

"SAN ACE MC note"

Michinori Watanabe

Toshiki Ogawara

Takashi Kaise

1. Introduction

As microprocessors (CPU) have become much faster in recent years, electronic equipment such as personal computers (PC) has progressed remarkably. In slim equipment such as notebook type personal computers, the heat dissipated inside the equipment has increased in line with the increased CPU performance, reduction in size and overall performance improvement of the equipment. As a result, forced air cooling such as by using cooling fans has become necessary in order to ensure stable operation of the CPU and entire equipment. A problem of the notebook type personal computer is that the forced cooling devices used in desk-top computers cannot be used in notebook computers due to the limited space available.

This report describes the development and features of a solution for this problem, namely "SAN ACE MC note" which is designed to fit in limited spaces such as in notebook computers.

2. Background of Development

The CPU alone of a typical modern notebook computer generates about 6 to 7 watts. Considering the additional heat generated by the other peripheral devices of the CPU, forced air cooling is becoming inevitable in such computers.

Sanyo Denki has developed and released CPU cooling device, "SAN ACE MC" series that was developed on the premise that the cooling device would be used in the products that had sufficient internal space such as desk-top computers. Hence, application of conventional "SAN ACE MC" to the thin products such as notebook computers was difficult. However, even if this forced cooling device could be used in thin notebook computers, the heated air from the heat sink would be exhausted in four directions and would circulate inside the computer, raising the internal temperature. It is thus not an appropriate method of cooling the entire system. "SAN ACE MC note" device of "SAN ACE MC" series was developed to overcome these problems for notebook computers.

3. Features of "SAN ACE MC note"

[Fig. 1](#) shows outside appearance of "SAN ACE MC note."

"SAN ACE MC note" is thin cooling device in which the cooling fan and the heat sink are combined as a single unit. This device is designed mainly for internal cooling of notebook computers.

Table 1 shows the performance of "SAN ACE MC note." This product has the following features.

- (1) Sanyo Denki's unique ventilation structure of fan and heat sink
- (2) Frame structure suitable for assembly into computer
- (3) High cooling performance when built into computer
- (4) Heated air exhaust in one direction only

- (5) High reliability
- (6) ON/OFF function of the fan
- (7) Connector for easy installation .

Table 1 Specifications of "SAN ACE MC note"

Model	109P4405H9026
Rated voltage (V)	5
Operating voltage range (V)	4.5 to 5.5
Rated current (A)	0.14
Rated input (W)	0.7
Rated rotation speed (min ⁻¹)	6000
Thermal resistance (°C)	3.2
Acoustic noise (dB[A])	27
Mass (g)	25
25	
Size (mm)	44.5sq. × 10

3.1 Structure

[Fig. 2](#) shows the dimensions of "SAN ACE MC note" and [Fig. 3](#) shows its internal structure.

"SAN ACE MC note" has the following structural features.

- (1) The fan is located at the intake side of the cooling air while the heat sink is located at the outlet side. This structure greatly prolongs the life of the fan and improves the cooling efficiency of the fan and heat sink.
- (2) The unique frame structure provides a cooling air passage even when obstacles are placed near the intake side of the fan. This structure prevents a decrease in the amount of fan air when "SAN ACE MC note" is installed in a computer and minimizes adverse effects on the cooling performance.
- (3) The ventilation system is such that the intake air drawn in by the fan is exhausted in one direction only. This allows the heated air to be exhausted outside of the equipment after passing over the heat sink.
- (4) The bearing used in the thin device has a large load rating, assuring high reliability.

3.2 Cooling Characteristics

3.2.1 Volume of Air versus Static Pressure Characteristics

[Fig. 4](#) shows an example of the volume of air versus static pressure characteristics of "SAN ACE MC note."

The dotted line in [Fig. 4](#) shows the effect of an obstacle wall of size 100×65 mm when placed at the intake plane of the fan. The dotted line shows the minimal effect of the obstacle wall. This is due to the unique frame shape mentioned in Section 3.1.

