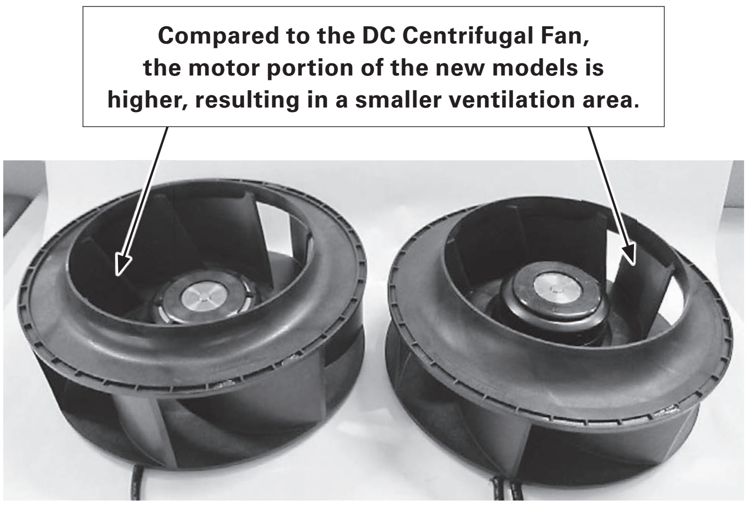


Fig. 6 Components mounted using a spacer



DC Centrifugal Fan (*San Ace C225*)   New model

Fig. 7 Comparison of new model and DC Centrifugal Fan impellers

We employed fluid analysis during impeller design and optimized the impeller shape through repeated cycles of model-making with a 3D printer and measurements. As a result, we succeeded in achieving high airflow and high static pressure performance at the same speed as the DC Centrifugal Fan despite the reduced ventilation area.

5. Conclusion

This article introduced some of the features and performance of the ø225 × 99 mm *San Ace 225AD* Centrifugal ACDC Fan and Splash Proof Centrifugal ACDC Fan.

The new models, with an AC-DC converter equipped and the same size as the current DC Centrifugal Fan, achieve equivalent airflow and static pressure. Moreover, these were our first products to have IP56-rated dustproof and waterproof performance with an AC-DC converter.

We believe that the new models will significantly contribute to energy savings and the cooling of devices used outdoors or in environments with only AC power.

Moving forward, we will continue to stay ahead of the changing market and develop products that create new value for customers and make customers' dreams come true.

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