EC35 VENTILATORS

As a manufacturer concerned about the environment and energy savings, our most important objectives are to help our customers reduce their total operating costs, increase their profitability and make their production more environmentally friendly. Avi-Air offers the high efficiency IE5 permanent magnet synchronous motor equipped with an integrated electronic drive. This technology reduces the electricity consumption of variable speed exchangers

Advantages of EC35 ventilators

Consumes 5 times less Watts at 50 % speed

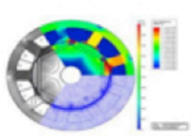
Consumes 2 times less Watts at 75 % speed

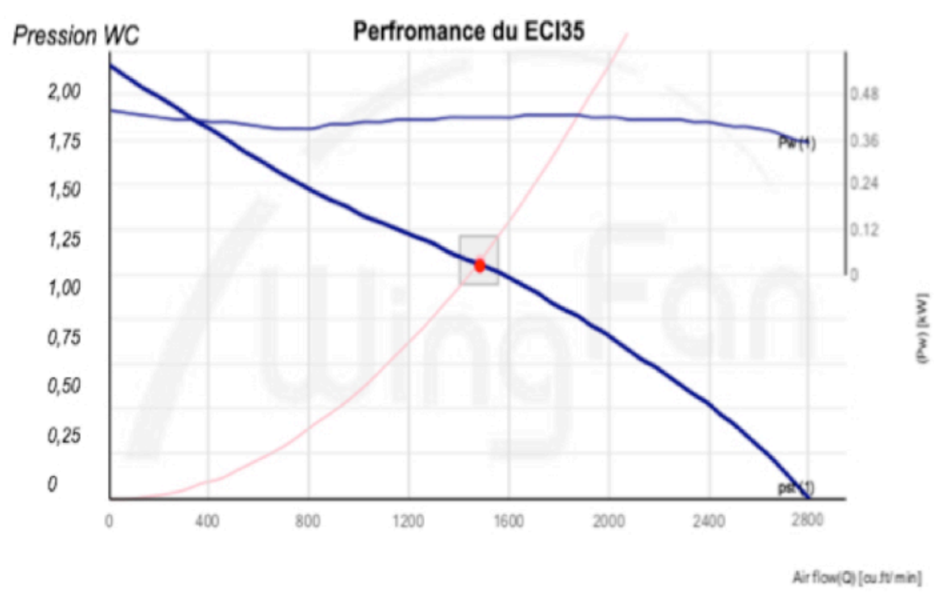
Motors are pre-wired ready for deicing cycles

