## INTRODUCTION

### SPEED CONTROL

Air capacity control of fans is most efficiently achieved by controlling the fan speed. The principle benefits to be gained are:-

- control of noise
- control of power absorbed

There are a number of methods that can be used to do this, including:-

- star/delta 2 speed switches
- triac speed controllers (example VA and AVA speed controllers.... *Ref. Pg. M5*)
- Variable speed drives (frequency inverters)
- multi-speed motors

There are many applications where the full capacity is required for only a short period of time and if no speed control system is available, there is an unnecessary loss of heated or conditioned air or wasted energy taking place. In addition, there are substantial reductions in fan noise and power that can be obtained.

Controlling the speed of a fan by means of changing the supply voltage with a triac speed controller is a simple and often-used method, but it does require certain conditions to be fulfilled:-

- the motor must have a high resistance rotor (single phase)
- the motor must have above average cooling

However a triac controller is not an efficient method of speed control.

**Note:** If more than one fan is to be connected to a single controller, the fans must be identical. Dissimilar fans should not be connected to the same controller and never to multiple multi-speed motors.

When using a speed controller on a single multi-speed single-phase fan, always set or connect fan to “high”.

## SPEED CONTROL OF EXTERNAL ROTOR MOTORS

External rotor motors generally have a high resistance rotor as an inherent feature of their design.

In addition the cooling of these motors is very efficient, so these motors meet the basic requirements necessary for speed control by triac control.

With triac control, heat is generated in the rotor, particularly at around two thirds of full speed. This heat is then transmitted directly to the impeller mounted on the motor and hence into the surrounding air without adding additional thermal stresses on the stator.

Therefore unless otherwise stated, motors operating with a speed-controller should not be run in ambient temperatures exceeding 40°C.

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### STAR/DELTA CONTROL

The three-phase external rotor motors fitted to backward-curved centrifugal fans have star/delta motors fitted to them as standard. This facility enables two speeds to be obtained using either a star/delta switch such as the SD1-S or star/delta controller. In addition some axial fans, such as SCD and CPD fitted with conventional motors, have the star/delta feature.

The speed ratio obtained with the star/delta feature is approximately 1.3:1.


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## TRIAC SPEED CONTROL

The triac is a type of semi-conductor device and is widely used to speed control single-phase external rotor motors. It functions as a quick-acting switch which turns on the current to the motor during each cycle of the alternating current waveform. The power to the motor can be regulated depending on the point at which the current pulse is received. If the current is switched on early in the cycle, the motor receives maximum voltage and thus full power. The later the current is switched on, the smaller the amount of voltage is released to the motor and thus the power to the motor is lower.

As the voltage waveform supplied to the fan is no longer a sinusoidal shape, magnetic oscillations occur in the fan motor. This is most noticeable at very low speeds. This noise, which is loudest at 100 Hz, may spread throughout the duct system if the motor is not properly vibration-suppressed.

The triac speed controllers are provided with radio interference suppression chokes to reduce the radio interference produced on medium and short-wave bands. The interference suppression is such that no special precautions have to be taken in normal installations. On premises where there is very sensitive electronic equipment, it may be advisable to use shielded cables and a separate supply or, alternatively, use an auto-transformer control where available.

If more than one fan is connected to a triac-type controller, the amperage of all the fans should not exceed 85% of the maximum rating of the controller. A speed ratio as low as 3:1 is possible.

## VARIABLE SPEED DRIVES (FREQUENCY INVERTERS)

External rotor motors can be speed-controlled using frequency inverters but only if used with all pole effective sinusoidal filters. If using a sinusoidal filter no VSD EMC shielding is needed after the sinusoidal filter.

See the special notes on page *O-2* for requirements.

# SPEED CONTROL OF STANDARD FOOT AND FLANGE-MOUNTED MOTORS

We do not recommend standard motors being controlled by voltage reduction unless they have specially designed high-resistance rotors and suitable cooling systems.

Experience has shown that trying to control the speed of a conventional motor by voltage reduction is seldom satisfactory. On a standard motor, all changes in speed when using a voltage reducing device, occur over a very narrow band of voltage and it is therefore hard to achieve an acceptable accuracy of adjustment. In addition, due to the level of heat generated, there is a risk of damage to the windings and bearings.

Some motors with these features are available on request.

## VARIABLE SPEED DRIVES (FREQUENCY INVERTERS)

Standard three-phase motors can be speed-controlled satisfactorily using frequency inverters which vary both the frequency and voltage of the electricity supply to the motor.

This system provides infinite variation of the fan speed, but the motors may become noisy because the dynamics of the mechanical system may cause resonances or the electrical noise may no longer be masked by the reduced air noise.

Shielded cable is normally required with frequency inverters.

**Electro-Magnetic Compability (EMC) Compliance**
These speed controllers normally require the electrical cables between the inverter and fan motor to be shielded along their entire length to comply with regulations. Inform our Sales Engineers if an Inverter is going to be used so it can be ensured that all fan internal wiring is shielded to meet EMC requirements.

Additional care must be taken if the inverter unit is mounted remotely from the fan being controlled.



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## MULTI-SPEED MOTORS

These can be either tap (Dahlander) or dual-wound.

Tap-wound motors use a single set of windings with a control 'tap' in each coil. The speed ratio is 2:1 and the maximum speed can be any synchronous speed. i.e 48, 24, 16, 12, rev/sec etc.

Dual-wound motors are effectively two motors in one as there are two separate sets of windings in the one motor frame. With dual-wound motors almost any combination of standard motor speeds is possible.

Multi-speed motors provide excellent power saving and the noise reduction is the same as any other fan with the same speed difference.

The air capacities available are directly proportional to the speeds.

Although by no means exclusive the above methods are more frequently applied to standard motors.

Note: Multi-speed motors are typically larger than their single speed equivalents.

## GENERAL

If you have requirements not detailed here, contact our Sales Engineers for assistance, as not all control devices have been covered in this catalogue.

## SUMMARY OF AIR CAPACITY CONTROL OPTIONS

| Control Type | Speed Ratio | Approx. Power Savings | Relative Cost |
|---|---|---|---|
| Star/delta switch | 1.3:1 | 50% | low |
| Star/delta controller | 1.3:1 | 50% | moderate |
| Triac | 10:1 | to 70% | low |
| Capacitance | Down to 2:1 | varies | low/moderate |
| Frequency inverter | 5:1 | to 90% | highest |
| Tap winding | 2:1 | 87% | low/moderate |
| Dual-wound | 3:2 | 70% | low/moderate |


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