Technical Data

Characteristics of Fans and Blowers

■ Airflow - static pressure characteristics (PQ characteristics)

1. Pressure loss (Ventilating resistance)

A force to obstruct the flow of air (pressure loss) is generated when air is channeled onto equipment, due to the parts layout and the shape of the air stream inside the equipment. This phenomenon is called ventilating resistance (also called "system impedance" and "channel resistance"). Air meets only modest resistance when it moves straight ahead within a wide space. (Fig. 1) When air passes through a narrow space or when the direction of an airflow changes, the ventilating resistance increases. (Fig. 2) The ventilating resistance increases further unless an outlet path (or a circulation path) is provided because an airflow cannot be created.

Ventilating resistance is small

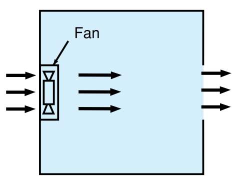


Fig. 1

Ventilating resistance is large

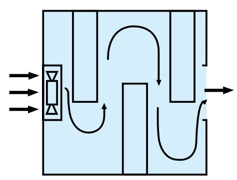


Fig. 2

2. Differences in PQ characteristics of fans and blowers

As illustrated in Fig. 3, the PQ characteristics exhibit characteristic trends when a motor of equivalent power is used. The fan has a large airflow and its static pressure is 1/2 to 1/5 that of the blower. The blower has large static pressure and its airflow is 1/2 to 1/5 that of the fan.

In the absence of a ventilating resistance (0 Pa), the max. airflow (QFmax) flows, under circumstances where there are no objects located around the fan (This free air condition is the x-axis). However, this condition does not exist as long as a fan is assembled in equipment. The state showing considerable ventilating resistance and a lack of airflow corresponds to the y-axis in Fig. 3 and the airflow is zero because the air does not move. In this condition, there are obstacles in front and to the rear of a fan that prevent airflow or that shut off the circulation path of the air. This operating condition cannot be considered when a fan is used for cooling or ventilation purposes. (Continuing operation in this condition may damage the fan.)

The actual operating conditions vary between the two aforementioned extremes. Fig. 3 plots four ventilating resistances (plotted via quadratic curves). Units of equipment containing either a fan or a blower have varying ventilating resistances, of which these four curves show typical examples. The airflow flowing into the equipment is at the intersection between the ventilating resistance curve and the PQ characteristics of the fan or the blower. The curve of Ventilating Resistance 1, which has the smallest inclination, is assumed to be the ventilating resistance of ordinary equipment. At this ventilating resistance, there are no large obstacles in front and to the rear of the fan and an adequate circulation path is provided. The fan can be operated most efficiently at this Ventilating Resistance 1, where about 80 % of the maximum fan airflow is possible. (Airflow of QF2 with a fan and of QB2 with a blower respectively)

Of the four curves, the airflow of any equipment that has Ventilating Resistance Curve 4, with the largest inclination, will be a fraction of the max. airflow, even though a high performance fan or blower is installed. In this condition, the airflow will be QB1 with a blower and QF1 with a fan, the airflow of the blower being larger.

The airflows of Ventilating Resistance Curves 2 and 3, in between, will also be airflows at the intersection with the respective PQ characteristics. NIDEC SERVO supplies fans dedicated to a high static pressure region, with fan motors optimally designed for intermediate ventilating resistances. As Fig. 4 explains, quieter and energy saving operations are more feasible in the high static pressure region compared with ordinary axial fans. (See page G-36)

By minimizing the ventilating resistance of the equipment and by using power-saving fans and blowers, both cost and noise reduction can be achieved, resulting in an ideal cooling solution. (Actual example: Ventilating resistance was reduced and quiet operation achieved by changing the thickness of a 92 square fan from 32 to 25 with equipment having densely mounted parts (Ventilating Resistance 3 in Fig. 4).

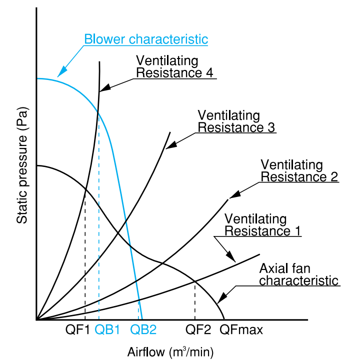


Fig. 3

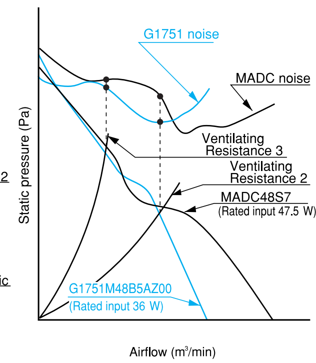


Fig. 4

3. Method for calculating the required fan airflow

The method to calculate the required airflows (ventilation rates) is described for the cooling of equipment which generates heat.

The airflow (ventilation rate) necessary for internal equipment cooling is calculated as follows: (Note: the entire heat is exhausted by ventilation airflow and heat from radiation or conduction is not taken into consideration)

$$Q = \frac{W}{\rho \times C \times \Delta T} = \frac{W}{1200 \times \Delta T}$$

Q : Required airflow 〔m³/s〕
W : Heat generation rate 〔W〕
ρ : Specific weight of air 〔kg / m³〕
C : Specific heat of air 〔J / kg°C〕
ΔT : temperature rise of air 〔°C〕

(ρ and C are values at 25 °C. Use the value 1100 instead of 1200 at 50 °C)

Example: When wishing to limit the air temperature rise inside equipment that generates 100 W of heat, the following calculation formula is used:

$$Q = \frac{100}{1200 \times 10} = 8.3 \times 10^{-3}\ m^3/s = 0.50\ m^3/min$$

An airflow of 0.50 m³/ min or more is required. This calculation formula for the required airflows (ventilation rate) can be translated into a graph as shown in Fig. 5.

Air temperature rise and required airflow

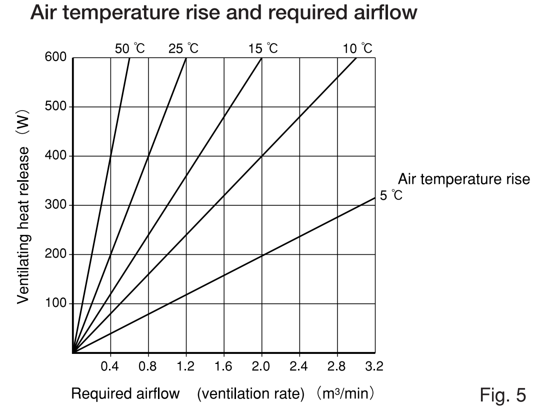


Fig. 5

4. Fan and blower selection

The required airflow and ventilating resistance of equipment must be determined when selecting a fan or a blower. However, accurate determination of a ventilating resistance is difficult. In general you can select a fan's max. airflow by multiplying the required airflow by 1.3 to 1.5. (The following figure [Fig. 6] shows the case of an air channel with an area approximately equal to that of the fan.)

