

**Master Control Systems, Inc.**  
**Engineering Memorandum**

Date: 2000.05.23  
To: All M.C.S. Representatives  
CC: Wm. F. Stelter  
From: James S. Nasby, Director of Engineering  
Re.: PhaseSmart™ Analysis, first installment.

Revised: 2005.09.20

---

The following excerpt is from our Bulletin # 400 - <http://mastercontrols.com/ProdInfo/phase.htm>  
PhaseSmart™ logic is smart enough to keep the motor from burning up under a single phase starting condition. Once started, it's also smart enough to keep the motor running during a fire condition.

Analysis:

Controllers equipped with the PhaseSmart circuitry has an extra voltage level sensing circuit. This detector is set to a low enough threshold level to assure that the fire pump motor will be allowed to start if there is enough voltage to allow it to do so. Once running, the back E.M.F. voltage from the motor keeps the PhaseSmart circuit in the running mode to keep the pump running.

The PhaseSmart voltage threshold is high enough to prevent the motor from being damaged if there is insufficient voltage on one or more phase to start the motor. The sensing is smart enough to also catch certain false voltage conditions and partial voltage which can occur during a single phase event.

Note that most single phase events do not result in zero voltage between two lines. This is not a common occurrence. Most single phase events result in partial voltages where the sum of two of the voltages add up to the third larger voltage. One example would be: 215 Vac, 255 Vac and 470 Vac.

The **PhaseSmart Protection** indicator light bar lights up when the voltage is too low to start the motor. Note that the regular **A.C. Power** light is set to a higher level and will already be off before the voltage drops to the lower PhaseSmart circuit set point.

Below are some of the false myths that we've heard or read lately:

False Myth #1: The fire pump circuit breaker will protect the motor from burn-out when trying to start under single phase conditions. Wrong! 1) A three phase motor fed with single phase power will draw only around 500% of FLA, not 600%. Moreover; 2) the current will drop as the winding(s) heat up, 3) the breaker trip setting is always higher than the motor FLA, the breaker trip setting must not trip at 300% and so is always higher than the indicated setting, and 4) the motor nameplate FLA is always lower than the required controller design value. Field experience shows that the motor can and often does burn out before the breaker trips. Motor Manufacturers and measurement confirm this fact.

False Myth #2: A three phase motor can accelerate (create torque) with single phase power. Wrong! At speeds below the pull-up torque speed, single phase power actually causes a small breaking torque. It will not accelerate. Anyone can verify this fact by trying it, if they don't believe it.

False Myth #3 (one of our favorites): Water flowing thru an unpowered pump will spin it fast enough to allow it to accelerate under single phase power. Wrong! Try it. Of course, you'll have to close off the required by-pass piping. The pump will rotate either very slowly or not at all even with a full rated pump water demand. Remember, booster pumps normally have tight packings. Think about it. If the water could rotate the pump at any significant speed and supply the water flow and pressure demand, you wouldn't need a pump in the first place.