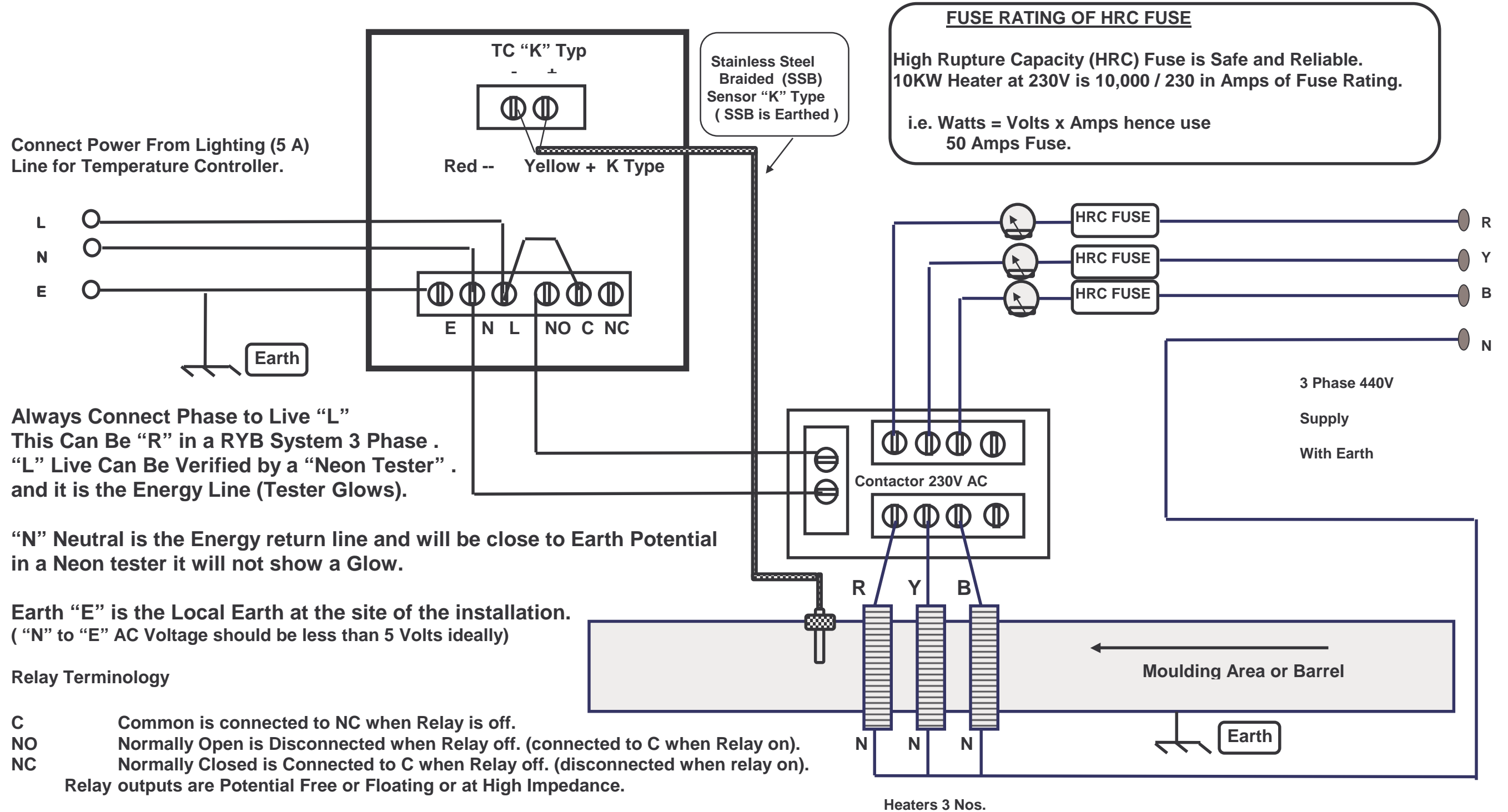


A. Temperature Control in Plastic Injection Molding.



N The Terminations of High Current Lines going to Heater must be very tight and crimped. Loose contacts will Spark and cause Fire.