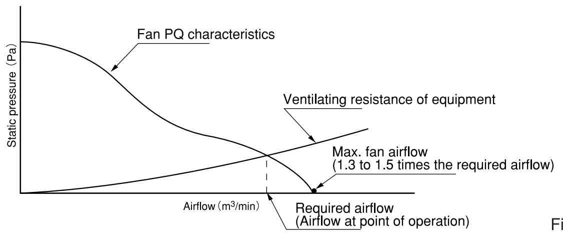


Fig. 6

If an adequate air channel is not available due to a high density of mounted parts, a fan with a max. airflow of more than two times the required airflow is sometimes needed. In this case, a special fan for a high static pressure region or a blower is recommended.

The following methods are used to accurately determine the ventilating resistance of equipment:

1) Send the equipment to a fan manufacturer and ask them to measure the ventilating resistance.

2) If 3D data of the equipment is available, ask the fan manufacturer to calculate the resistance.

3) Install a fan or a blower, whose relationship between the PQ characteristics and speed is already known, within the equipment and determine the ventilating resistance by measuring the speed.

5. PQ characteristics via the parallel or serial operations of axial fans Parallel operation of 2 fans

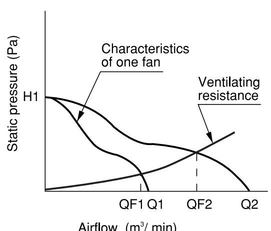


Fig. 7

When two fans are operated in parallel, only the max. airflow will double. Intersections QF1 and QF2 with ventilating resistance curves of the equipment will be the airflow actually flowing. This mode is advantageous when wishing to increase the airflow of equipment with only modest ventilation resistance.

Serial operation of 2 fans

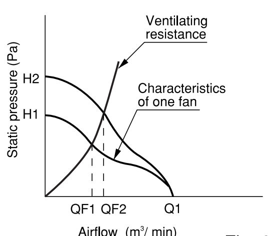


Fig. 8

When two fans are operated in series (stacked), only the maximum static pressure will increase by 1.5 times. Intersections QF1 and QF2 with ventilating resistance curves of the equipment will be the airflow actually flowing.

This mode is advantageous when wishing to increase the airflow of equipment with high ventilation resistance.

(Note: A fan specially designed for a high static pressure region will be further advantageous for equipment that has high ventilating resistance. [See Fig. 9.])

Serial operation of 2 fans with stationary blades for a high static pressure region

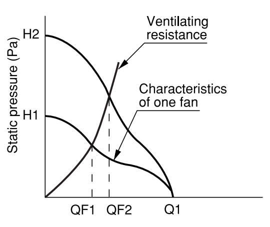


Fig. 9

When two fans are run in series (stacked), only the maximum static pressure will increase by 1.8 to 2 times. NIDEC SERVO special fans for high static pressure regions have stationary blades and achieve a lower reduction in static pressure during serial operation. The intersections QF1 and QF2 with ventilating resistance curves of the equipment will be the airflows actually flowing.

6. Voltage imposed to fan and blower and PQ characteristics

DC powered fans and blowers have the following relationship between the imposed voltage and the PQ characteristics. The following information will be useful when fine tuning performance or when using a fan or a blower for experimental purposes:

(Note: Only test operation is allowed to be used outside of the specified voltage range. Note that this information is not applicable to AC powered fans, nor to certain DC fans. [Example: SADC fans] Please check the product information pages.)

Operation at 10 % higher voltage

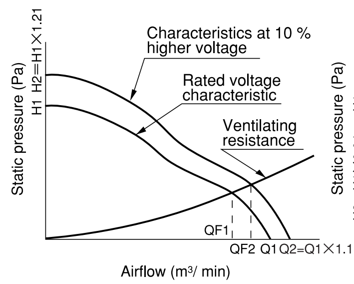


Fig. 10

Operation at 20 % lower voltage

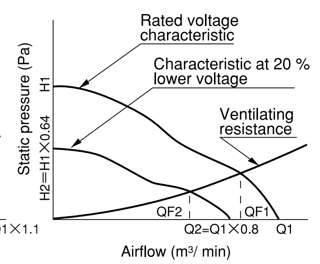


Fig. 11

The speeds of fans and blowers vary in proportion of the voltage. Varying the voltage ±10 % will also cause the speed to vary by ±10 %. The speed affects the static pressure and airflow as follows. The static pressure varies based on the square of the speed and the airflow varies in proportion of the speed. Varying voltage±10 % will cause the maximum static pressure to vary -19 to +21%, and the max. airflow to vary ±10 %. (See Fig. 10.)

An understanding of these relationships will allow free adjustment of the PQ characteristics during fan and blower operation.

7. Performance degradation of PQ characteristics when options are installed

Options such as a fan guard and filter are sometimes installed for safety. These options, however, increase the ventilation resistance and noise. A fan guard has slight ventilation resistance and degrades the PQ characteristics only negligibly. However, when tightly fitted onto a fan, the noise level increases by about +1 to +5 dB. In particularly, options should be installed more than 10 mm away from the fan to minimize the increase in noise.

Using a □120 mm×38 mm AC fan (CN55B3) as an example, fluctuations of the PQ characteristics when options are installed are plotted in Figs. 12 and 13.

Fan guard installed

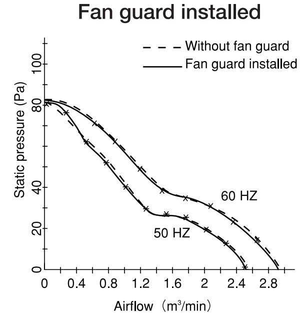


Fig. 12

Filter installed

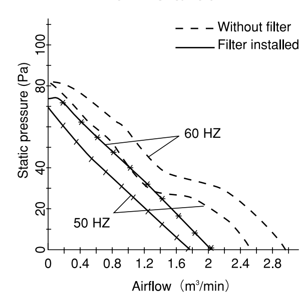


Fig. 13

8. Unit conversion tables of PQ characteristics

At present, the PQ characteristics are expressed in Japan by Pa (static pressure) and m^3/min (airflow). Use the following conversion tables for conversion between CFM, which is used in some countries, and between the units previously used in Japan.

