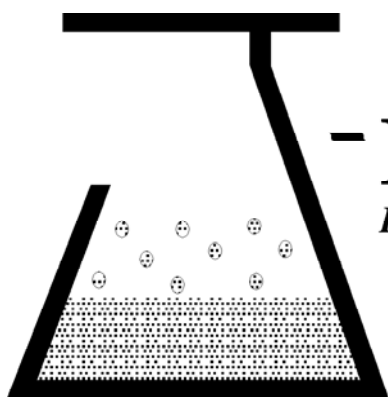


# Temperature Control for Research and Industry

## **RT-100/SA** **User's Manual**



**- KEM Scientific, Inc.**  
*Instruments for Science from Scientists*

# Warranty

J-KEM Scientific, Inc. warrants this unit to be free of defects in materials and workmanship and to give satisfactory service for a period of 12 months from date of purchase. If the unit should malfunction, it must be returned to the factory for evaluation. If the unit is found to be defective upon examination by J-KEM, it will be repaired or replaced at no charge. However, this WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of being damaged as a result of excessive current, heat, moisture, vibration, corrosive materials, or misuse. Components which wear or are damaged by misuse are not warranted. This includes contact points, fuses and solid state relays.

THERE ARE NO WARRANTIES EXCEPT AS STATED HEREIN. THERE ARE NO OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND OF FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL J-KEM SCIENTIFIC, INC. BE LIABLE FOR CONSEQUENTIAL, INCIDENTAL OR SPECIAL DAMAGES. THE BUYER'S SOLE REMEDY FOR ANY BREACH OF THIS AGREEMENT BY J-KEM SCIENTIFIC, INC. OR ANY BREACH OF ANY WARRANTY BY J-KEM SCIENTIFIC, INC. SHALL NOT EXCEED THE PURCHASE PRICE PAID BY THE PURCHASER TO J-KEM SCIENTIFIC, INC. FOR THE UNIT OR UNITS OF EQUIPMENT DIRECTLY AFFECTED BY SUCH BREACH.

## Service

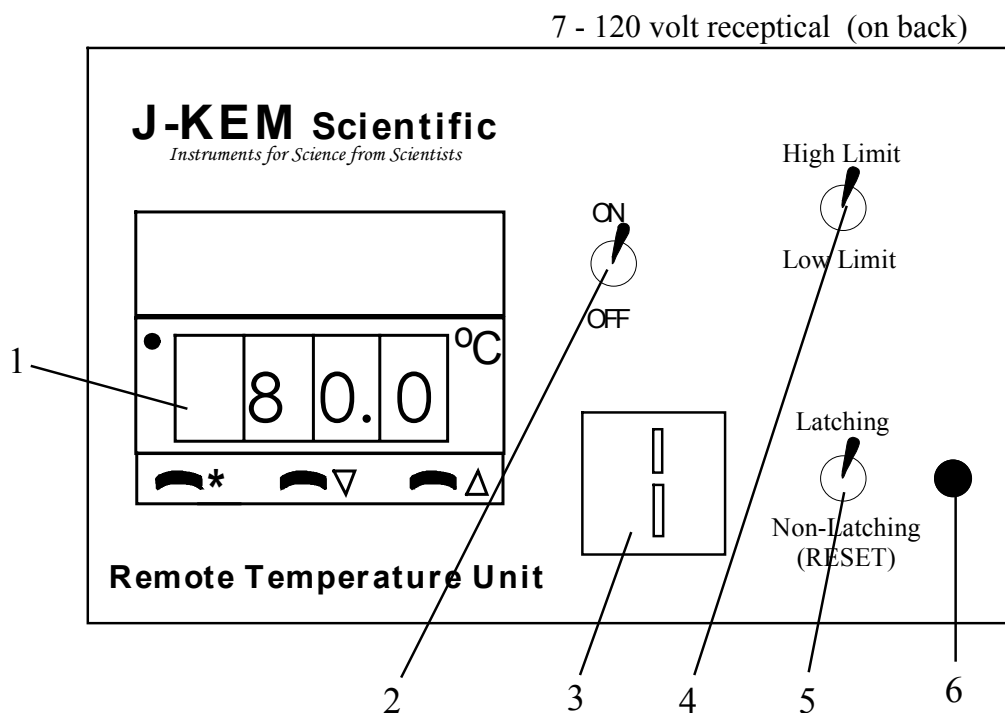
J-KEM Scientific maintains its own service facility and technical staff to service all parts of the controller, usually in 24 hours. For service, contact:

J-KEM Scientific, Inc.  
6970 Olive Boulevard  
St. Louis, MO 63130  
(314) 863-5536  
FAX (314) 863-6070  
Web site: <http://www.jkem.com>  
E-Mail: [jkem911@jkem.com](mailto:jkem911@jkem.com)

This manual contains parameters specific to temperature controller Serial # \_\_\_\_\_.  
When calling with a technical question, please have the controller's serial number available.

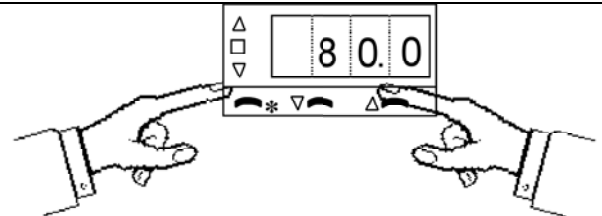
# Remote Temperature Unit Operating Instructions

J-KEM's Remote Temperature Unit (RTU) is an ON/OFF style temperature controller, which is useful for its simplicity of operation. That means the controller is ON when below the entered temperature and OFF when above it [later in the manual, we'll explain how this operating characteristic can be reversed for cooling applications (i.e., ON when above the entered temperature and OFF when below)]. The controller also has a feature which allows it to be placed in "Latching" or "Non-Latching" mode for safety or unattended applications. The full usefulness of this feature is explained later, but briefly, it allows the user to decide if the controller cycles around the entered temperature (i.e., continuously turns OFF and ON as the reaction goes above and below the entered temperature) or if it turns OFF permanently the first time the reaction reaches the entered temperature.



- J-KEM 3300** The default display of the J-KEM 3300 is the process temperature (i.e., the temperature of the reaction being measured).

To enter a set point (i.e., the desired temperature). Hold in the \* button and simultaneously press the ▲ key to increase or the ▼ key to decrease the set point. The set point can be seen at anytime by holding in the \* key. The set point appears as a blinking number in the display.



2. **ON/OFF Switch** Turns on power to the RTU.
3. **Thermocouple Input** The color of the plug on the thermocouple and the color of the thermocouple extension cord must match the color of the thermocouple receptacle on the front of the RTU, otherwise an incorrect temperature will be displayed.
4. **High Limit/Low Limit** When set to “**High Limit**”, the output receptacle (7) is ON when the process temperature is below the set point and OFF when above the set point. The controller is set to this position for heating applications since in this mode it turns the heater ON when the reaction is below the entered temperature and OFF when above it. When on “**Low Limit**” the output receptacle (7) is ON when the process temperature is above the set point and OFF when below the set point. The controller is set to this position for cooling applications since in this mode it turns the instrument used for cooling ON when the reaction is above the entered temperature and OFF when below it.
5. **Latching/Non-Latching** This switch determines how the RTU responds to an over or under temperature condition. When set to “**Latching**”, if the temperature limit (either high or low, determined by the position of the limit switch) is exceeded, the RTU turns the outlet receptacle (7) permanently OFF until the RTU is manually reset to clear this condition. When set to “**Non-Latching**” the RTU turns the outlet receptacle off only as long as the temperature limit (high or low) is exceeded and then turns it back on. See the examples on the following page to see how the limit and reset switches affect heating.
6. **Alarm** This light is lit when the temperature limit (either high or low) is exceeded or the RTU has latched because the temperature limit was exceeded at an earlier time.
7. **Outlet Receptacle** Supplies 1200 watts of power at 120 volts AC.