Uses compatible ancrage to original Multifan

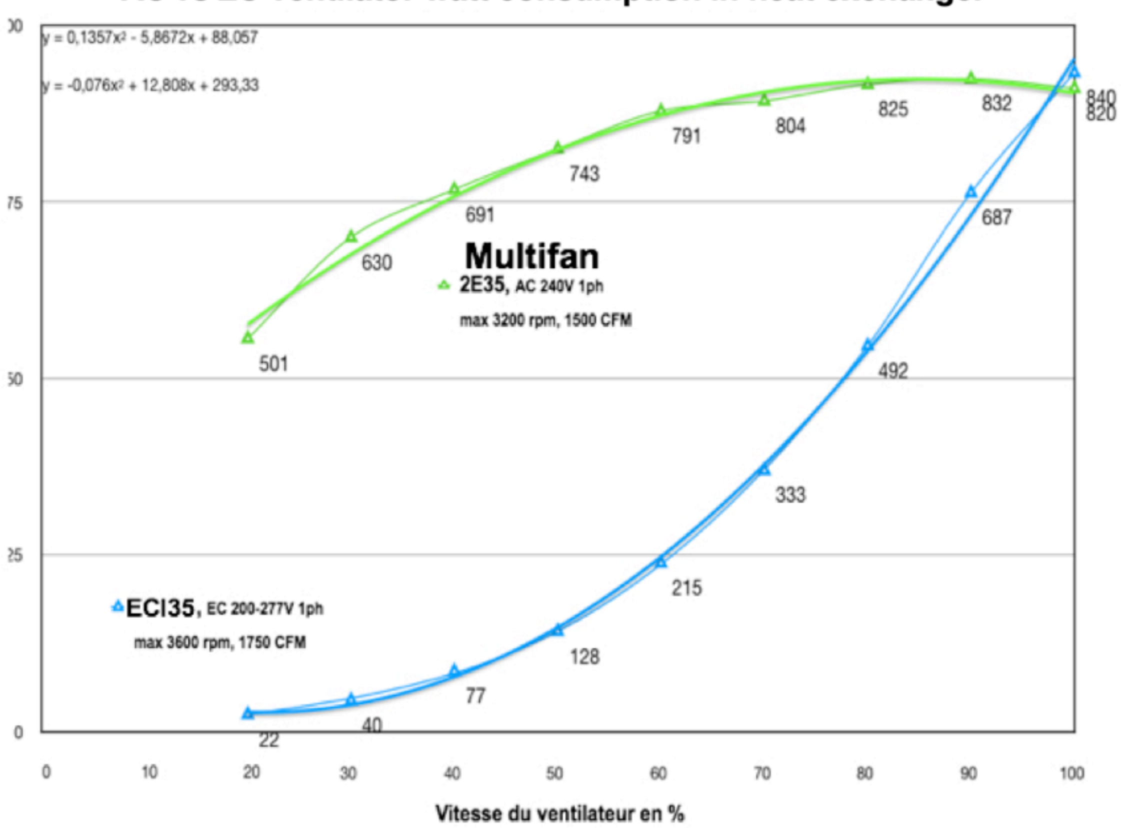
IE5 89,6 % effiecIency at 3600rpm

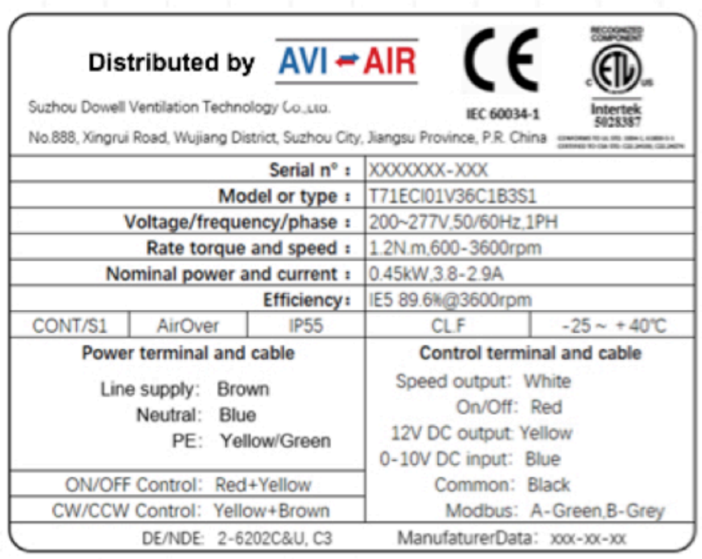
Does not generate heat





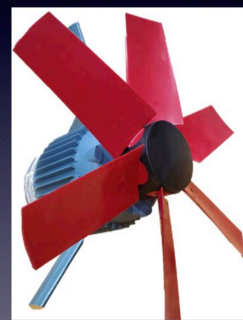
AC vs EC ventilator watt consumption in heat exchanger





EC motors vs AC motors

Current and power factor properties



AVI AIR Heat Exchangers

EC motors require less power to operate, but do they consume more current ?

To address this questions , one must understands some key basic notions of electrical engineerings .