Table 1 Static pressure conversion table

Pa=N/m^2	mmH_2O	inH_2O	kgf/cm^2	atm	bar	lbf/in^2
1	1.02×10^{-1}	4.02×10^{-3}	1.02×10^{-5}	9.87×10^{-6}	1.00×10^{-5}	1.45×10^{-4}
9.81	1	3.94×10^{-2}	1.00×10^{-4}	9.68×10^{-5}	9.80×10^{-5}	1.42×10^{-3}
2.49×10^{2}	25.4×10^{1}	1	2.54×10^{-3}	2.46×10^{-3}	2.49×10^{-3}	3.61×10^{-2}
9.81×10^{4}	1.00×10^{4}	3.94×10^{2}	1	9.68×10^{-1}	9.81×10^{-1}	14.2×10^{1}
1.01×10^{5}	1.03×10^{4}	4.07×10^{2}	1.03	1	1.01	14.7×10^{1}
1.00×10^{5}	1.02×10^{4}	4.02×10^{2}	1.02	9.87×10^{-1}	1	14.5×10^{1}
6.9×10^{3}	7.03×10^{2}	2.77×10^{1}	7.03×10^{-2}	6.81×10^{-2}	6.90×10^{-2}	1

Table 2 Airflow conversion table

m^3/s	m^3/min	l/S	l/min	m^3/h	ft^3/S	CFM
1	6.00×10^{1}	1.00×10^{3}	6.00×10^{4}	3.60×10^{3}	3.53×10^{1}	2.12×10^{3}
1.67×10^{-2}	1	1.67×10^{1}	1.00×10^{3}	6.00×10^{1}	5.89×10^{-1}	3.53×10^{1}
1.00×10^{-3}	6.00×10^{-2}	1	6.00×10^{1}	3.60	3.53×10^{-2}	2.12
1.67×10^{-4}	1.00×10^{-3}	1.67×10^{-2}	1	6.00×10^{-2}	5.89×10^{-4}	3.53×10^{-2}
2.78×10^{-4}	1.67×10^{-2}	2.78×10^{-1}	1.67×10^{1}	1	9.81×10^{-3}	5.88×10^{-1}
2.83×10^{-2}	1.7	2.83×10^{1}	1.70×10^{3}	1.02×10^{2}	1	6.00×10^{1}
4.72×10^{-4}	2.83×10^{-2}	4.72×10^{-1}	2.83×10^{1}	1.70	1.67×10^{-2}	1

9. Measurement method of PQ characteristics

The aerodynamic characteristic measuring apparatus is illustrated in Fig. 14. This apparatus conforms to the ANSI/AMCA Standard 210-85, as well as JIS B 8330 (Testing methods for turbo-fans).

It is very difficult to measure PQ performance with high accuracy and the various measuring equipment used by fan manufacturers feature a wide range of accuracy. For this reason, simultaneous acquisition of comparable data obtained by the same measuring apparatus is recommended when verification of strict variation in performance is desired. (NIDEC SERVO also measures the comparative data of fans manufactured by other fan manufacturers as a customer service - please make use of this.)

Aerodynamic test apparatus (Double chamber type)

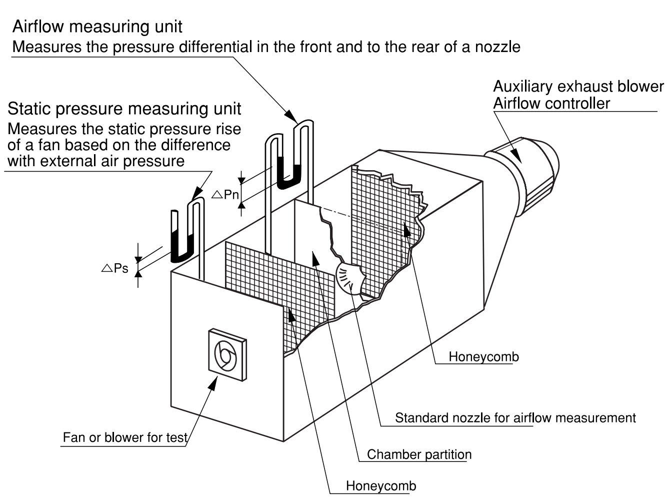


Fig. 14

■ Noise

1. Types of noise

Noise is generated by the combination of various conditions. Measures to eliminate or reduce noise can be taken more easily by analyzing the details of the noise.
When reducing the noise of your equipment, take into account the following factors that contribute toward noise generation:

Aerodynamic noise	Noise of rotation	Propeller sound・・ Sound emitted by the revolutions of blades Periodic flow fluctuations of flow・・・・・ Interference and air separation with stationary blades, strut and venturi.
	Eddy flow sound	Turbulence in inflow flow, random eddy discharge from the eddy flow boundary layer on blade surfaces and air separation.
Mechanical noise	Vibration sound	Mechanical motor vibration sound・・・ Imbalanced revolutions, resonance and vibration transfer sound. Electromagnetic sound of motor・・・ Vibration sound by phase change (switching).
Cavity noise		Air column resonance and other sounds

2. Noise of fan

The noise of the fan itself (catalog noise) is measured in a small anechoic room, in which background noise is adequately low, in a free-air state with no objects surrounding the fan. The aerodynamic noise (blade sound) and motor sound are the principal noise sources.

3. Noise after installation in equipment

After installing the fan in your equipment the noise level sometimes increases drastically (up 8 dB to 15 dB) compared with the noise emitted by the fan itself. This is caused by the resonance of the fan vibration within the equipment, an obstacle in front of the intake (the fan guard may also become an obstacle), an increase in load noise due to ventilating resistance, the use of a fan with excessively large power, an insufficient circulation path, and other causes.

Noise can be reduced significantly by reducing the factors that increase noise. (In the best case scenario, only the noise level of the fan itself is generated)

NIDEC SERVO provides a service to analyze customers' equipment noise. Please contact NIDEC SERVO with your requirements.