# Affect of LATCHING and LIMIT Switch Settings

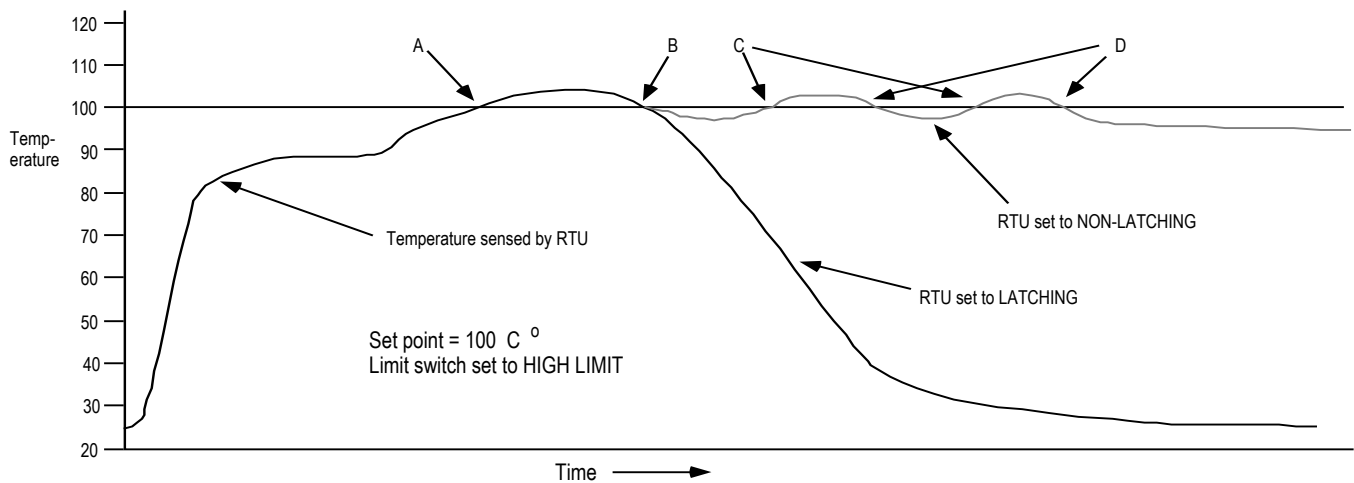
The plots below show how the RTU acts depending on the setting of the Limit and the Latching switches.

**EXAMPLE 1**    **Limit switch set to High Limit**  
**RTU's set point = 100° C**

**Heating Application**

**Latching Switch set to “Latching”**    As long as the temperature sensed by the RTU stays below 100° C the outlet receptacle (7) in on. When the sensed temperature exceeds 100° C (point **A**) the RTU turns the outlet off. Since the controller is set to the “Latching” position, it will not turn power back on when the temperature falls below 100° C (at point **B**) because it has latched (or locked) the over temperature condition. When the RTU is set to latching, exceeding the temperature limit even for a moment turns the outlet receptacle off permanently.