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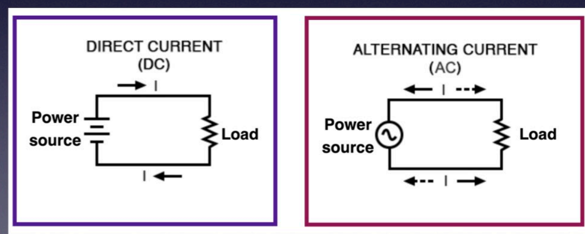
AC current behavior

As oppose to direct current, which is unidirectional, AC changes its polarity (positive and negative) and magnitude (voltage) periodically and continuously with respect to time. The number of times the current (moving electrons) changes direction in one second is called frequency. Its unit is Hertz



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AC current behavior

A simple way to imagine current changing direction is the water wave analogy

Let's Understand the Ac current with the water analogy-

Consider a scenario where a piston is placed inside a pipe and connected to a rotating rod, as shown in the provided diagram.

In this setup, the piston undergoes two distinct strokes: an upward stroke and a backward stroke.

During the upward stroke, the water within the pipe moves in a clockwise direction. Conversely, during the backward stroke, the water displaces in an anticlockwise direction. Consequently, the direction of water flow changes periodically as the piston oscillates back and forth.

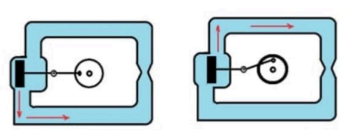

Fig.3: Alternating Current Working

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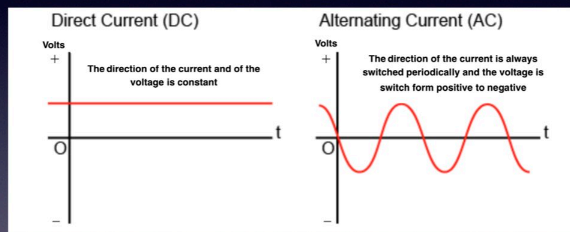
AC current behavior

You can also visualize the alternative current like ocean waves that moves back and forth through time. It can be illustrated as a sine wave where the pressure forcing the movement of electrons on a wire changes from positive to zero to negative periodically. DC current would be like the flow of a river, unidirectional through time.



However in a more complex circuit, for example when a resistor, a capacitor or an inductor is included in the circuit, there can be a delay or advance in the current flowing to the load in relation to the voltage behavior. This loads will be known as resistive, capacitive an inductive.

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Resistive loads

When the load is resistive , voltage and current would rise and fall together during each cycle.

In other words, the pressure moving the electrons and the flow rate of electrons in a wire rise and fall at same time

This scenario is best in any power system. It is known as resistive power, like the power used in electric heater and incandescent light bulbs. There are no power lost.

In this scenario, the power factor is unity or equal to 1.

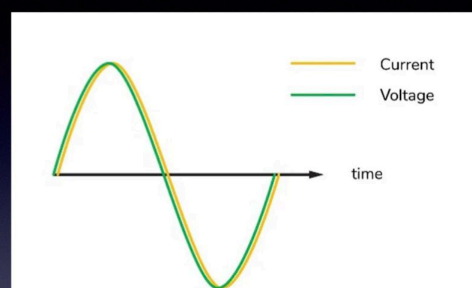

Figure 1: Current and voltage near unity

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Inductive loads

However, in a farms, there are far more power loads than the ideal resistive loads

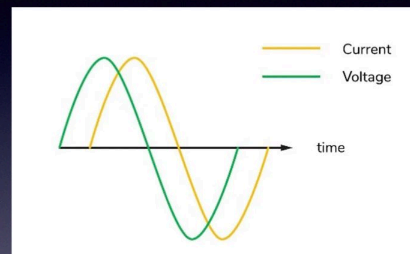


Figure 2: Inductive power, where current lags voltage

All AC fan motors and feeders are inductive loads. The inductive load absorb energy that do not create useful work. This results in the current being out of phase with the voltage in time. That energy will be released later in time to the circuit which creates the lag. The current is lagging the voltage.

The further appart are the peaks between voltage and current, the greater is the energy temporarily stored in the induction motor in electric or magnetic field, then returned to the power grid a fraction of seconds later. This is non useful energy. The further apart are the voltage and current peaks, the more work is required to deliver the power to the load. The distance between the peaks is referred as a phase angle.