4. Noise measurement

Noise is measured in accordance with the test method specified in JIS C 9603 Ventilating fans in Range A measurement, placed in a position 1 m in front of the intake side of fans and blowers. (Background noise 15 dB (A))

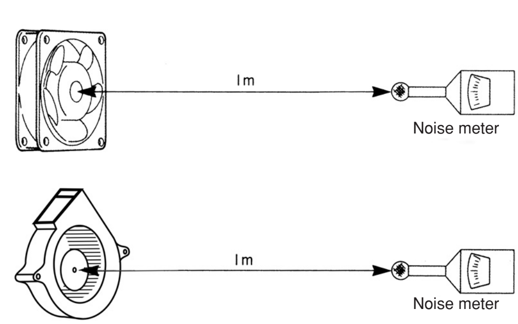


Fig. 15

Technical Data

5. Noise calculation

Noise is a sound pressure value measured in a position where the energy of a sound source arrives. It is called a sound pressure level (SPL) and is expressed in dB.

If the sound energy increases 10 times, the sound level increases 10 dB and 60 dB represents sound pressure energy that is 1000 times that of 30 dB and 10000 times that of 20 dB.

The total noise of several fans is calculated as follows:
(Noise values of individual values are L1, L2 .... Ln)

Total noise (L) = 10 log ($10^{L1/10} + 10^{L2/10} + \cdots\cdots 10^{Ln/10}$)

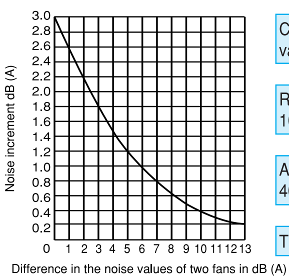
Example: If four fans individually emit noise of 30 dB, 35 dB, 40 dB and 45 dB,
the total noise of the four fans will be:

$$L = 10\log(10^{30/10} + 10^{35/10} + 10^{40/10} + 10^{45/10}) = 46.6\text{ dB}$$

If all three fans emit 40dB, their total noise will be:

$$L = 10\log(10^{40/10} + 10^{40/10} + 10^{40/10}) = 40 + 10\log 3 = 44.8\text{ dB}$$

The noise can be calculated from the following graph in Fig. 16 if the noise difference between two fans is 13 dB or less:



Calculate the difference in the noise values of two fans 40 dB - 30 dB = 10 dB

↓

Read the value on the axis of ordinates from 10 dB on the axis of abscissas on the graph.→0.4 dB

↓

Add 0.4dB to the larger noise value. 40 dB + 0.4 dB = 40.4 dB

↓

The total noise of the two fans will be 40.4 dB

Fig. 16

6. Speed and noise value

A fan´s noise value is the total of the aerodynamic and motor noise. Most noise is aerodynamic in nature, except in products with a low speed.

The speed and noise value vary in proportion to the sixth power and the noise value increases when the speed increases. (Some people say that they vary in proportion to the fifth power.) Increasing the speed will double the max. airflow and quadruple the maximum static pressure. Noise increases 18.1 dB (+15 dB at the fifth power).

dB2 = dB1 + 60 log (N2/N1)
dB1: Noise value when the speed is N1
dB2: Noise value when the speed is N2

Speed	2000 min⁻¹ (Standard)	2200 min⁻¹	2600 min⁻¹	3000 min⁻¹	4000 min⁻¹
Noise value	0	+2.5 dB	+6.8 dB	+10.6 dB	+18.1 dB

7. Propeller diameter and noise level

The fan noise is strongly linked to the propeller size. Comparing the noise of fans with equivalent speed, the noise theoretically varies to the seventh power of the propeller diameter as follows:

In reality, the propeller shape is not symmetric and calculations cannot be performed as explained in the theory. However, the noise value with equivalent airflow rate will be as shown in the following table, indicating that a larger fan will reduce noise. (Value calculated based on the theory that the airflow varies to the third power of the propeller diameter)

dB2 = dB1 + 70 log (D2/D1)
dB1: Noise value when the speed is D1
dB2: Noise value when the speed is D2

Propeller diameter	55 mm	75 mm	86 mm	114 mm (Standard)	121 mm	142 mm
Noise value with equivalent speed	−22.2 dB	−12.7 dB	−8.6 dB	0	+1.8 dB	+6.7 dB
Noise value with equivalent airflow	+34.8 dB	+20.0 dB	+13.5 dB	0	−2.8 dB	−10.5 dB

8. Object distance and noise value

The noise value (SPL) decreases as the sound source becomes distant while the fan noise value varies in proportion to the square of the distance and can be expressed by the following formula: (When the reflection sound to nearby walls is ignored)

dB2 = dB1 - 20 log (L2/L1)
dB1: Noise value when the distance from the sound source is L1
dB2: Noise value when the distance from the sound source is L2

Distance from sound	50 cm	1 m (Standard)	150 cm
source Noise value	+6 dB	0	−3.5 dB

9. Ventilating resistance and noise value

Fan manufacturers note the noise values in their catalogs assuming a free air condition (ventilating resistance 0). When fans are physically assembled in equipment, the ventilating resistance cannot be zero and the noise values listed in catalogs are for reference purposes only. A method used to estimate sound values when fans are assembled in equipment is described below.

A noise value at each point of the PQ characteristics is called "load noise" and fans and blowers have their own characteristics. (See Figs. 17 and 18.)
The load noise is the noise of the fan itself at the point of operation. Fan characteristics include a "neck" (dip) in the plotted curves. This dip is caused by turbulence in the airflow on the propeller surfaces and noise increases steeply between this part and a low airflow region.

The fan has an area where noise becomes lowest (region of higher airflow than the neck). The circulation path should be designed such as to reduce ventilating resistance. However, if the ventilating resistance cannot be reduced with any equipment after trying various ideas, the study of fans for a high static pressure region is recommended. These are fans that have been developed and designed to emit low noise in a high static pressure region compared with ordinary fans. (See Fig. 4 on pages G-6 and G-31 to G-36.)

As plotted in Fig. 18, the load noise of blowers generally varies only slightly, while trends in load noise differ from one product to another of the blower manufacturers. Even if the catalog values are the same, noise invariably varies at the same operating point.

The blowers manufactured by NIDEC SERVO are designed to emit the lowest noise at customers' operating points so that the customers can base catalog load noise values reliably as actual blower noise.

Load noise of fan (CNDC24B7)

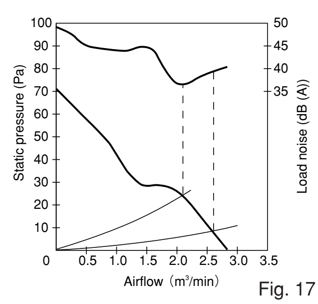


Fig. 17

Load noise of blower (E1331K and SCBD [former model])

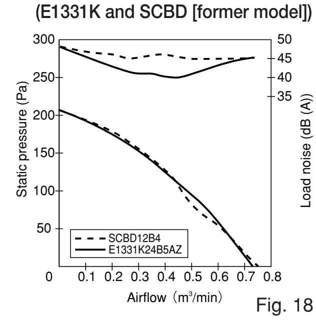


Fig. 18

10. Fan guards increase noise

When mounted directly onto a fan, a fan guard increases noise by about +1 to +5 dB. Install a fan guard more than 10 mm from equipment to reduce the increase in noise.

