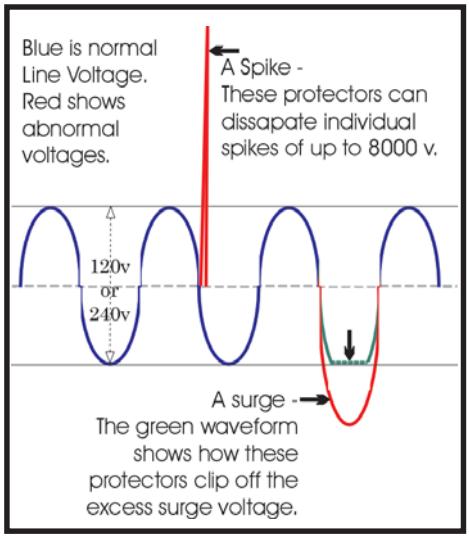
Some Technical Information for the ZAP-PRO™ Condensing Unit and Furnace Protectors

There have been some requests for Technical Information on Zebra's line of surge protection devices. One of these devices, the ZAP-PRO (for Condensing Units and Furnaces/Air Handlers) works to protect the expensive Circuit Boards and Components from damage by "dirty" input power. This dirty power can be in the form of spikes, surges, and other transient voltages, as well as lightning strikes nearby. However, the ZAP-PRO (nor any other protector of this type) cannot protect a motor from overheating if the incoming voltage is too LOW.

Since the circuit boards and components include delicate electronics and processors, it is vital to insure that input power does not exceed nameplate recommendations - even for a moment - or some of the electronics may be permanently damaged, rendering the unit useless.

The main leads of the ZAP-PRO are designed to be simply plugged into the LINE side of the contactor of the Condensing Unit, or the main LINE IN terminals of a unit's circuit board. The ZAP-PRO has a ground strap wire with an attached ring terminal that needs to be secured to a good ground path on the equipment. It is the primary path of electrical flow of excess voltages away from the units delicate components. **Failure to attach that ground strap/wire will significantly reduce the overall effectiveness of the protector system.**

My unit says it has built-in protection. Why do I need this product? Condensing Units and Furnaces/Air Handlers often have *some* protection built in. No unit tested has protection better than that found in the ZAP-PRO. Also, what do you do if the threshold voltage (described below) is exceeded and their internal protector fails? When that happens, the only option is to replace their circuit board. *That's really what we were trying to prevent, isn't it?* It's far easier to simply plug-in a new ZAP-PRO, than it is to order (and wait for) a new circuit board or component.



The ZAP-PRO protectors are ***plug-in*** devices that intercept most voltage problems **BEFORE** they get a chance to do any damage to the circuit boards or components. The chart at left shows what AC waveforms look like on an oscilloscope, and also shows what some damaging transients might look like.

The blue sine wave is normal AC voltage. Each complete wave (up and down) lasts 1/60th of a second. The red items are spikes and surges. The green line shows what happens to damaging voltages when the ZAP-PRO is in the circuit to protect the units. (The green line, visible on the surge, can't be seen on the tall spike because of printing considerations, but it "clamps" the excess voltage to a value safe for the unit's components.)

The devices that Zebra's products use to stop these voltages are called MOV's (Metal Oxide Varistors) We use two of them for the best protection; one across each leg of the incoming line voltage and the ground. The typical response time for these solid-state devices to begin clamping off excess voltage is between 28 microseconds (millionths of a second) and 30 milliseconds (thousandths of a second).

How do the protectors work? They react ***only*** when the voltage is above 135 volts on that leg with respect to ground. They convert the excess voltages into heat. Since the devices are usually near the aircream, they are actually able to be more effective than what their ratings claim. The ZAP-PRO is pre-wired to protect both (either) 120 VAC and 240 VAC systems.

What exactly are their ratings? These devices are able to dissipate (turn into harmless heat) voltages as high as 8000 volts for one cycle of voltage (this is normally called a spike). They can dissipate lower voltages for much longer, say, a 2 second increase from 125 volts to 190 volts (commonly called a surge). Electrical items downstream from these protection devices simply never see the excess voltages.

What happens when voltages exceed the thresholds mentioned above? When that happens, these MOV's will fail. Their breakdown will cause the devices to short their poles together, permanently, and will cause discoloration of the device and its clear plastic package. This short will, in turn, cause the circuit breakers supplying the equipment to trip. They will continue to trip if reset. The sticker included with each product tells a Technician that if the device has failed and repeatedly trips the breaker, to not just *remove* the protector - but *replace* it - it has sacrificed itself so the system would not be damaged.

So, it will protect the units many times, right? Yes, it can block voltages thousands of times as long as they don't exceed the thresholds above.

Can it protect against a lightning strike to the building? A direct lightning hit to the building the equipment is installed in would probably arc over the device (and everything else there) and ruin other parts. A general rule is that if the lightning strike is on the *other sid*e of the utility transformer (i.e.: not struck between the utility transformer and the house or building), our devices usually save the circuit boards and parts.