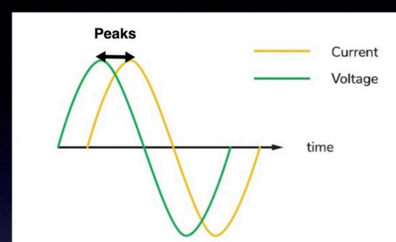
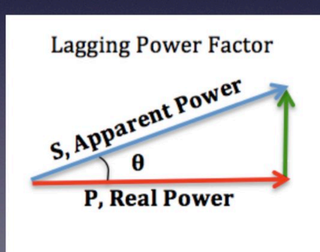
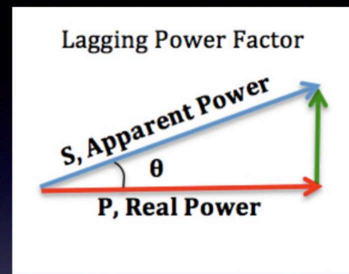


Figure 2: Inductive power, where current lags voltage



The phase angle can be illustrated by vectors in a triangle.The red arrow represents the real power that does the work. It is measured in Watts. The green arrow is the the reactive power which is useless and is the consequence of the phase angle. The blue arrow is the true power or also known as the apparent power, which is the total power or work used in the system. It is measured in VA. The apparent power is always the largest. The relationship between the blue and red vectors and the angle in between is expressed as a factor between 0 and 1. The power factor.

However, in our situation, it is most important to remember that most hydro suppliers will charge you only for the real power. The red arrow. The Watts. The extra amps used to create the absorb energy during part of the AC cycle, which is stored in the motor's magnetic or electric field, only to return this energy back to the source during the rest of the cycle is not charged to the consumer.



However, the total net power factor can be calculated and appears on the consumers electrical bill. A client can be penalized when the factor is out of acceptable range because they consume more current that they actually use and pay for. This is especially monitored in large manufacturing industries using large inductive motors.

Capacitive loads

Opposite of inductive loads are the capacitive loads, where non useful reactive power is generated instead of being consumed. This makes the current lead the voltage in time. The contrary effect. Example of capacitive loads are capacitors, rectifiers, lighting ballast

The rectifier present in EC synchronous permanent magnet motor electronics are capacitive loads. Current is leading the voltage in time.

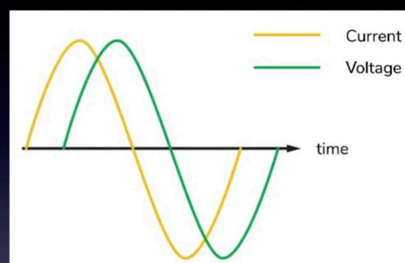
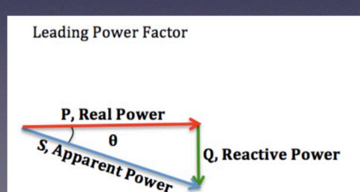
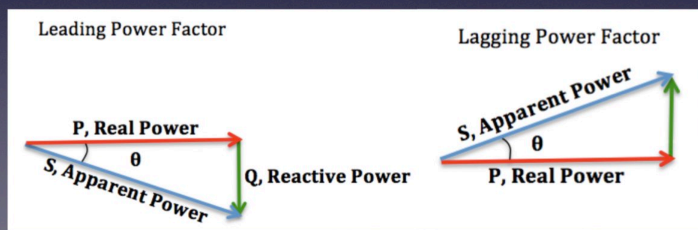


Figure 3: Capacitive power, where current leads voltage



The phenomenon is referred to a leading power factor where the phase angle is negative

In the electric power grid, reactive loads (green arrow) cause a continuous nonproductive power. It draws nonproductive current. This is what happens with both AC motors wired to a triac or with an EC motor rectifier. The good news is that since they have opposite phase angle, when combined, the power factors correct each other and the overall net power factor becomes closer to unity. In the electricity industry, inductive loads are said to consume non useful reactive power and capacitive loads are said to supply it, even though reactive power is just energy moving back and forth on each AC cycle.