11. Equipment resonance with fan

The fan contains a motor that causes mechanical vibration and electrical vibration, which sometimes causes equipment containing a fan to resonate. This problem can be solved by combining the following three methods:
1) Cut off the vibration transfer route to equipment by providing a rubber vibration isolator or other cushioning.
2) Change the natural frequency of equipment by changing the board thickness or by other means.
3) Change to a low-vibration fan (customized product), in which case consult NIDEC SERVO for more information.

12. The low-noise benefits you can get from our GentleTyphoon. It has the perfect noise performance !

We at NIDEC Servo enhanced our Silent Fan Technology to bring you a brand new series called GentleTyphoon in 2008. Designers can expect drastic noise reductions when building products with this fan.
Our GentleTyphoon works to dampen noise in your products based on the combination of the propeller blades,which brings to mind spinning vortices of air and the square venturi which deters the occurrence of turbulence. Not only is the acoustic level improved, but so is overall noise quality.
The square shape offers compatibility conventional fans currently used by designers. Replace your current use fan for the GentleTyphoon and experience a tranquil quieting of your next device. (G-20 and G-23)

Technical Data

Life of fans and blowers

The life of fans is solely dependent on bearings. The bearing load P in relation to the basic rated load C is P<<C, (meaning P is a great deal smaller than C). Therefore we can say that grease life determines the fan life.
Grease life is significantly affected by ambient temperature. The fans of NIDEC SERVO feature a special design that minimizes grease temperature rises as illustrated below.

● AC fan

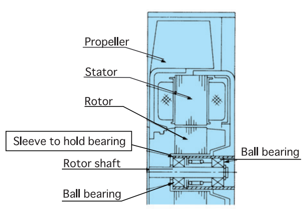


Fig. 21

● DC fan

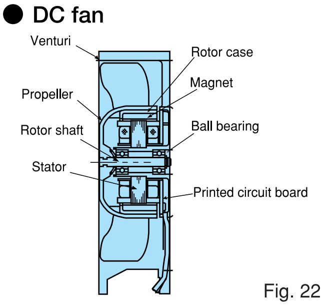


Fig. 22

■ Long-life structure

The fan motor contains two parts which generate heat, namely, the stator and rotor.
The AC fan holds a bearing in a dedicated sleeve to help retard the transfer of heat generated by the rotor, and limit the temperature rises of the bearing.
The DC fan has an external rotor structure and the temperature of the bearing is significantly affected by stator temperature. When the speed rank rises, the motor temperature also rises, thereby increasing the heat transfer to the bearing. NIDEC SERVO fans feature a high-efficiency circuit and low motor losses to keep the bearing temperature below the preset temperature, thereby ensuring a long life.
The bearing temperature differs depending on the structure, materials and other factors and life varies to some extent. However, the life expectancy as illustrated in Fig. 23 is the basic data.
NIDEC SERVO accepts inquiries and orders for semi-customized products (long life products) featuring a reduction in bearing temperature increase. Please contact NIDEC SERVO for further information.
The life expectancy curve that is common to AC and DC fans is plotted in Fig. 23. (The curve represents the life expectancy based on a survival rate of 90 % and is not the guaranteed life. NIDEC SERVO will provide the MTTF (mean time to failure) data upon request.)

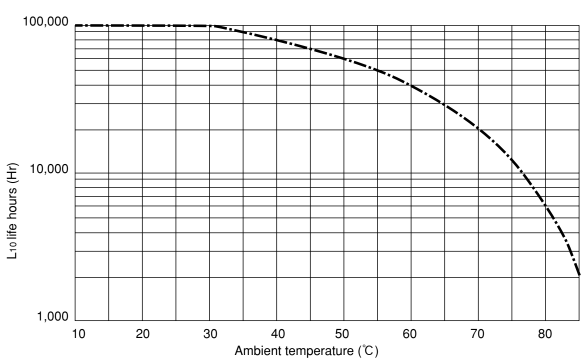


Fig. 23 Life expectancy curve (Survival rate 90 %)

(Note: This life expectancy curve has been prepared based on the results of life tests conducted at a rated voltage in a free air condition in an environmental test room with a negligible amount of dust. When using the fans in your application please take into consideration the actual operating conditions and safety factors. Some of the products contained in the catalogs do not meet the foregoing life expectancy data. [Products which do not meet the standard life are listed on the product information pages.])
(Definition of life: End of life is defined when the speed of a product deteriorates by 20 % or the noise increases by 8dB.)

Applicable standards

NIDEC SERVO fans and blowers have been accepted in certification tests for Japanese and overseas safety standards for use in various applications. (Please inquire to NIDEC SERVO for standards that are not included in the following.)

◆ Electrical Appliance and Material Safety Law (Japan)

The AC fans that fall under the scope of the Electrical Appliance and Material Safety Law are manufactured in compliance with its technical standard. AC fans are classified as fans and blowers in one of 480 electrical appliance item categories other than specified electrical appliances. The marking of the (PS)E mark is a legal obligation. See page G-53 and subsequent pages for NIDEC SERVO products with the (PS)E mark.
Power plug cords are classified as specified electrical appliances and the marking of the 〈PS〉E mark is a legal obligation. (See page G-66.)

◆ Certification test by the UL Standard

NIDEC SERVO fans and blowers have been accepted in certification tests under the fan and blower safety test standard UL-507,73 of UNDERWRITERS LABORATORIES INC., the electrical appliance safety inspection organization of the United States. Products that are accepted in certification tests are marked with the UL mark on their nameplates and model names are registered, to attest that they are certified products.
The registration No. of NIDEC SERVO is
E 48889: Fans and blowers
E 78112: Plugs and cords
(Category Nos. W1007, W1008)
Non-regular factory audits by UL are conducted in connection with the production of certified products and safety verification is performed by ensuring the materials used, electrical characteristics and other items pass strict factory test inspections.