B. Terms in Process Control and Explanation.

There are three Controls to be Adjusted to make a Proportional temperature Controller Perform Properly. This method has to be practiced and experience gained from it can be used to get very good and stable Control of the temperature or other process parameters.

1. Set Point. (SP)

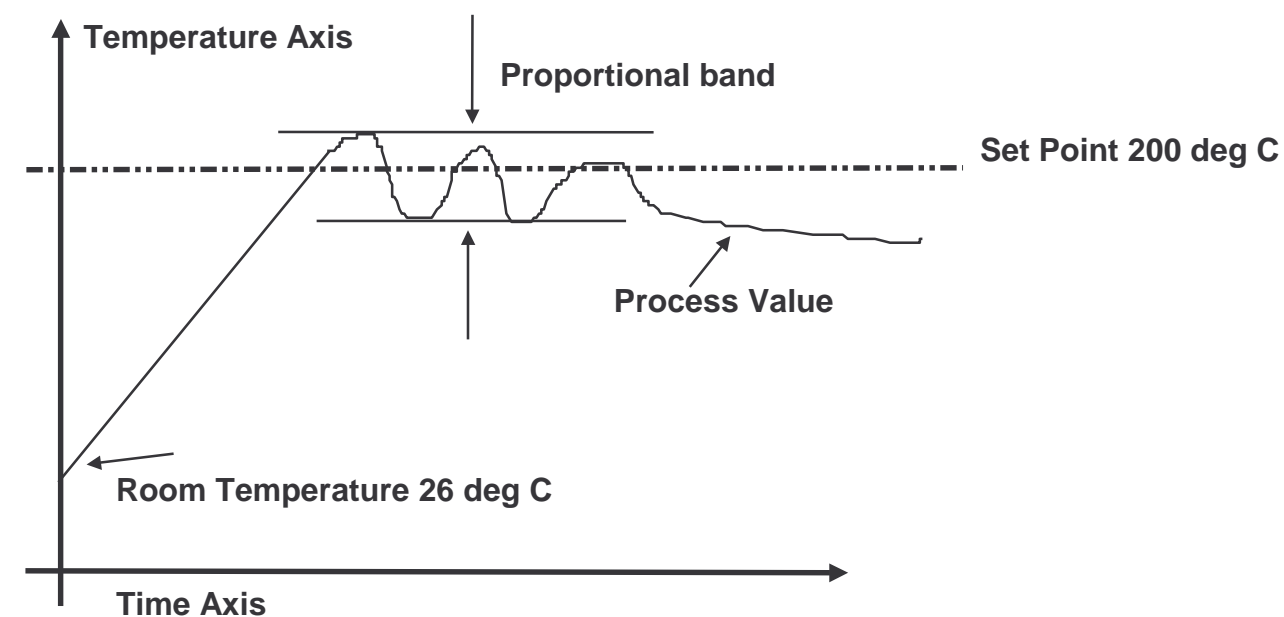
This is the Temperature at which you require the Heated area to be. Here we have to remember it is better to control the temperature of the metallic area closest to heater to avoid thermal Cushions. In Rubber and Plastic Molding if you are measuring the plastic temperature directly it may give rise to oscillations and proper control may not be possible. In Controlling the Temperature of Air or Water (Bad Conductors of Heat) Forced Convection with a. Fans for Air, or b. Stirrers for Liquids, can be used when Sensing temperature of the Liquid or air directly. But in Plastic such things cant be done as it is a semi-solid when heated hence. Control of Temperature of the Metal Discharging Heat to the Plastic is most practical. Oscillations are inevitable if the sensor is away from heater or is in contact with a non-conductor of heat.

2. Process Value. (PV)

This is the Temperature at the Tip of the sensor or the material touching the tip of the sensor. In Non-Conductors of Heat like plastic if we are monitoring plastic at a certain point the temperature of the plastic will be very different at various points depending on the Distance of the Heater from that point due to thermal gradients.

3. Proportional Band or Dead band. (PB)

Dead band or H % or Hysterisis are terms used in on / off Controllers in proportional controller we use the term proportional band.