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If EC motors require less power, do they consume more current ?

Because permanent magnet synchronous EC motors are capacitive loads and supply reactive power, that useless power is the product of volts and amps. The more reactive power they supply, the higher the amps will be regardless the useful work measured in watts.

The reactive power they supply can help to balance the reactive power consumed by other AC inductive motors on the farm. This helps improve the farm net power factor and reduce pressure on hydro provincial distribution.

The higher amps will only imply to chose an appropriate electrical wire gauge and breakers to connect the motor to the source, accounting for the reactive current. The same applies for an AC motor running variable on a triac. Only the real current creating real power has a financial meaning.

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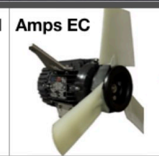
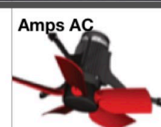
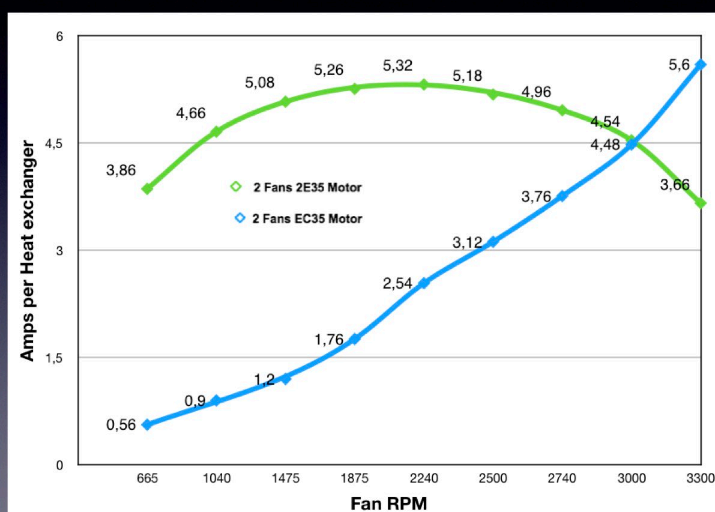
Amps of heat exchanger at variable RPM

Fan RPM	Fan % Monitrol curve 2	Amps EC 	Amps AC 
665	20	0,56	3,86
1040	30	0,9	4,66
1475	40	1,2	5,08
1875	50	1,76	5,26
2240	60	2,54	5,32
2500	70	3,12	5,18
2740	80	3,76	4,96
3000	90	4,48	4,54
3300	100	5,6	3,66

EC35 motors in Avi-Air heat exchangers draw more amps at max RPM as oppose to AC motors.

However, measuring tools read true rms amps which are the total amps. The amps created be the phase angle and the working amps.

Amps of Avi35 heat exchanger at variable RPM



EC motors vs AC motors

The future of barn minimal ventilation systems

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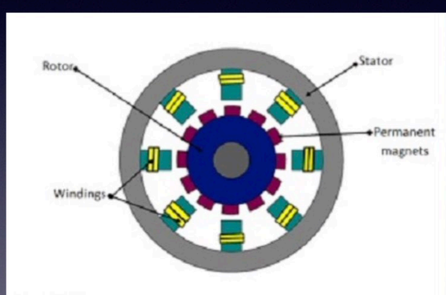
EC motors, how do they work ?

Ec Motors are DC electric motors powered with AC current equipped with on-board electronics.



The rotor is a permanent magnet and the stator winding is essentially an electromagnet. The electronic components in the motor commutes the right amount of current, in the right direction at the right time to the stator through each of the windings. This develops magnetic poles in the stator, which interact with the permanent magnets in the rotor.