◆ Certification test by the CSA Standard

NIDEC SERVO fans and blowers have been accepted in certification tests, based on general specification requirements and rules to prevent overheating inside motors under fan and blower safety test standard CSA STANDARDS C22.2 Nos. 113 and 0.077 of the CANADIAN STANDARDS ASSOCIATION, the electrical appliance safety inspection organization of Canada. Products that are accepted in certification tests are marked with the SP mark on their nameplates and model names are registered, to attest that they are certified products under the CSA standards.
The registration No. of NIDEC SERVO is
LR49399: Made in Japan
LR108118: Made in Indonesia
As with the UL standards, safety verification is performed by ensuring non-regular factory audits are performed by CSA.
(Some products are certified by the cUL mark.)

◆ Certification test by TUV

NIDEC SERVO fans and blowers have been accepted in safety certification tests based on the Business-Use Electrical Equipment Standard EN60950 and the VDE Standard No. 0806/08.81 of T RHEINLAND e.V, the industrial electrical appliance safety inspection organization of Germany. Products that are accepted in certification tests are marked with the TUV mark on their nameplates and model names are registered, to attest that they are certified products under the TUV standards.
The registration Nos. of NIDEC SERVO are:
LICENCE No.:R60299, R60300, R60301, R60302, R9451586
:R9750695, R9750455, R9650662, R2-50004410
REPORT No.:E61087, E61088, E61089, E61090
As under the UL and CSA standards, safety verification is performed by clearing non-regular factory audits by TUV.

◆ Certification test by VDE

NIDEC SERVO fans and blowers have been accepted in safety certification tests based on the Fan and Blower Safety Inspection Standard DIN VDE0700 of VERBAND DEUTSCHER ELEKTROTECNICKER e.V, an electrical appliance safety inspection organization of Germany with the highest authority. Products that are accepted in certification tests are marked with the mark on their nameplates and model names are registered, to attest that they are certified products under the VDE standards.

The registration No. of NIDEC SERVO is 3019.

As under the UL, CSA and TUV standards, safety verification is performed by clearing non-regular factory audits by VDE.

Common electrical specifications (Operational cautions)

● Insulation class

The insulation class of AC and DC fans and the blowers of NIDEC SERVO meet the heat resistance performance of Class E (120 °C) under JIS C 4004 (Rotating electrical machines - General), CLASS A (105 °C) under the UL-703 standard, CLASS A (105 °C) under the CSA-C22.2 standard, and DIN IEC950/VDE0806 standard and CLASS E (90 °C) under the VDE0700 standard.

● Dielectric strength

The AC fans and blowers of NIDEC SERVO satisfy 1500 V 50 Hz for one minute or 1800 V 50 Hz for one second. Dielectric strength tests under JIS C 4004 specify a voltage impression of "2 x rated voltage + 1000 V."

The DC fans and blowers of NIDEC SERVO are accepted in withstand voltage tests of 500 V 50 Hz for one minute or 600 V 50 Hz for one second. The interrupting current of 5 mA is set for the dielectric strength testers.

Dielectric strengths are tested between the power terminal of the fan/blower or lead wire conductor (two lead wires tied together) and metal frame (or other metal part) using a dielectric strength tester.

● Insulation resistance

The insulation resistance of the AC and DC fans and blowers of NIDEC SERVO is 10 MΩ or higher at 500 V DC between the power terminal or lead wire conductor and frame. Insulation resistance tests are conducted between the power terminal of the fan/blower or lead wire conductor (two lead wires tied together) and metal frame (or other metal part) using an insulation resistance tester.

● Electrical performance

The values described in the catalog are average values. Please request NIDEC SERVO to send a product drawing or delivery specification for products when wishing to confirm standard values.

● Temperature protection

Two methods are used to protect the temperature of the windings of AC fans and blowers, namely, impedance protection and thermal protection. These two methods are used differently depending on the type of motor used.

Impedance protection method

This method is generally used with shaded pole induction motors. Temperature increase is limited below a preset value by impedance (AC resistance) natural to the motor windings. In particular, the UL standard specifies that motors must not burn out when the rotor is operated for 18 days at normal temperature (24 °C). NIDEC SERVO fans and blowers meet this standard. Those products that are controlled by the Electrical Appliance and Material Safety Law of Japan are designed to limit coil temperature rises to less than 75 K.

The impedance protection method is effective only within the usage range. Note that smoke will be generated and ignition caused if a high voltage is imposed.

Thermal protection method

This method is used with motors of a capacitor phase advancing type or triple-phase induction motors. Embedding a bimetal switch with a contact in the motor winding part, the current is shut off when the preset winding temperature is exceeded, to prevent burning caused by abnormal overheating of the motor.

The windings of DC fans and blowers are protected against abnormal temperature rises by automatic reset, by shutting off the current if it detects a locked state or by current limiting automatic reset. This method involves the energizing circuit being turned off by a lock detection function inside the motor drive circuit when the fan is locked, shutting off (or limiting) the current.

Operation is reactivated automatically after the locking is reset. Note that this protection system does not function properly if used with duty (PWM) control power supply. NIDEC SERVO supplies variable-speed fans whose speed can be variably controlled by a PWM signal. (See pages G-31 to G-36, and G-51.)

Vital Precautions for DC Fans and Blowers

● Reverse connection protection

The DC fans and blowers embed a reverse connection protection circuit. Fans or blowers will not fail, even if connected in reverse within the usage range. (The fans or blowers will not activate, as no current flows to the circuit.)

● Yield strength to electrical noise

Yield strength to induced noise: Yield strength by an induced noise test apparatus is 2 kV.
Note 1: Malfunction of the sensor alarms will result if the induced noise exceeds 1 kV. Insert a 0.1μ F capacitor between the sensor line and ground as a precaution.
Note 2: Some of the products without a 15-digit product code cannot guarantee these yield strengths. Contact NIDEC SERVO for further information.

● Static electricity control

A static electricity measure is needed if a terminal trailing from the fan motor is touched, otherwise the circuit is prone to damage by static electricity.

● Handling of the alarm output lead wires

Inadvertently using a tester or other apparatus with a sensor lead wire will cause overcurrent to flow to the sensor circuit inside the motor, potentially causing a circuit fault. Pay attention to the permissible current and prevent any overcurrent from flowing. Contact NIDEC SERVO if it becomes necessary to connect an LED or relay directly to a sensor lead wire. (There are products that allow a current larger than the permissible current described on page G-15 depending on conditions.)

● Power supply selection for DC fans and blowers

Select a power source that supplies smooth power (ripples within ± 5 %, peak within operating voltage). Significant line noise (including surge voltage) causes circuit faults. Make it a point to check line noise after assembling a fan.

Select a power source remembering that a current 2 to 5 times the rated current flows at startup. (If an inrush current [normally less than 10 μ s] poses a problem, measure it and take action accordingly.)

