The A1 - Silver Standard - Motor Controller

"Adaptive Speed, Intelligent Control, Improved Operation"

<u>10 KEY Features and Facts:</u> The A1 Uses a Patented Optical Programming (OP) Technology that gives it superior performance to other digital software based motor control products.

1-Soft Start:

When first powering up, AC induction motors are like a long piece of copper wire. When full line voltage is applied to a non-moving AC motor, a huge motor startup / in-rush current flows, much like what happens in a short circuit. This can be many times greater than motor's full load current for a standard AC motor. – i.e. at startup, AC induction motors act more like an "electric short" than an "electromotive machine". (Watch the lights in your home dim, the next time an electric motor starts)

The A1, using OP based techniques optically programs and intelligently controls / limits / lessens motor startup current, voltage, and power to only as much as needed to get the motor moving. This is often much less current than the full speed load power, voltage, and current. The A1 then increases speed and power but "gently / softly, intelligently adjusts" or adapts the motor to its Optically Programmed actual operating speed. Motor start current / voltage, "Electric Power" is "softened" substantially or "greatly reduced" vs. the "standard or normal" AC motor startup electric power.

2-Demand Power Reduction:

As noted above in the soft-start feature, this A1 ability to greatly reduce start-up power, voltage, and current also provides a significant reduction in energy and costs commonly known as "kw demand." These are actual extra fees charged by Utility Companies because of the added costs associated with providing extra grid or system capacity to handle the excess power needed to accommodate AC motor start-up. Picture the thousands, if not millions of motors powering up every morning, each consuming up to ten (10) times what it needs normally. This "demands so much excess power" in the same time frame that incentives are given by the Utilities to stagger the start times for many electric users …. This "Demand Problem", or amount of kW demand, is eliminated on AC motors that are powered with the A1..!!!…

3-Anti-Stall:

Many AC electric motors have mechanical loads that are not always passive, consistent, or static. These "mechanical" loads may, and often do change (Pressure, temperature, humidity). Even if the motor's mechanical load doesn't change, the input voltage / electric power to the motor does. In fact the AC electric grid to which motors are connected can vary significantly many times throughout the day. To overcome this variability and avoid stalling, most electric motors are designed to provide more mechanical power than is usually needed. Slowing a motor down using a variable speed controller cuts down the electric power to the motor, and thus mechanical power or horse power output, as horse power or mechanical power is a product of motor speed times motor torque, (h.p.=rpm · torque) but this can make the motor even more susceptible to the variations mentioned above.

The A1 not only can slow the motor down and reduce electrical consumption and mechanical power use, as do other variable speed controllers, but it goes further and "dynamically adapts the speed" if /as needed; if the motor's electric power drops too low it intelligently increases power to the motor to prevent stalling!

4-Brown-Out Ride-Thru & Recovery :

Brown-out is a term often heard more in the summer months and it refers to a "bad" condition of the Utility Company's electric power grid. When the power demands on the electric grid exceeds the electric power available from it, the grid's electric power delivery drops.

This lower electric power level means that all the electric loads, machines and systems connected to the grid have less electric power than they require. This will cause lights to dim (brown), and electric motors to run slower. This slower rpm drives them and causes them to work harder (remember h.p.=rpm · torque), run hotter, and draw even more electric power. These increasing power stresses to the grid can have a downward power spiral effect "lowering, dimming or browning" the grid power to the point of a shutdown or blackout –i.e. no power is left on the grid.

If the "in-between" brownout condition (partial voltage) remains for any length of time, the above stresses could severely damage motors and machines to the point of "burnout". The A1 again has the OP based intelligence to recognize this threat condition and will then "adapt the electric power to the motor" to minimize the brownout effects. If there is any sufficient power to safely run the motor, the A1 will actually protect and save the motor from burnout due to brownouts!

5-Adaptive vs Variable Speed:

Many motor controllers tout "variable speed" operation when in point of fact they are only multi-speed; i.e. they do not continuously and smoothly vary speed throughout an operating range. These have instead a series of "fixed motor steps or speeds" that cannot settle in between or at the optimum speed for the current need.

For instance in a fan operation there may be up to 3 or 4 preset speeds (=airflows), but the climate conditions at the moment prefer 650 cfm of airflow; but there is either 800 cfm or 400 cfm as the "step / variable speed" option. Now the choice is either too much air or not enough for the conditions preferred.

The A1 is truly not just "variable speed" (i.e. it has continuous smooth full range) it uniquely has "adaptive speed". For instance it can provide 400 cfm or 800 cfm, as do competing units, but it can also provide any speed (airflow) in-between; so if conditions call for or want 650 cfm, 525 cfm or anything else it will intelligently and dynamically adjust to it. And if conditions change (i.e. when conditions change real time) unlike competing digital systems that "presume a fixed airflow profile" the A1 OP based unit "Adapts to the real time, real world airflow needs."

6-Idle Speed :

This was / is another A1 first and plus feature. Most conventional and competing units turn the fan off once climate conditions appear met. The A1 throttles back to a very low speed, quiescent level airflow or "idle speed". This allows for a gentle but continuous air movement that helps keep equilibrium of climate conditions in the occupied space. Rather than static stationary air that creates hot and cold spots along with poorer air quality, the A1 improves the indoor air climate, comfort and quality. Instead of hot/cold convection problems, the A1 gives continuous forced convection, think of old furnace stoves vs. fans… use fan! Also remember the energy impact that starting and stopping AC motors causes (see 2- above). **B**y not starting and stopping the motor saves motor energy, lessens motor and system stresses and reduces air noise. Just as it really is not practical or sensible to shut off your car motor at every stop light but instead let it idle, then gradually add power / speed as needed, so does the A1 to fan motors.

