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# Temperature Control for the Recycler Stochastic Cooling Optical Components

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The Recycler Stochastic cooling system uses optical links to transmit pick-up data to the kickers. The optics are located in temperature controlled boxes. The controllers are characterized and the performance indicated.

## 1. Introduction

The temperature controller is an OMEGA iSeries controller. This controller switches a 250W heater on/off to regulate the temperature in the plexiglass box containing the optical components. The controllers may be operated using a "dead band" or PID control method. The second method is chosen for a tighter control of the temperature. This method requires the setting of the proportional band, integration and derivative times with the optimum found through trial and error.

## 2. Parameter Settings

The proportional band is defined as the change in the instrument input to cause a 100% change in the controller output. The reset, or integral, is the time over which the deviation signal is integrated. The reset time is adjusted to compensate automatically for any offset from the set point. The rate, or derivative, is the time over which the rate of change of the input is determined. The rate time is adjusted to compensate for overshoots, without "ringing", caused by rapid temperature changes.

For the controllers in MI-11 and MI-21, the settings are the same. The proportional band is $3^oF$, the integral or reset is 1200s and the derivative or rate is 120.0s. Table 1 shows the button functions on the controller which enable one to move through the configuration menus. Figure 1 is the flow chart for the OUTPUT1 menu, with the parameters changed from the factory settings shown in red.

| | |
|---|---|
| ◉ MENU | • To enter the Menu, the user must first press ◉ button.<br>• Use this button to advance/navigate to the next menu item. The user can navigate through all the top level menus by pressing ◉.<br>• While a parameter is being modified, press ◉ to escape without saving the parameter. |
| ▲ (UP) | • Press the up ▲ button to scroll through "flashing" selections. When a numerical value is displayed press this key to increase value of a parameter that is currently being modified.<br>• Holding the ▲ button down for approximately 3 seconds will speed up the rate at which the set point value increments.<br>• In the Run Mode press ▲ causes the display to flash the PEAK value – press again to return to the Run Mode. |
| ▼ (DOWN) | • Press the down ▼ button to go back to a previous Top Level Menu item.<br>• Press this button twice to reset the controller to the Run Mode.<br>• When a numerical value is flashing (except set point value) press ▼ to scroll digits from left to right allowing the user to select the desired digit to modify.<br>• When a setpoint value is displayed press ▼ to decrease value of a setpoint that is currently being modified. Holding the ▼ button down for approximately 3 seconds will speed up the rate at which the setpoint value is decremented.<br>• In the Run Mode press ▼ causes the display to flash the VALLEY value – press again to return to the Run Mode. |
| ↵ ENTER | • Press the enter ↵ button to access the submenus from a Top Level Menu item.<br>• Press ↵ to store a submenu selection or after entering a value — the display will flash a StRd message to confirm your selection.<br>• To reset flashing Peak or Valley press ↵.<br>• In the Run Mode, press ↵ twice to enable Standby Mode with flashing Stby. |

**Table 1:** Button function in configuration mode.

## 3. Performance

The temperature contolled boxes are located in environmentally controlled enclosures (Peanuts). The Peanut environment supplies the "restoring force" for the optical box temperature. All this is to buffer the optical equimpment from the outside temperature changes. Performance of the two optical enclosures are shown in Figures 2 & 3. For the MI11 optical box, except when there are rapid changes in the Peanut temperature, the temperature is regulated within 1/2$^{o}$F. For the MI21 optical box, the temperature is regulated within 1/4$^{o}$F. The differing performance show in Figures 2 & 3 suggests that the MI11 Peanut is more susceptible to outside temperature changes and that it's environmental controls are not regulating the Peanut temperature as well as in MI21.