The operating current peaks when the motor load is largest (at maximum static pressure for fans and in free air condition for blowers). When assembled, the current sometimes exceeds the rated current (fans) or smaller (blowers). (See the diagrams below.)

When current is flowing, connect all terminals from the fan motor before turning it on. Imperfect wiring connection or a wiring change while the power is turned on will damage the circuit inside the fan or cause it to deteriorate.

Example of fan operating current
〈SCNDM12B4〉

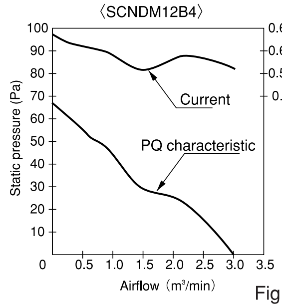


Fig. 24

Example of blower operating current
〈E1331K〉

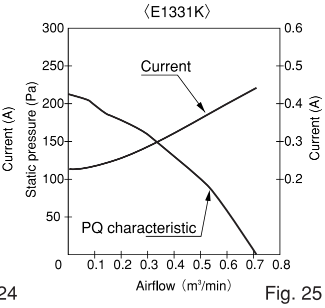


Fig. 25

● Power ON and OFF of DC fans and blowers

Always perform ON-OFF control on the + side. ON - OFF control on the ground level causes circuit failure. ON-OFF control directly before a DC fan or a blower (between a fan and power supply) increases the risk of failures due to the counter-electromotive force from the motor coil. In this case, be sure to insert a diode or other device in parallel.

Surge voltage can sometimes be generated with DC fans and blowers due to a wiring condition or other reason, even if the power is turned off. Insert a diode or other device in parallel to the power lead wire when the equipment requires very high reliability.
(Recommended diode: With a capacity to withstand reverse voltage and a starting current 3 times the rated voltage)

● DUTY (PWM) control of DC fans and blowers

The locking protection circuit does not function properly if variable-speed operation is performed through DUTY (PWM [pulse width modulation]) control of the power lead wire using a speed controller sold on the market or other device. The alarm output does not function properly with fans that are installed with sensors. As mentioned earlier, caution should also be exercised with surge voltage that occurs during ON-OFF switching in DUTY control (out of guarantee.) Please note that this operating method increases fan vibration, increasing the likelihood of abnormal sounds due to vibration. Dedicated fans and blowers are recommended for variable-speed operations. (See pages G-31 to G-36 and G-51.)

● Connect multiple DC fans and blowers in parallel

Connect multiple fans and blowers in parallel to the power supply. A serial connection (example: two 12 V products connected serially to a 24 V power supply) will cause the voltage for each product to fluctuate, resulting in a drastic excess of the usage range and circuit failure.

Please direct your questions or inquiries to NIDEC SERVO Sales or to the NIDEC SERVO website.

● Reduced Rotational Speed Operation

By placing a resistor in line with the power, designers may induce low voltage operation to achieve reduced speeds.
(Note: please be sure to calculate the resistor value such that the actual voltage the fan receives falls within the rated ranges for start-up and operation)

● Conditions for Failed Fan Starts

Electric power conditions for when the fan does not operate normally. The fan will not operate properly in instances, for example, the fan is rotating in the reverse direction or when the voltage is applied too slowly upon start up. Please be sure to review the system design beforehand.

Feel free to ask your questions via our homepage or sales network.

Technical Data

Operational and handling precautions

■ Operational precautions

The products of NIDEC SERVO are designed and manufactured to be as versatile as possible. Nevertheless, exercise caution with the following:

1. Operating environment

1) Only highly durable flame-retardant resin is used. Nevertheless, avoid the presence of petroleum oil, such as cutting fluid and toxic gas from contact with resin sections of fans and blowers where such oil or gas is frequently used in operation by installing a filter or other apparatus. (If the operating environment cannot be improved, NIDEC SERVO will be glad to conduct a yield strength verification test upon receipt of fluid and other item/s. Consult NIDEC SERVO for more information.)
2) Open-type motors are used. The use of a fan or blower in a dusty place will adversely affect the circuit and ball bearings.
3) Avoid operating a fan or a blower in relative humidity exceeding 90 %.
4) The maximum storage temperature is normally 70 °C. Products with an operating temperature of 70 °C or higher can be operated only up to the specified temperature. Check the operating temperature range on the product information pages.
5) Exercise reasonable care with condensation when returning to an environment higher than 0 °C from storage or operating conditions below freezing point. Condensation results in failure and shortens the life.
6) The life may shorten considerably if a fan or a blower is installed in equipment that vibrates prominently. NIDEC SERVO products conform to JIS C 0040 (Vibration testing methods for small motors) and withstand a maximum vibration acceleration of 9.1 G maximum (10 Hz to 55 Hz, amplitude 1.5 mm, sweep 1 minute/cycle, two hours each in X, Y and Z directions). However, operation at 5 G or less is recommended.
7) AC and DC fans and blowers cannot be operated while the intake side is tightly closed. This will shorten the motor life and result in circuit failure.
8) Operation near a high frequency power source may on rare occasions cause inflow of an induced current into the inside of a fan, shortening the life (and increasing noise due to BB galvanic corrosion). If an induced current flows, measures to prevent such inflow are needed.

2. Imposed voltage and frequency

1) The permissible range of AC fans and blowers is ±10 % of the rated voltage. Operations outside of the rated frequency result in considerable fluctuations in performance and life. Operations in serial connection (example: two 100 V products connected serially to a 200 V power supply) will increase the imposed voltage beyond the permissible range and should be avoided.
2) Use a sufficiently smooth power supply with DC fans and blowers. (Ripples of ±5 % or less, and peak within the usage range) The usage range differs from one product to another. Check it on the product information pages.

3. Installation orientation

There are no installation orientation limitations for products containing ball bearings. Operate fans and blowers in compliance with the operating environment temperature and other conditions. Contact NIDEC SERVO for further information or if clarification is needed.