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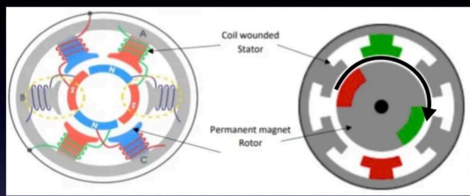
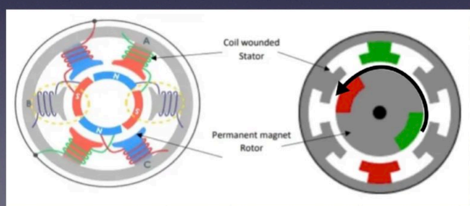


As the electronics changes the poles in the stator winding, it forces the permanent magnet rotor to revolve and it tries to align its north and south pole with the ever revolving winding electromagnet north and south. These attraction and repulsion forces combine to achieve rotation and produce the optimal torque.



You change motor clockwise rotation to counter clockwise by simply asking the electronics to change the direction the electromagnets are energized. Same for rate of acceleration, deceleration and rotor speed. The faster the electronics change the electromagnets position, the faster the rotor will revolve.

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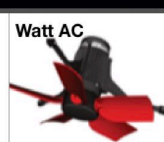
What are the advantage of EC motors?

Fan RPM	Fan % Monitrol curve 2	Watt EC 	Watt AC 
665	20	40	294
1040	30	80	440
1475	40	110	560
1875	50	180	646
2240	60	262	726
2500	70	336	762
2740	80	424	790
3000	90	520	820
3300	100	720	850

Electronically commutated EC motor efficiency is often above 90%. By adjusting an EC motor's speed to match the demand, the potential for energy savings continues to grow. In other words, low running rpm consumes low power. Higher running RPM consumes more power.

The power of the Avi-Air heat exchanger with both AC and EC motors are different at same fan speed using the same impeller.

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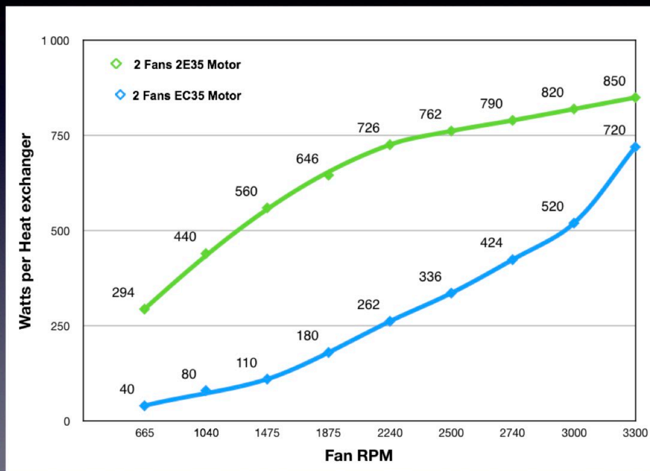
Lower power consumption of EC motors



The lower power curve translates in electrical energy savings

Higher efficiency at low speed translates in less energy loss trough motor heat

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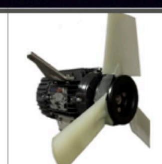
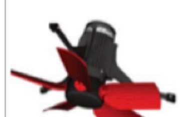
Savings based on power difference at different broiler days in a winter flocks

				Based on 24 hrs working time and 0,1$/ KW*hr
Broiler age	Fan rpm	Watts for 2 fans	Watts for 2 fans	Savings per week
0-6	1150	80	440	6,05 $
7-13	1875	180	646	7,83 $
14-20	2500	336	762	7,16 $
21-27	3300	720	860	2,35 $
28-35	3300	720	860	2,35 $

Assuming 3500 broilers per AVI35 heat exchanger, savings are estimated at 26

Savings based on power difference at different broiler age in summer flocks

				Based on 24 hrs working time and 0,1$/ KW*hr
Broiler age	Fan rpm	Watts for 2 fans	Watts for 2 fans	Savings per week
0-6	1875	180	646	7,83 $
7-13	2500	336	762	7,16 $
14-20	3300	720	860	2,35 $
21-27	3300	720	860	2,35 $
28-35	3300	720	860	2,35 $