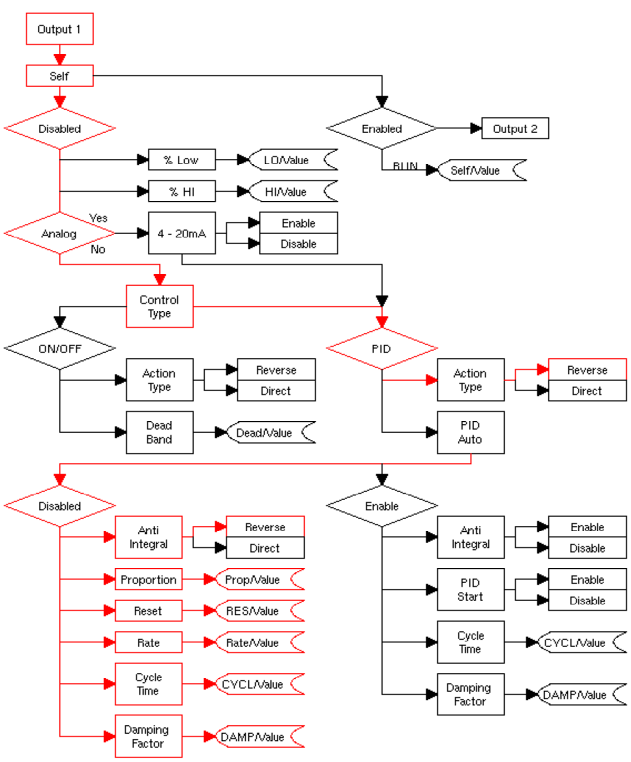


**Figure 1:** Flowchart for the OUTPUT1 menu.

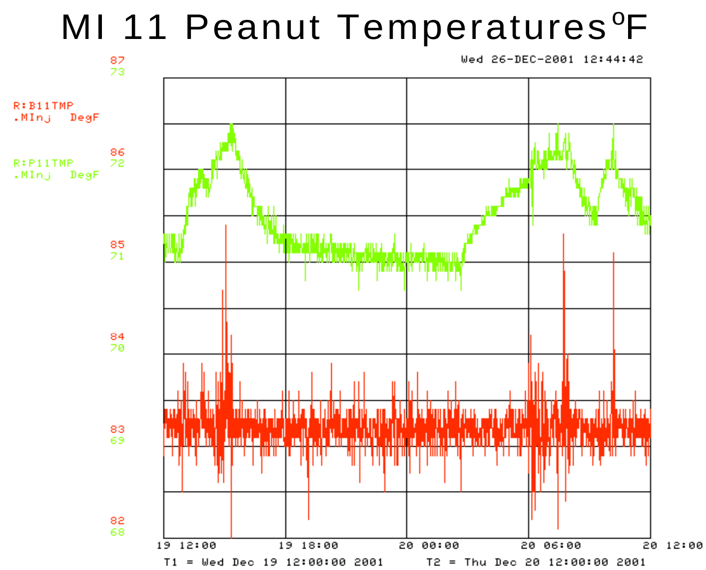


**Figure 2:** MI11 Peanut temperatures for a single day in Dec 2001. Each vertical division is 0.5 $^{o}$F. The red trace is the optical enclosure temperature. The green trace is the Peanut temperature.

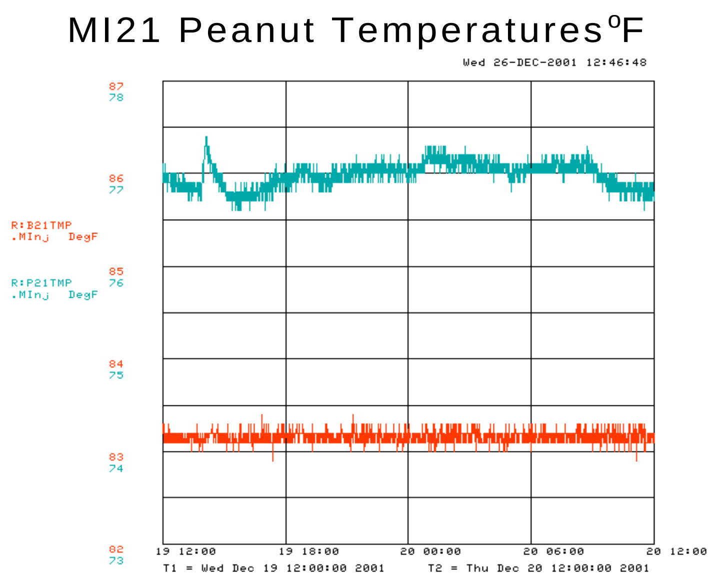


**Figure 3:** MI21 Peanut temperatures for a single day in Dec 2001. Each vertical division is 0.5 $^{o}$F. The red trace is the optical enclosure temperature. The teal trace is the Peanut temperature.