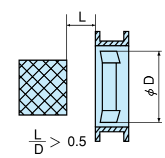
■ Handling precautions

The fan motors of NIDEC SERVO contain double side shielded precision ball bearings. Dropping the product could result in abnormal noise (Brinell dent) of ball bearings during operation. Exercise care when handling the products as follows:
1. Product falling: Avoid dropping the product from a height of 5 cm or higher.
2. Falling of crated product: Avoid dropping a crated product from a height of 30 cm or higher.
3. Storage and stacking of crated products: Crated products may be stacked up to seven layers. Take sufficient precautionary measures to prevent getting them wet.
4. Do not apply a load of 2 kgf or more to the connecting part of the lead wire of a DC fan.
5. Fan installation: Exercise caution as follows when installing a fan on a panel or elsewhere.
1) Clamping of both flanges: The permissible tightening torque of M4 screws is 8 kgf · cm with an AC fan that has a metal venturi and up to 10 kgf · cm with a DC fan that has fan ribs. Through screws are not acceptable for the DC flange type. Use reinforcing spacers (for the KUDC and CNDC series) to tighten the double flanges on these products. (See page G-65.)
2) Clamping of single flange: The permissible tightening torque of screws when the installation surface is flat is 10 kgf · cm to 14 kgf · cm for both AC and DC fans.
3) Avoid contact with a propeller or impeller when mounting the intake side of fans and blowers. Excessive screw tightening will result in contact with a deformed venturi or housing.

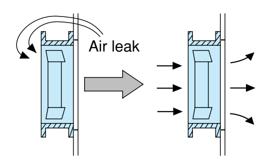
■ Fan operational precautions

• Strive to ensure the channel shape is as smooth as possible to avoid stagnation in the airflow.
• Make the flow velocity larger around the object for which cooling is desired.
• Place the fan on the downstream side when wishing to cool the entire space inside the equipment.
• An upward flow in conjunction with the ascension of heated air is recommended for airflow inside equipment.
• Take actions to mitigate the impacts of fans and for reverse flow in the event of failure where multiple fans are installed.

1. When placing an object on the fan intake side, try to maintain a distance of more than half a blade diameter.

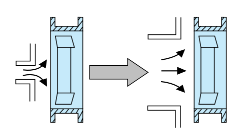


2. The pressure varies on the fan intake and outlet sides. The leakage of air from the outlet side causes noise. Minimize air leakage from the outlet side when installing a fan.



3. Design the channel (circulation path) selecting a good flow direction in terms of both noise and PQ characteristics.

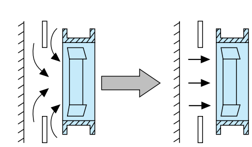
● Ventilating resistance can be expressed by the following formula:



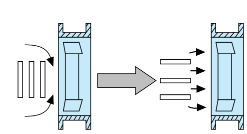
$$P = 0.000243Q^2 \sum_{i=1}^{N} \frac{1}{A_i^2}$$

A reduction of Ai (the channel cross sectional area) is critical. Avoid any sharp change in the cross sectional area in the flow direction.

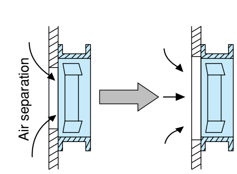
● Avoid any sharp change in flow direction.



● Avoid placing a printed circuit board and other parts orthogonal to the flow direction.



4. Drill fan mounting holes to ensure the smooth flow of air to reduce noise by referring to the recommended dimensions for fan mounting holes on the fan or blower's catalog page.



Technical Data

DC axial fans & blowers with sensors

The DC fans and blowers of NIDEC SERVO have a function to send an alarm signal when the fan motor revolutions slow down. Several systems are used to cut off the system power supply by this alarm signal, with three types of sensors available. Select the right type of sensor in accordance with the purpose of use. The lead wire for the sensor is yellow. The output type is an open collector output for all three types.

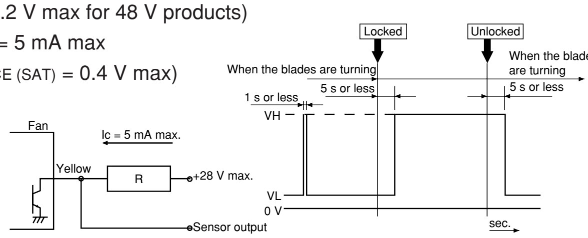
■ Sensor type

1. Lock detection type (Product code: S)

The output signal indicates an [L] state (transistor is ON) while the propeller is rotating, changing to an [H] state (transistor is OFF) less than five seconds after the propeller stops rotating. The propeller automatically restarts operation within five seconds when the lock is unlocked. ([H] → [L] 5 s). If the pull-up voltage is live, the [H] state (transistor is OFF) will engage in less than five seconds, even when the power is turned off.

● Specification: V_{CE} = 28 V max
(55.2 V max for 48 V products)
I_C = 5 mA max
($V_{CE\ (SAT)}$ = 0.4 V max)

● Output waveform



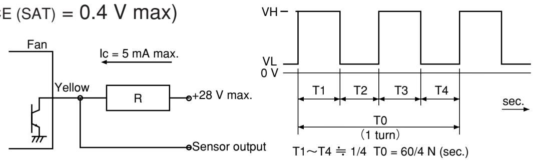
※When the power is turned on, the state sometimes becomes high [H] for several hundred ms.

2. Pulse output type (Product code: P)

A rectangular wave of two pulses will be output for each turn of the propeller while the propeller is rotating, outputting two types of signal depending on the propeller position when the propeller is locked. (See the note below ※)

● Specification: V_{CE} = 28 V max
(55.2 V max for 48 V products)
IC = 5 mA max
($V_{CE\ (SAT)}$ = 0.4 V max)

● Output waveform



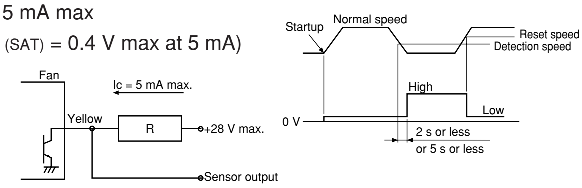
※Output signal waveform when the fan is stopped: The following two types of waveform are output, depending on the blade position when the propeller is stopped:
Pulse outputs of High - constant or restart timing (0.05 Hz to 2 Hz).

3. Speed detection type (Product code: Q)

The output signal indicates the [H] state when the propeller revolutions are slower than the preset speed, changing to the [L] state when the propeller revolutions exceed the reset speed.
[Products with a reversed output waveform are also available, suitable for a wired OR connection when several fans are installed. Contact NIDEC SERVO for further information. {Former code: SQ, new code (15 - digit code products): R}]

● Specification: V_{CE} = 28 V max
(55.2 V max for 48 V products)
IC = 5 mA max
($V_{CE\ (SAT)}$ = 0.4 V max at 5 mA)

● Output waveform



Note: The output waveform for type SQ (R) will be reversed.
The speed setting for the alarm output is about half the rated speed.
For more detailed information, please request a product delivery specification from NIDEC SERVO.