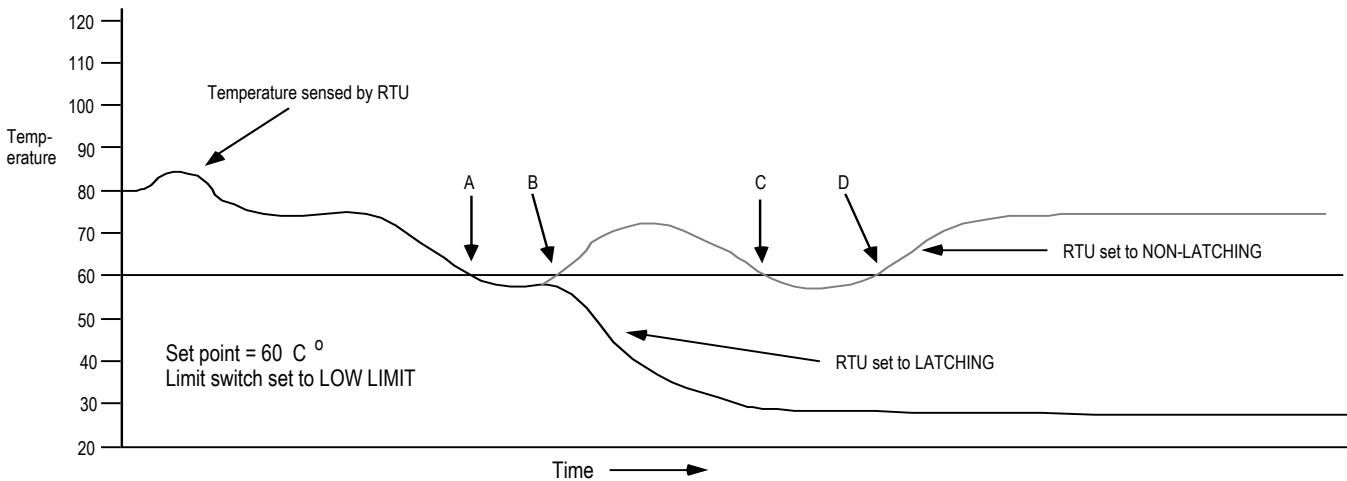
**Latching Switch set to “Non-Latching”**    Again, as long as the RTU's sensed temperature stays below 100° C the outlet receptacle in on. When the sensed temperature exceeds 100° C (point **A**) the RTU turns the receptacle off. In the “Non-Latching” position, when the temperature falls below 100° C the RTU automatically turns the receptacle back on. When set to the “Non-Latching” position, the heating outlet is on when below the RTU's set point and off when above it. In the example below, the heating outlet is turned off at points **A** and **C** and on at points **B** and **D**.



<p><b><u>EXAMPLE 2</u></b>    <b>Limit switch set to <u>Low Limit</u></b>  <b>RTU's set point = 60° C</b></p> <p style="text-align: center;"><b>Cooling Application</b></p>
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**Latching Switch set to “Latching”**    As long as the RTU’s sensed temperature stays above 60° C the outlet receptacle (7) is on. If the sensed temperature falls below 60° C (point **A**) the RTU turns power to the receptacle off and will not come back on when the temperature of the reaction warms above 60° C. When the “Latching Switch” is set to the “Latching” position, falling below the set point temperature, even for a moment, turns the outlet receptacle off permanently until the RTU is manually reset.

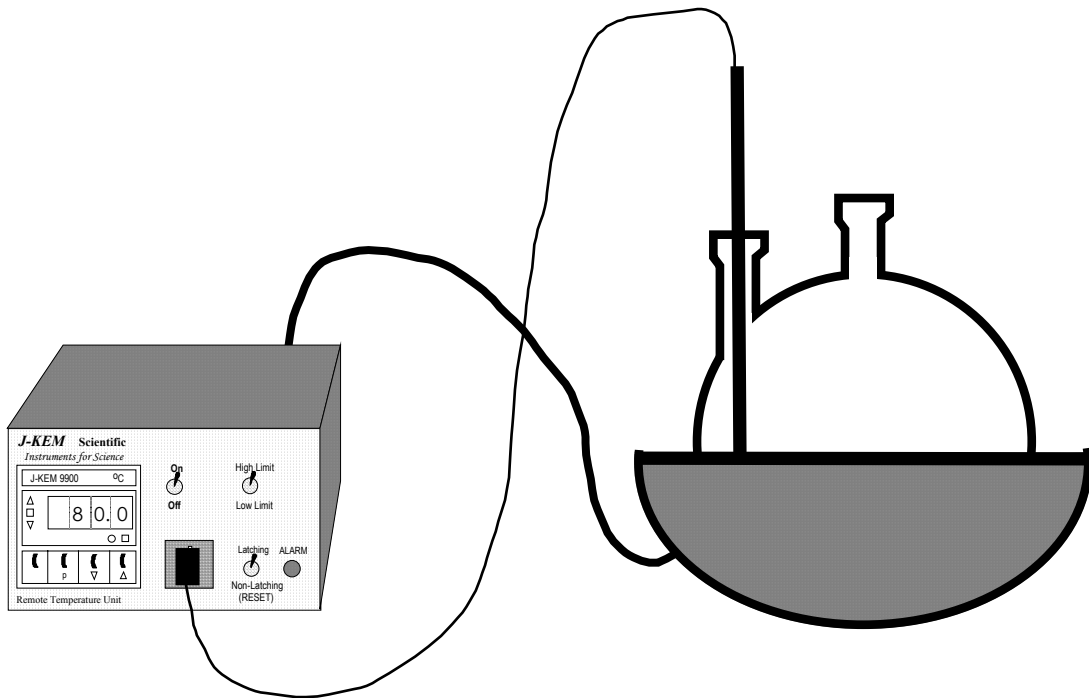
**Latching Switch set to “Non-Latching”**    Again, as long as the temperature sensed by the RTU stays above 60° C the outlet receptacle (7) is on. If the sensed temperature falls below 60° C (point **A**) the RTU turns the receptacle off. In the “Non-Latching” position, when the temperature rises above 60° C the receptacle is turned on and when below 60° C it’s turned off. In the example below, the heating outlet is turned off at points **A** and **C** and on at points **B** and **D**.



