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Why Use DC Power Instead of AC Power on a Sensor?

Most modern HVAC control systems have 24 VAC available, and most of BAPI's products can run on 24 VAC, yet BAPI recommends powering them with DC voltage. Why?

Twisted wire cables have high wire-to-wire capacitance. Capacitors totally block DC voltage, but allow a little bit of AC voltages to couple from wire to wire. A portion of the 50 Hz or 60 Hz, 24 VAC running through one pair of wires in a multi-wire cable will combine with the normal signals on all the other wires in the cable. The Laws of physics mandate that this will happen no matter whose sensor is used.

The AC noise coupled into a sensor signal in a multi-wire cable may cause the controller to think that the measured parameter is changing back and forth rapidly. The controller may drive the mechanical equipment into an oscillation that overdrives the actuators and causes the mechanical equipment to wear out prematurely. For example, in a room at 72°F, BAPI's tests show that for a nominal 25-foot sensor wire length, the 60Hz noise in a multi-wire cable can change a 10K thermistor's temperature measurement from 69.4°F to 74.7°F. The controller thinks that the zone temperature is fluctuating by 5°F and drives the output actuators more than necessary.

There are two ways to avoid this situation. The first way is to convert the AC power to DC power with a voltage converter (such as BAPI's VC75, VC100 or VC350) at the controller end of the cable. If you power the sensor with DC voltage, then there is no AC noise within the multi-wire cable to influence the temperature reading. But remember, the DC converter has to be mounted at the controller end of the wire, not at the sensor end, otherwise there will still be AC power within the multi-wire cable.

If you choose to power the sensor with 24 VAC, then the second way to avoid the AC noise is to run the AC power in a separate, shielded cable with the shield connected to a good building ground at the controller end. In this situation, the capacitance from the 24 VAC wires to the sensor's signal wires is so low it is effectively ZERO. No AC voltage combines with your sensor's signal, but you must run two separate cables.

Either of these methods will prevent the AC noise from influencing the sensor's signal, but BAPI recommends converting the AC power to DC power because we feel it is easier and more economical to install a low cost voltage converter rather than making two cable runs.

If you need further information about this topic, request the application note [Understanding Noise from AC Power](#) from your BAPI representative or download it from our website at bapihvac.com.