3.2.2 Thermal Resistance

The thermal resistance is shown in Table 1 when there are no obstacles. When "SAN ACE MC note" is installed in a device, the air flow changes depending upon the installation conditions, and so the value of the thermal resistance also changes. The thermal resistance is 3.95°C/W when the obstacle wall used in Section 3.2.1 is placed at the intake plane of the fan. The temperature rise at the contact surface of

the heat sink is thus given as follows, assuming that the temperature of the intake air remains the same and that the input from the cooled object attached to the heat sink is 8 watts:

①When there are no obstacles:

$$3.2^{\circ}\text{C}/\text{W} \times 8\text{W} = 25.6^{\circ}\text{C}$$

②Where there is an obstacle wall:

$$3.95^{\circ}\text{C}/\text{W} \times 8\text{W} = 31.6^{\circ}\text{C}$$

The temperature rise is thus only 6°C with the obstacle wall, compared to without the wall.

Thus "SAN ACE MC note" offers superior cooling characteristics when installed in thin equipment.

3.3 Fan ON/OFF Control Function

"SAN ACE MC note" has a fan ON/OFF control function. Table 2 shows the specifications and [Fig. 5](#) shows a connection example.

When the fan ON/OFF control function is used, for example, coupled with a temperature sensor such as thermistor, the fan stops when temperature inside the equipment becomes constant, and starts only when the temperature inside the equipment starts to rise. This reduces the overall power consumption of the equipment.

Table 2 Control specification

Control terminal	State of rotation
Hi level	Fan stops
Lo level	Fan rotates
Hi impedance	Fan rotates

4. Conclusion

We have introduced the main features of our "SAN ACE MC note" that complements the Sanyo Denki's "SAN ACE MC" product series.

As the heat generated by notebook computers increases, demand for thin-type forced air cooling devices such as "SAN ACE MC note" is likely to increase. "SAN ACE MC note" will also be used in other compact and thin devices in addition to notebook computers.

Michinori Watanabe

Joined company in 1989

Cooling Systems Division, Design Dept.

Worked on development and design of "SAN ACE MC"

Toshiki Ogawara

Joined company in 1984

Cooling Systems Division, Design Dept.

worked on development and design "SAN ACE MC"

Takashi Kaise

Joined company in 1990

Cooling Systems Division, Design Dept.

Worked on development and design of "SAN ACE MC"

Fig. 3 Internal structure of "SAN ACE MC note"

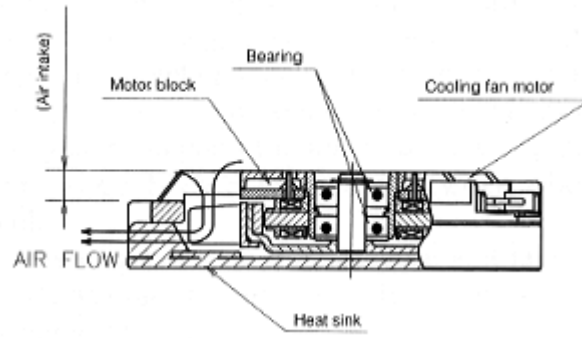


Fig. 4 Example of volume of air versus static pressure

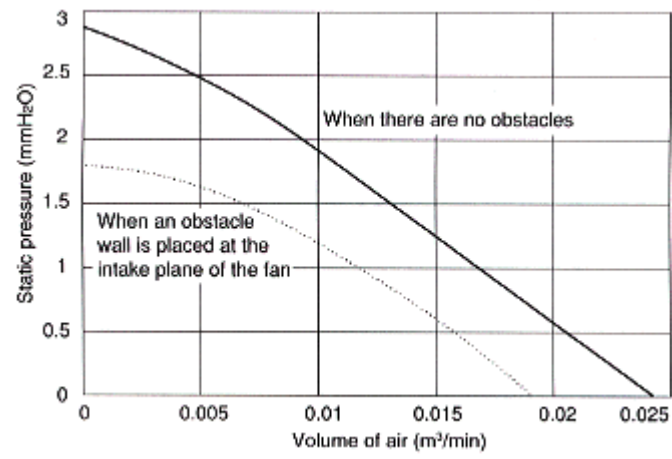


Fig. 5 Connection example of "SAN ACE MC note"