# Uses of the Remote Temperature Unit

## 1. Heating A Reaction to a Constant Temperature.

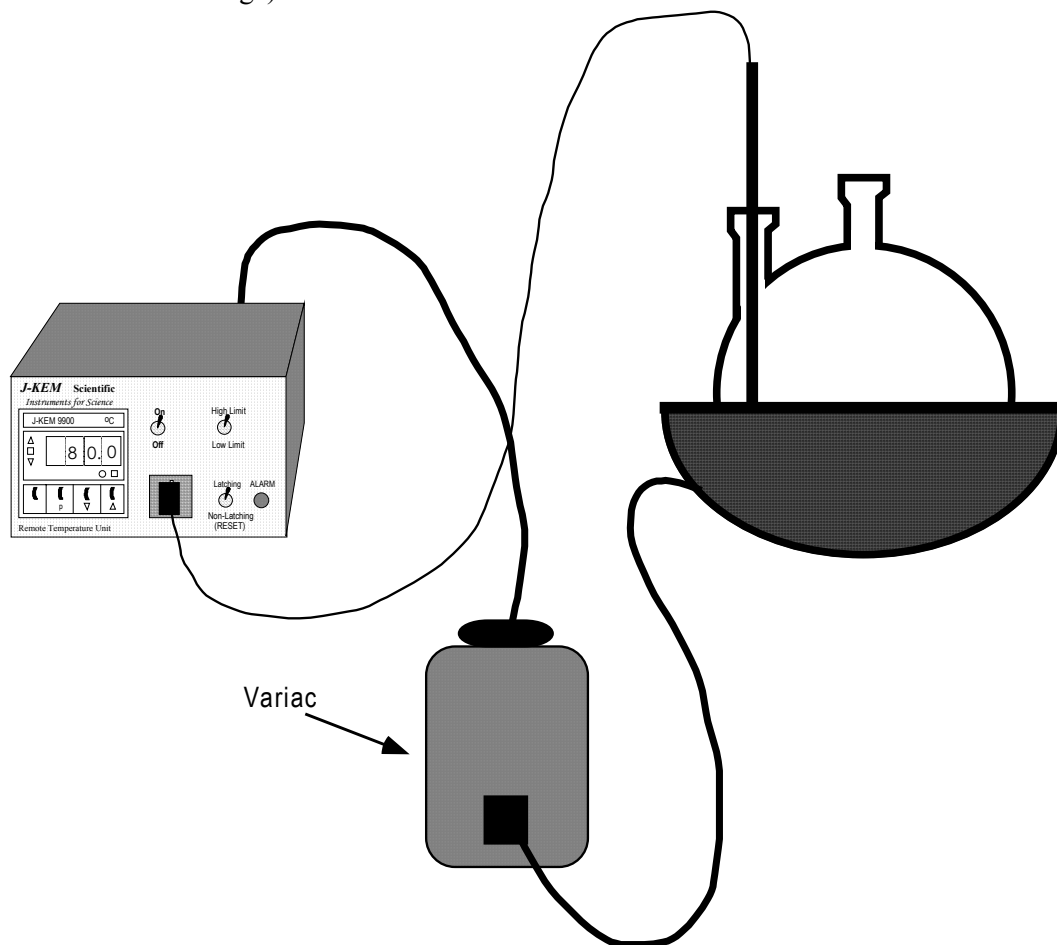
The RTU is ideal for simple heating applications. Plug the heater into the RTU's power receptacle, place the thermocouple in the solution to be heated and then enter the desired temperature into the J-KEM 3300. The "Limit Switch" should be set to "High Limit" since you want the controller to go off when it reaches the entered temperature and the "Latching Switch" should be set to "Non-Latching" since you want the controller to maintain the entered temperature rather than turn off permanently when the temperature is reached.



