Power-io Application Note:
Analog 4-20mA input for AC switching using a HMA-3V50E or HMA-3V90E

The HMA family is capable of high speed switching of AC resistive loads, such as heaters.

In the past, control systems would often switch the heater load ON/OFF/ON/OFF based upon a system cycle time of 1 – 30 seconds. As the temperature control technology improved, this cycle time often remained the same.

Solid state relays are able to turn ON and OFF precisely at the zero crossing mark at the beginning of each half sine wave (120 times per second, in 60Hz installations). Therefore, a temperature controller's request for a 50% output, using a cycle time of 1 second = 60 half sine waves ON, 60 half sine waves OFF, 60 ON, 60 OFF….

Previously, some systems used "phase-angle" switching which resulted in chopping the leading edge of every half sine wave in order to provide better control. However, this creates 120 electronic noise events per second which can impact nearby computers, PLCs, and control systems. The CE regulations do not permit electrical noise generation and special noise filters may be required.

The Power-io HMA family uses a 4-20mA analog input control signal and an internal microprocessor to calculate the minimum amount of half sine waves to achieve the requested performance. The overall Power-io minimum cycle time is 3 half sine waves such as: 2 half sine waves ON, 1 half sine wave OFF, 2 ON, 1 OFF…. The microprocessor will add additional half sine waves to this to precisely match the control input request. When the addition might be requesting a fraction of a half sine wave, this information is stored and accumulated until it reaches a half sine wave in size, and then one half sine wave is added to the output.

The Power-io product permits the heater to be turn ON and OFF precisely 20-40 times per second, while continuing to use "clean, noise free", zero crossing, half sine waves.

System Advantages:

Precision – for small size temperature zones; such as extrusion die zones, high speed IR heater zones, and packaging machines where the heater zones are a small mass in size and high speed in response.

Heater life – thermal expansion and contraction cause a heater to fail. Using smaller ON, OFF, ON, OFF time periods extends the life of a heater by dramatically reducing the thermal cycling and heater fatigue. The heater remains at a stable level.

PLC applications – using a 4-20mA output is a quick, easy, programming output. In some process industries, using a 4-20mA output is the preferred output for heater control.

Pot control – In some open loop control applications, a simple 5k potentiometer can be used as the control input device to adjust the Power-io HMA product. See Power-io for details.

LED:
The green LED is an indication of a control signal being present. It will increase in pulse speed as the 4-20mA signal increases.

Sine Wave Reference:
The Power-io HMA is used to control the power going to the heater, and the sine wave reference point is monitored after the heater, or elsewhere in the control cabinet, for that phase. The reference is used for the calculations for that particular phase. The current rating of the reference wire is 0.001 amps. Heaters, on the same phase, can daisy-chain the reference connection.

L2 / N

Heater
Load

L1   Fuse

| 1 | 50 amp w/ heatsink | 2 |
| L1 | 24 - 277 VAC | T1 |

Power-IO™
Solid State Relay
HMA-3V50E
Maximum Surge Survival™
A1+ A2-4 to 20mA
CONTROL

RoHS ✓
CE
L2/N

+   –

4-20mA
Control
Signal

Sine wave
reference
point