AG-SCREH-00
December 3, 2002

Application Guide

SCR Controlled Electric Heat

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Introduction

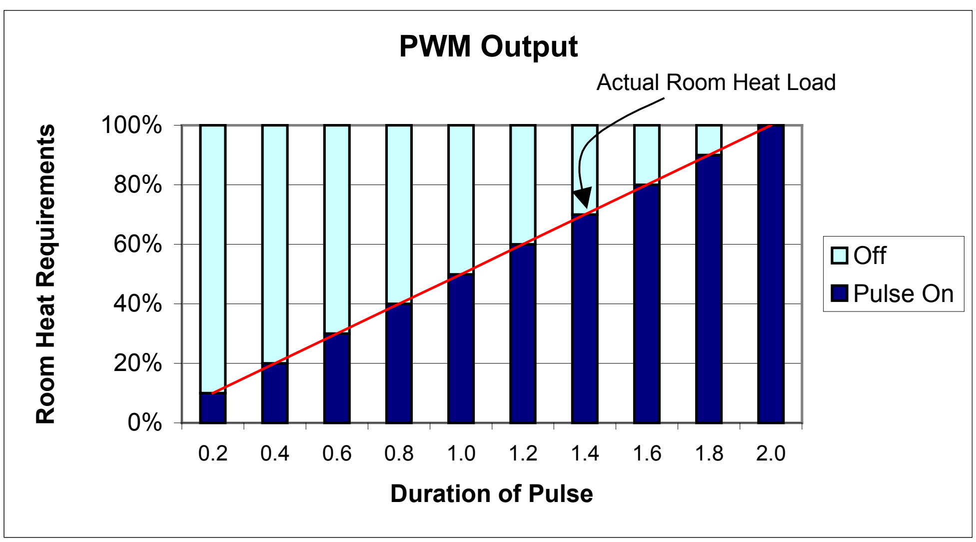
Engineers are specifying modulating or time proportioned electric heat, typically called SCR electric heat as an energy savings. If there is a limited number of steps of electric heat, then the amount of heat energized can be greater than or less than the heat required. For example, if the zone requires 50% of heat output, but the three stage heater can turn on one stage at 33% heat output or two stages at 67% heat, it cannot achieve 50% heat. The heater will cycle the stages on and off to satisfy the zone requirements. When on, the zone will be over heated, when off, the zone will become too cold. Energy is wasted when the zone is too warm and it requires more energy to heat a space to a desired temperature than to maintain it at the temperature. Modulating electric heat solves this problem by only utilizing the amount of heat required by the zone.

How SCR Controlled Electric Heat Works

An SCR controller is a time proportioned controller that modulates the heater to supply the exact amount of heat required to satisfy the zone requirements. SCR electric heat works by modulating the time the electric heater is powered on, not the kW of the heater.

As an example, assume the controller has a time base of 2.0 seconds. As the zone requires heat, the pulsed signal time on increases to meet the requirements of the zone and turns off the duration of the 2.0 seconds. During this no-pulse time, the electric heat turns off. The total heat output is an average between ON and OFF periods. In the example below, the heater would pulse on for 0.8 seconds and off for 1.2 seconds to meet a 40% heat requirement.

As the zone temperature decreases, the signal length increases until it is eventually at 100%, or 2.0 seconds in duration with no no-pulse time. At this time, the electric heat is on 100% of the time. The chart below shows an example of increasing ON/OFF intervals from 0% to 100% heat requirement. (This example is for reference only, actual ON and OFF time will be determined by the controller and the heat output requirements.)

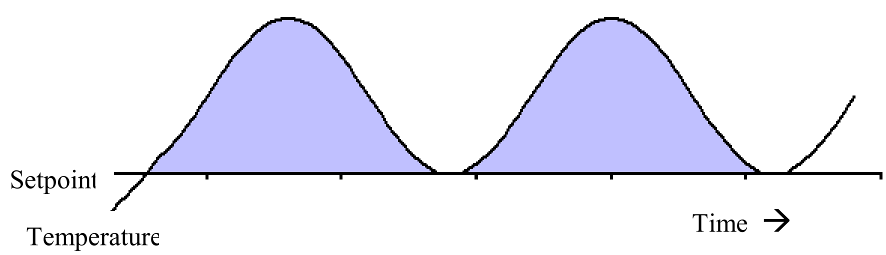


The heater gives the full kW output for a pulsed duration of time. The heater is not “dimmed” to provide a lower heat output. If, in the example above, the heater was a 7 kW heater, a 40% heat requirement would be met by pulsing the full 7 kW output on for 0.8 seconds. The heat produced during the ON period continues to dissipate during the OFF period, creating an average temperature output matching the room sensor setpoint. Unlike magnetic contactors, the SCR controller is a silent controller, so the pulsing of the heater on and off, cannot be heard.