## 2. Turning a Reaction Off When a Limit Temperature is Reached.

There are many applications where you don't want to maintain a constant temperature, but to turn off heating when a certain temperature is reached, such as an unattended distillation or as a safety limit controller. An unattended distillation may be something like recovering hexane from hexane/ethyl acetate mixtures. This application requires that you monitor the temperature of the distillate vapor and turn off heating when the vapor temperature exceeds the boiling point of hexane. For this application, you'd place the mixture of hexane and ethyl acetate in a distillation flask equipped with a heating mantle. The heating mantle plugs into a variac which is set at a power level great enough to cause a reasonable rate of distillation, then the variac is plugged into the RTU. Hexane boils at  $69^{\circ}\text{C}$ , so a set point of  $70^{\circ}\text{C}$  is entered into the J-KEM 3300. Since you want to monitor the vapor temperature of the distillate, the thermocouple should be placed in the take off head of the condenser rather than in the flask as pictured below. The RTU should have the "Latching Switch" set to "Latching" since you want the controller to go off permanently when the set point temperature is reached and the "Limit Switch" should be set to "High Limit". In this configuration, as long as the temperature stays below  $70^{\circ}\text{C}$ , power is applied to the heating mantle which allows the hexane to distill. When the controller senses a vapor temperature of  $70^{\circ}\text{C}$ , hexane is no longer distilling and heating is permanently turned off (because the controller is set to the "Latching" position).