The Temperature zone in which the Controller turns on or off The heaters in a time proportional manner is the proportional Band. It is Given in % e.g. 10% PB of 200 deg SP is 20 deg. the Heaters are on till 190 deg C and off above 210 deg. C. Between 190 to 210 is the PB. A little above 190 the Heaters are on for 90% time. A little below 210 Deg C the Heaters are on for 10% of the time. When SP=PV the Heaters are on for 50% of the time i.e. 50% Duty Cycle.

Cycle Time :

This is the repetitive rate at which the heaters are Turned on or off For a Cycle time of 12 Seconds, when PV=SP heaters are on for 5 seconds and off for 5 seconds and this goes on as long as PV=SP.

C. Tuning or Adjusting a Proportional Temperature Controller.

Step # 1

Ensure Sensor is properly connected to the Temperature Controller TC polarity reversal will show reducing reading in the Display as heat builds up. The Heaters used and wattage selected must be able to bring the temperature more than the maximum required control temperature with TC. If Supply Voltage is down or heaters are blown or not in contact TC can not solve the problem. So when in doubt connect heaters directly to supply (without TC) and see observe maximum temperature e. g. if max. temp. is 500 deg C the TC can control temperature upto 480 deg C.

Step # 2

Keep PB in minimum position and power on system e. g. set temperature is 300 deg C. Now Observe maximum overshoot. and adjust proportional band as in table below.

SP 300 deg C

PV (Process Value or Measured Temperature)

PV overshoot	Proportional Band.
10 % 330 deg C or more	Near Maximum fully clockwise till end.
5 % 315 deg C to 360 deg C	Middle of the PB Control or towards max.
2% 306 deg C	Little above present setting.
Less than 300 deg Droop e. g. 290	PB is Critically set Do not Change.

THUMB RULE !

Increment PB to Decrease Overshoot.
Increment PB to Decrease Oscillations.

Stop adjustment when PV droops < SP

Adjust EC to match SP = PV after PV is stable at a point less than SP.

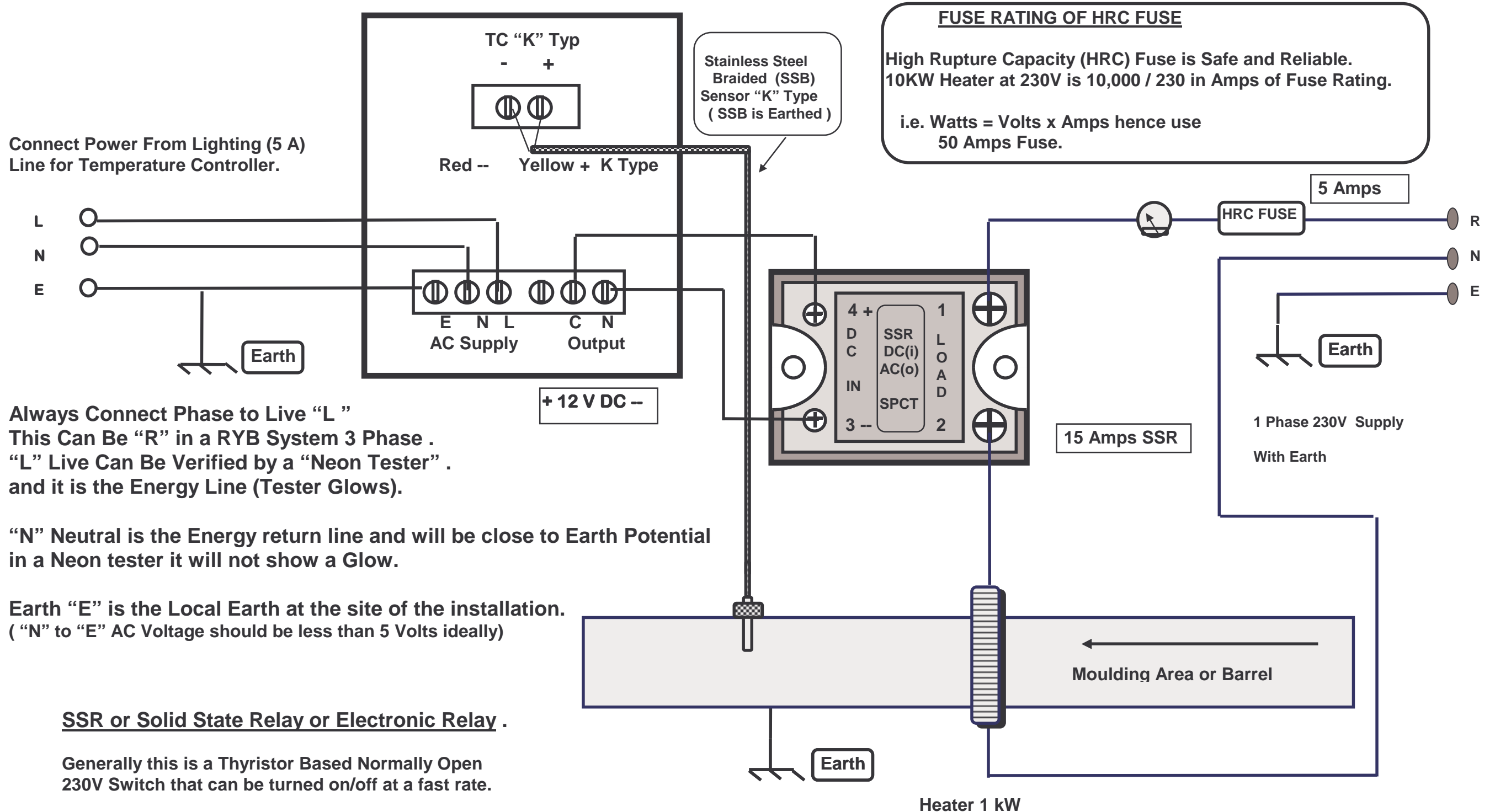
After each change turn on system again to see response till 2 % or less variation or overshoot or oscillations are obtained.