7-Energy Efficiency :

The value of variable speed on AC motors has long been pursued primarily to achieve energy savings. It is well known in the HVAC Industry and many others also that slowing a motor down reduces the power the motor is consuming. When this is done with a fan the savings become even more dramatic… For instance if the speed of a motor running a fan is <u>cut to 50%</u> of full speed the power is <u>cut by over 75% !</u>

Often the load, machine, system or unit that the motor is operating does not require or always need full power. As an example in several installations using an HVAC fan coil it was determined that <u>only 15% of the on-time</u> was necessary for the fan to be at full speed …, 20% transit, 65% low, most of the time, only low to very low speed was needed!

Yet without variable speed there are only two choices, full power or no power. So 35 – 40% of the time on full off, the rest of the time it's on, but starting stopping 20-40 times a day. Most motors flip between on or off –i.e. full power or no power. Any variable speed system that can go "in between these two extremes" should and usually does save energy; but some do this better than others and many do this with more or less harm to the motors, machines, loads, AC grid and even nearby unconnected systems.

Energy savings achieved with the A1Unit are throughout the entire operating range and generally save from 20% to over 40% of the energy the same system uses in its standard operating mode. This is not only much greater than competing systems, but the OP based methods used by the A1 also saves this energy in a "clean way" without many of the harmful electrical noise effects caused by other digital based units.

8-Temperature Tracking and Control:

One of the main components of the A1 Unit's many features is real time system output temperature tracking and resultant motor fan speed control. The A1 is capable of monitoring temperature and adapting fan speed for changes detected in system output air, heat or cool.

But the A1 does more than just output a fixed airflow to temperature line as some others do; it " tracks and adapts the airflow to actual heat (or cool) capacity available"! A unique patent pending profiling technique is used to provide a nonlinear but adaptable "thermal capacity content" vs just "temperature level" based on airflow tracking.

Most systems wait until the plenum or coil is well into its heating or cooling cycle before turning on the fan motor to full speed, and then turning off well before all the heat or cool available has been utilized.

With the A1 the fan motor is always at idle until the temperature sensors detect a real capacity change that will increase fan speed proportional to the heating or cooling available to be distributed into the occupied space. What this means to you is: quicker and more uniform distribution of climatized or desired air; better usage of heating and cooling generated in your system, or more simply stated **improved comfort and savings**.

9-Direct Sensor Input and Control:

As mentioned above the temperature tracking and control is a direct result of sensor input and control. Currently temperature and remote building control systems are the two main inputs to the A1 that will result in fan motor speed control. These sensor and control inputs will cover the majority of retrofit and OEM market applications currently being installed. Sensor or control inputs take the guesswork out of the old manual speed adjustment systems, once properly installed the A1 will take control and eliminate the necessity of constant manual speed changes.

There are several other sensor inputs, such as; humidity, pressure, rpm, and remote control inputs that are in development, which will, when properly installed, result in the best possible comfort level and energy efficiency for your application. If these sensors, systems, controls already utilize standard electrical parameters (i.e. volt, current, resistance) then the A1 can interface to them.

10-Analog vs Digital for Motors :

Most motors are analog, yet most controllers that power them are digital. Digital controllers try to force analog AC motors to accept a digital power signal known as PWM (Pulse Width Modulated) power. This type of power is NOT motor friendly, especially to AC motors. PWM signals introduce a myriad of new problems: high voltage overshoots, EMI, unnatural electronic stresses on the motor windings, unnatural mechanical stresses in the motors bearing systems, and so on. Not only is a PMW drive unfriendly to the motor, it also creates electrical noise, unwanted harmonics and unnatural stresses that reflect out into the electric power lines, and also affect devices nearby or connected to the same power grid.

The A1, by using OP based techniques, is a lot more motor friendly and also avoids creating many of the other noise and stress problems found in other variable speed drives and units.

Summary; <u>PWM Digital</u> vs. <u>OP Analog</u>:
<u>PWM Digital</u> generates and reflects "dirty" electric power both into the motor, and back into the AC line. By "dirty" we mean: 1) poor pf (power factor), 2) high dpf (distortion power factor), 3) wide spectrum of undesirable voltage, current, and power harmonics, 4) each of the generated harmonics have their own associated undesirable "pf" and "dpf" factors, 5) frequencies of the harmonic series are significant and stretch all the way up into the AM radio frequency band (and higher), 6) FCC issues need to be dealt with, and 7) special EMI and ESD shielding considerations need to be made. By comparison, <u>OP Analog</u>'s power output is "clean". By "clean" we mean excellent pf and dpf, near zero harmonic energy content and almost no EMI radiation.

By analogy, <u>PWM Digital</u> is like fossil fuel for motors, it contains lots of contaminants, pollutants, etc. that ultimately hurt the motor and the environment; <u>OP Analog</u> is like clean burning natural gas; helping the motor and helping the environment.

Electric power transmission systems are designed to accommodate so called "worst case scenarios". A given power company's primary concern is to be able to deliver sufficient power to statistically accommodate the worst case potential loading. In electric motors, start up currents are significant, and can be typically 3 – 4 times a motors quiescent current. From this, as far as the power company is concerned, the motor's quiescent power consumption is not important, but its startup current is. This creates a need for oversized transformers, oversized wire, heavy contact switches, unnecessary power plants, and so on. The advantages of reducing a motors startup current are enormous.