MPTS®

MAXIMUM POWER TRANSFER SOLUTION

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Big Power Benefits from Small Changes

By Alex Wenger

Cool, Clean Conditioned Power™

AC induction electrical devices are ubiquitous in factories, offices and retail space throughout the United States and other developed and developing nations. They consume more than 50% of the energy used in industry and commerce. These devices run our air conditioners, elevators and escalators, chillers and air handlers, conveyors and a panoply of other industrial, commercial and retail applications.

Reducing the current requirements of induction motors by minimizing their reactive power consumption can result in significant savings in electric power bills. Many electric power suppliers incorporate demand charges in their tariffs. In large industrial settings these demand charges can amount to 30% of the total electric power charges or more. Other electric power suppliers measure the power factor at the point where power consumption is measured, the connection point to the customers' premises. If the measured power factor is below a specific value defined in the power companies' tariff, extra charges are levied against the customers' bill. Since it takes additional fuel, generating capacity, and transmission/distribution capacity, in the end rate payers pay for this reactive power, which does no useful work.

Maximum Power Transfer Solution (MPTS) solves these problems. Users save money, reduce CO2 emissions and extend the useful life and MTBF of connected devices. The MPTS is an industrial scale device that uses a patented technique to match the impedance of a 3 phase electric power source and a 3 phase electric power load. The line impedance conditions are sampled and evaluated at a rate of 20,000 times a second. Adjustments to the impedance on the 3 phase power lines are made to optimize the impedance matching.

When the MPTS is used to perform power conditioning for induction motors, the current drawn from the power distribution network is typically reduced by 30%. This is due to a reduction in the flow of reactive current. It is manifested as an improvement in THD (Total Harmonic Distortion) and power factor in the power distribution network. Electric power company demand charges and/or power factor charges are reduced. The reduction of THD can result in significant improvement in the performance of inductive motors.

Induction motors produce undesirable harmonic currents in the power lines connected to them. These harmonic currents can cause non-linearities in the motor torque curve and they will also cause additional heating of the motor. The MPTS will reduce the harmonic currents, which waste power and reduce mechanical performance. One recent engineering paper estimates that the effects of harmonic currents alone can increase the operating temperature of an induction motor by 4o to 6 o Celsius.

Reducing I2R losses due to harmonic current flow in an induction motor will reduce the power losses and operating temperature of the motor for a given amount of motive power output.

It is obvious that you can save money operating an induction motor by reducing electrical losses thus reducing the input power needed to run the motor. What is not obvious is the large cost savings that occur due to a small reduction in motor operating temperature.

The Arrhenius equation relates chemical reaction rates to temperature. It has long been used to estimate the effects of temperature on the reliability of electrical and electronic equipment because it accounts for temperature dependent processes like rates of corrosion, chemical degradation, etc. Simply stated, the Arrhenius equation says that for every 10o C increase in operating temperature of a device, the functional life of the device will be cut by 50%. A reduction in temperature of 10o C, will double the operating life of a device. By reducing the operating temperature of the induction motors that we use in industry by a few degrees Celsius, we could extend the life of these motors and improve the reliability of the manufacturing production activities that are dependent on them. To be specific, a reduction of 4o C in the operating temperature of an induction motor would extend the average operating life of an induction motor by 32%!

What would a 32% improvement in operating life mean to a medium size business? The savings that come from extending the life of a 60HP induction motor is de minimis when compared to the cost of a lost day of production due to a motor failure. Imagine a company with a factory of 120 people, whose average annual revenue per employee was $110K per annum. A motor failure that shuts down the entire production line for a single shift would cost $60K in lost productivity, assuming a 220 day work year.

Can we reduce the operating temperature of a 60HP induction motor by 4o C? From the datasheet of a typical induction motor we can learn that the temperature rise at 100% load is 80o Celsius, efficiency is 92.6% at full load, power factor at full load is 0.84, operating voltage is 415VAC, and operating current is 80.5A.

When MPTS is not present, total losses are approximately 4.28 kW, resulting in a temperature rise of 80o C. The implicit thermal resistance of the motor to the ambient environment is 0.0187o C per Watt.

In a recent study of a typical operating environment for 25kW and 50kW motors, the THD on the power lines was measured at 9.2%. This exceeds the recommended maximum THD levels specified in IEEE Std. 519-1992 by 84%. The losses due to the 3rd and 5th harmonics of the power line frequency constituted 10.1% of the total losses. Assuming a similar response in our 60kW motor, we can infer a loss due to harmonics of 432 Watts.

The reduced losses result in an operating temperature reduction of 8o Celsius for the 60HP induction motor in this example. This results in a substantial improvement in the motor's operational reliability… longer MTBF.

Another non-obvious benefit of reducing the operating temperatures of devices attached to MPTS is that reducing the heat generated by those devices also reduces the air-conditioning (AC) load for the facility, thus reducing the power needed to meet cooling objectives.

Features and Benefits Comparison Chart

FEATURES & BENEFITS COMPARISON	AUTOMATIC POWER FACTOR CORRECTION	HARMONIC FILTER/POWER CONDITIONING	UPS AND BATTERY BACK-UP SYSTEMS	VARIABLE FREQUENCY DRIVES	MPTS MAXPOWER TRANSFER SOLUTION
Reduces Amp Consumption by 20% to 40%					X
Improves Power Factor	X	X		X	X
Improves Power Quality					X
Reduces Carbon Footprint				X	X
Decreases Amperes, (KVA, KVAr, KVAh, and KVArh)					X
Decreases Total Harmonic Distortion (THD)		X			X
Does NOT Interrupt Power to the Load When Off					X
Increases Useful Life of Connected Equipment					X
Decreases Capital Costs					X
Decreases Service, Repair and Maintenance Costs					X
Increases Facility Wiring Capacity Due to Reduced Current					X
Adds Load or Capacitance or Harmonics to the System	X	X	X	X	
Requires Programming and Significant Maintenance	X		X		
No Parasitic Load					X
Works on Balanced or Unbalanced Load Conditions		X			X
Decreases Downtime Costs Related to Electrical Power Issues					X
Electronic Solution - Consumes Less than 100w					X
Standard Models and Capacities			X	X	X
Can be moved to different Applications or Loads					X
Stabilizes Voltage					X
Reduces Switching Gear and Facility Wiring Heat		X			X