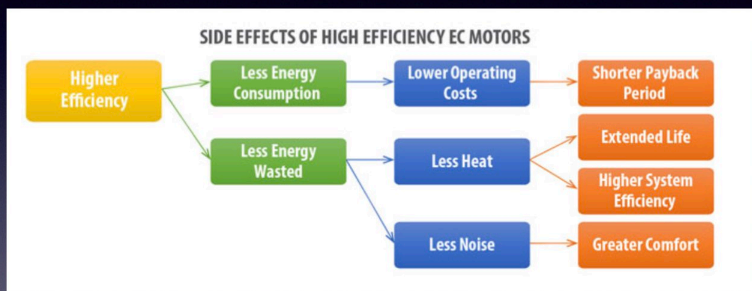
Assuming 3500 broilers per AVI35 heat exchanger, savings are estimated at 22 $ per summer batches

Total estimated savings

Assuming 3500 broilers per AVI35 heat exchanger, the average savings per flock is 24 $ per batch per exchanger. Based on 6,5 batches per year, the annual savings can be estimated at 156 $

One can argue that 156$ is underestimated because the 2E35 AC motor is air cooled and require a minimum appropriate airflow. Curve 1 is used in broiler barns because it boosts RPM at a given fan speed percentage to better cool the motors. For example 40 % speed is 1600 RPM at curve 1 instead of 1475 RPM at curve 2. Minimum speed is often set at 35 % to preserve motor lifetime; however it is over the CFM chick requirement. Therefore, by reducing RPM to the absolute chick CFM requirement, farmers will save even more on both electrical and gas energy.

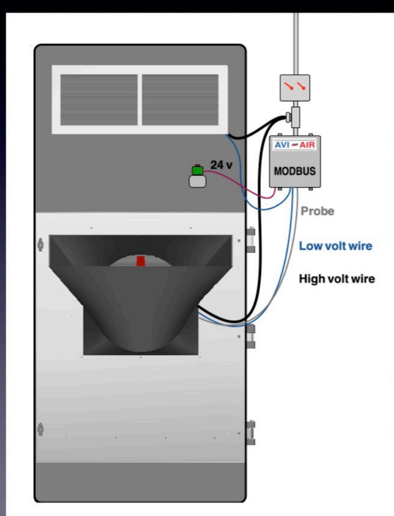
What are the other advantage of EC motors?



Moreover, since EC motors produce less heat, their windings and bearings undergo less stress, which extends the life of the motor.

In addition, since reversing fan rotation is done electronically, the reverse contactors AC motors required become obsolete. Both motors come pre-wired.The cost of Avi-Air installation with EC motors is drastically reduced, especially with MODBUS option.

MODBUS advantage from Avi-Air EC35 motors



Avi-Air EC35 motor electronics can use MODBUS as a communication protocol with the farm controller.

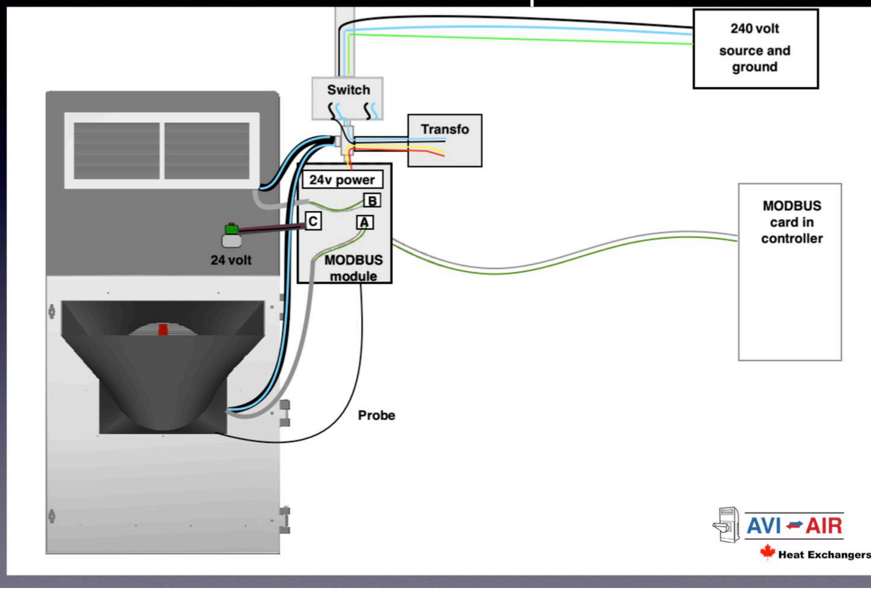
A MODBUS module is provided and installed next to each heat exchanger. A transfo installed in or next to the module box provides 24 volts to power the valve and the module.