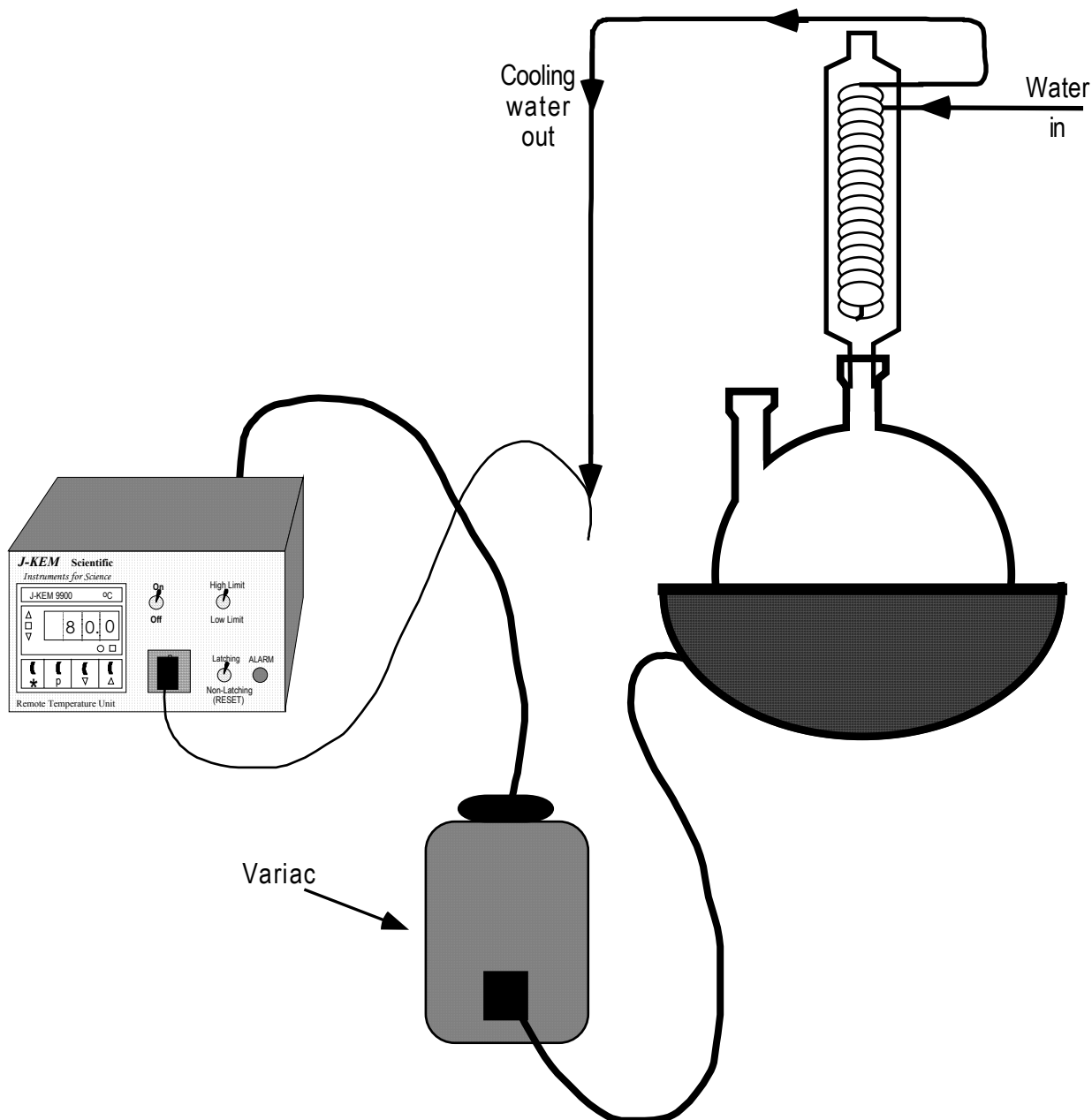
This set up can also be used as a limit controller for safety critical reactions that cannot exceed a certain temperature. If you had a reaction that needed to be heated at  $100^{\circ}\text{C}$ , but under no circumstance could exceed  $110^{\circ}\text{C}$ , the set up below could be used. In this case the heating mantle is plugged into a variac which is adjusted to heat the reaction to  $100^{\circ}\text{C}$ , then the variac is plugged into the RTU. A set point of  $110^{\circ}\text{C}$  is entered into the J-KEM 3300 and the "Limit Switch" is set to "High Limit" and the "Latching Switch" is set to "Latching". In this configuration the variac will power the heating mantle as long as the temperature sensed by the thermocouple (which is in the solution) stays below  $110^{\circ}\text{C}$ . If the reaction temperature ever exceeds  $110^{\circ}\text{C}$ , the RTU turns power off to the variac and keeps it off permanently (because the "Latching Switch" is set to "Latching").





### 3. Monitor Cooling Water Temperature

With the RTU set on the “High Limit” position it can be used to monitor the temperature of cooling water. If the temperature of the cooling water rises above 15° C (for example) the RTU turns heating off to prevent the reaction solvent from boiling away (place the RTU on “Latching”). With the RTU’s thermocouple placed after the outlet of the condenser, the RTU protects the reaction from any type of coolant failure. If for any reason the temperature of the thermocouple rises above 15° C (e.g., inadequate flow rate, water pressure drop, hose breaks, etc.) heating is turned off.



#### 4. Cooling Application

In this example, a compressor is plugged into the controller which the controller turns on and off to regulate the reaction temperature. It's important to determine the amount of power the compressor requires since the RTU supplies 1200 watts of power while many compressors require significantly more power. In this set up the RTU is set to "Low Limit" because you want the compressor to turn off when the reaction temperature goes below the set point and on when above it. The "Latching Switch" is set to "Non-Latching" because you want the controller to maintain the set point rather than permanently turning off when you reach it the first time.