NOTE: SCR controlled electric heat should not be confused with the type of SCR controller that adjusts fan speed on a fan powered terminal. The SCR controlled electric heater pulses the FULL kW of the heater over time to provide the required amount of heat for the space. SCR electric heat does NOT reduce the kW of the electric heater.

Energy Usage

With two and three stage electric heaters, the heater cycles the stages on and off to meet the comfort requirements of the space. As stated above, when the zone requires 50% heat output, on a three stage heater, the second stage of heat will cycle on and off. When the second stage is on, the heat output is 66.6%, 16.6% more than required to satisfy the zone. In the figure below, the shaded areas indicate when the heat output exceeds the zone requirement. This is essentially wasted energy.



In the case described above, the SCR controlled heater would modulate the heater to supply 50% heat output to satisfy the zone. This results in a more consistent discharge temperature and therefore a more comfortable zone, without the wasted energy.

Proportional Electronic Flow Sensor

The Titus SCR controlled heater has a patented proportional electronic airflow sensor. This sensor allows the heater to operate at extremely low airflow. With typical differential pressure airflow switches, the heater requires a minimum differential pressure on the switch of 0.05” +/-0.02” of water. This pressure determines the minimum CFM that the heater requires to energize the electric heater.

The unique electronic flow sensor allows the heater to respond exactly to the quantity of air flowing through the unit and safely de-energize in case of a total loss of airflow. The electronic airflow sensor allows you to size the box for the exact space requirements instead of oversizing for minimum required heater CFM, which can reduce the initial terminal unit cost.

Suggested Specification

ESV:

1. Proportional, modulating electric coils shall be supplied and installed on the terminal by the terminal manufacturer. Coils shall be ETL listed. Coils shall be housed in an attenuator section integral with the terminal with element grid recessed from unit discharge a minimum of 5" to prevent damage to elements during shipping and installation. Elements shall be 80/20 nickel chrome, supported by ceramic isolators a maximum of 3.5" apart, staggered for maximum thermal transfer and element life, and balanced to ensure equal output per step. The integral control panel shall be housed in a NEMA 1 enclosure with hinged access door for access to all controls and safety devices.

2. Electric coils shall contain a primary automatic reset thermal cutout, a secondary manual reset thermal cutout, proportional electronic airflow sensor for proof of flow, and line terminal block. The proportional electronic airflow sensor shall be totally independent of the duct static pressure and shall adjust the heater capacity according to the available airflow. The heaters shall deliver maximum heating when needed with normal minimum airflow, reduce heating with lower than minimum airflow and stop heating with no airflow. Unit shall include an integral door interlock type disconnect switch which will not allow the access door to be opened while power is on. Non-interlocking type disconnects are not acceptable. All individual components shall be UL listed or recognized.

3. Heaters shall be equipped with a proportional SCR controller to modulate the heater load according to the temperature control signal. The electronic controller shall be compatible with the following input signals:

    - Variable voltage signal 0-10 VDC

    - Pulse width modulation AC or DC

TQS / TQP:

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step. The integral control panel shall be housed in a NEMA 1 enclosure with hinged access door for access to all controls and safety devices.

2. Electric coils shall contain a primary automatic reset thermal cutout, a secondary replaceable heat limiter per element, proportional electronic airflow switch, and line terminal block. The proportional electronic airflow sensor shall be totally independent of the duct static pressure and shall adjust the heater capacity according to the available airflow. The heaters shall deliver maximum heating when needed with normal minimum airflow, reduce heating with lower than minimum airflow and stop heating with no airflow. Unit shall include an integral door interlock type disconnect switch which will not allow the access door to be opened while power is on. Non-interlocking type disconnects are not acceptable. All individual components shall be UL listed or recognized.

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