Defrost cycles is controlled by the module. All exchangers may now defrost independent one another to reduce barn static pressure. Valves are prewired and also controlled by the MODBUS module.

The intake air probe is already wire to the module, each exchanger has its own probe. No need to bring a probe from controller

Hence, no relays and less wires are required from the barn controller. Only a small two wire conductor and a 240v source is needed to wire all MODBUS modules in parallel.

MODBUS Option



0-10 volt option from Avi-Air EC35 motors

If MODBUS is not available from the farm controller, then <u>0-10 volt</u> communication can control the fan speeds only.

Double interlock relays are <u>not required</u>. It is an intermediate setup between MODBUS and 2E35 motor setup

A 0-10 volt card with two outputs is needed from barn controller.

1 On/Off relay per valve is also needed from controller.

1 On/Off relay for defrost cycles is also required.

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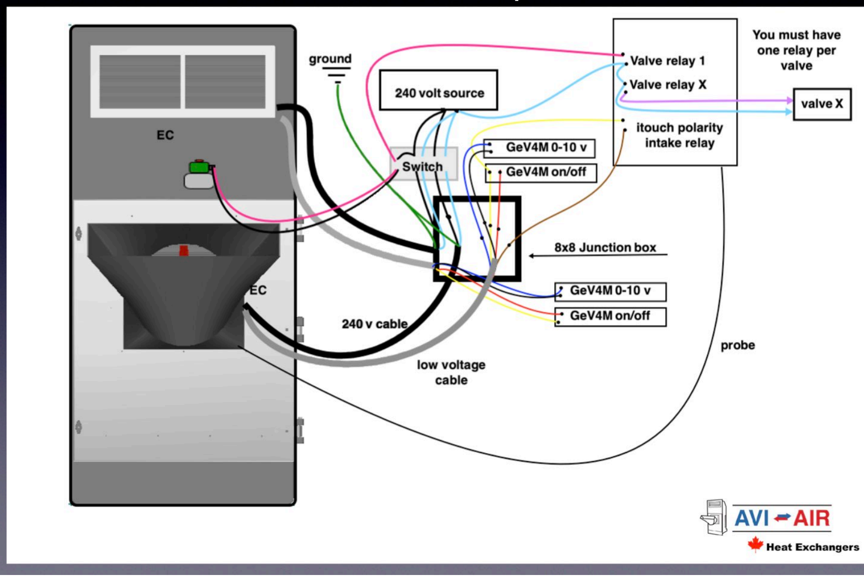
0-10 volt option



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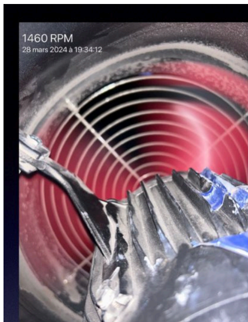

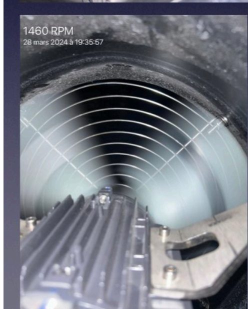

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The RPM of the 2E35 motor is measured with a flash light tachymeter at different fan percentage provide by a triac on Monitrol fan curve 2

One of the pales is identified with a tape and the flash light will blink at a certain rate. Once one have the illusion that the impeller stops moving, the rpm is in phase with the flash light. The rpm is then defined and compare with the rpm provided by MODBUS on the EC motor.

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