Step # 3

There is an additional control called Error Cal EC (manual reset or Integral) which is factory set for SP=PV 50% duty cycle. In certain cases after stable reading is obtained after adjusting or tuning PB the temperature may stabilize say at 290 deg for a set point of 300 deg the process is stable but a ten degrees process error is present. this can be compensated in two ways.

- a. Increase setpoint to 310 deg the process settles at 300 deg but this may not satisfactory even if it is practical.
- b. Adjust Error Cal provided in the back panel to increase temperature to 300 deg from 290 deg. when this is done give some time for system to respond after every 1/2 a turn 180 deg of the control. the EC control is a Ten turn potentiometer like the SP potentiometer after 10 turns the direction of turning must change. Clockwise Increase temperature Anticlockwise decrease temperature. (at min. PB setting EC pot sets the On/Off Operating Point).

D. Temperature Control using SSR and STC1000PK.



Connect Power From Lighting (5 A) Line for Temperature Controller.

FUSE RATING OF HRC FUSE
 High Rupture Capacity (HRC) Fuse is Safe and Reliable.
 10KW Heater at 230V is 10,000 / 230 in Amps of Fuse Rating.
 i.e. Watts = Volts x Amps hence use 50 Amps Fuse.

Always Connect Phase to Live "L"
 This Can Be "R" in a RYB System 3 Phase.
 "L" Live Can Be Verified by a "Neon Tester"
 and it is the Energy Line (Tester Glows).

"N" Neutral is the Energy return line and will be close to Earth Potential
 in a Neon tester it will not show a Glow.

Earth "E" is the Local Earth at the site of the installation.
 ("N" to "E" AC Voltage should be less than 5 Volts ideally)

SSR or Solid State Relay or Electronic Relay .

Generally this is a Thyristor Based Normally Open 230V Switch that can be turned on/off at a fast rate.

- a. No moving parts hence no wear and tear.
- b. Dissipates Heat when in On Condition.
- c. Use adequate Heat Sink or SSR will fail.
- d. Input to Output is optically isolated.
- e. The one used here is DC Control AC 230V 15A Load SSR.

N The Terminations of High Current Lines going to Heater must be very tight and crimped. Loose contacts will Spark and cause Fire.