

Manual Control Settings for Temperature Controller Model 320.

To put the instrument in Manual Control Mode, press the Setup key until the display shows the tuning selection (P, PI, PID or Manual). Press the Up arrow key until the unit displays **Manual**.

Gain (G)	<p>Adjustment of the gain or the proportional (P) part of the control function gives the controller an overall range of a 1 to 999.</p> <p>To enter a gain value, press the Setup key until GAIN is shown. The display will show the current gain setting. Use the Left and Right keys to cursor to the digit to be changed. It will flash to indicate that it can be incremented or decremented with the Up or Down key. When the gain value is set, press the Setup or Scroll key to enter it.</p>
Reset (I)	<p>Adjusts the reset time constant of the integrator (I) in the control function. Effective reset time constants, between 999 s and 1 s, can be achieved by entering reset settings of 1 - 999. Reset time in seconds is $(999/\text{Value Entered})$. A reset of zero will make the controller proportional only.</p> <p>To enter a new reset value, press the Setup key until the RESET is shown in the display. The display will show the current reset setting. Use the Left and Right keys to cursor to the digit to be changed. It will flash to indicate that it can be incremented or decremented with the Up or Down key. When the reset value is set, press the Setup or Scroll key to enter it.</p> <p>For example, if the Reset setting is 20 the reset time in seconds is approximately 50 $(999/20=50)$.</p>
Rate (D)	<p>This adjusts rate time constant of the differentiator (D) in the control function. Effective settings are between 0 seconds and 200% of 1/4 of the reset time. In manual mode, rate is normally set at 1/4 the reset time in seconds (100%), because larger values may cause system instability.</p> <p>To enter a new rate, press the Setup key until RATE is shown in the display. The display will show the current rate percentage setting. Use the Left and Right keys to cursor to the digit to be changed. It will flash to indicate that it can be incremented or decremented with the Up or Down key. When the rate value is set, press the Setup or Scroll key to enter it.</p>

How to Manually Set PID Parameters

<p>How do I determine an appropriate gain setting for my cryogenic system ?</p>	<p>First, turn off both RESET and RATE. Set a nominal gain setting of 50. Make sure that the heater turns on; if not, increase the gain setting until the heater turns on. Let the system stabilize. Note that it will stabilize at some point below the set point. Keep increasing the controller gain by factors of two until the system temperature begins to oscillate. Adjust the gain for small, sustained oscillations. Measure the period of these oscillations for determining the correct setting for reset. Reduce the gain by a factor of two to three until the temperature again becomes stable with time. Be sure that you allow time at each setting for system to stabilize, if it will. For some systems and cryogenic sensors with low sensitivity, the maximum controller gain may not cause the system to oscillate, even at maximum gain settings.</p>
<p>When I enter a reset number, how does that relate to my cryogenic system?</p>	<p>The reset number is an industrial control term, which in the 320 corresponds to the number of repeats (or time constants) per 1000 seconds. The time constant is 1000 divided by this number in seconds. Consequently, a reset number setting of 20 corresponds to a time constant of 50 seconds. A system will normally take several time constants to settle into the set point. E.g. the 50 s time constant, if correct for the system being controlled, would result in a stable set point in a time frame between 5 and 10 minutes.</p>
<p>How do I determine RESET?</p>	<p>The oscillation period, which you measured in determining the appropriate gain setting, is equal to the reset time constant, which is desired. Divide this number in seconds into 1000 and set the result into the RESET register. This result is the number of repeats per 1000 seconds. If the system did not oscillate at the highest gain setting, use the following procedure. Stabilize the temperature at a high gain. Change the set point downward by one or two degrees and observe the time that it takes for the temperature to change 60% of this excursion. Use this number as the reset time constant; divide it into 1000 and set in the result as the RESET value.</p>
<p>What about RATE?</p>	<p>The rate time constant should normally be somewhere between 1/4 and 1/8 the reset time constant if it is used at all. Consequently, we allow you to set it between 0 and 200% of 1/4 the reset time constant. Start with settings of either 0, 50 or 100% and determine which setting gives you the type of control which you desire. Don't be surprised if for your system, the setting you prefer is 0 (OFF). Note that by using a percent of reset time constant, rate scales automatically with changes in the reset value and does not have to be revisited frequently.</p>
<p>How does reset change with temperature?</p>	<p>In a normal cryogenic system, the time response of the system slows down as the temperature increases. Consequently, as the temperature rises the time constant will become longer as well. Therefore, if you have determined a valid value of reset at a particular temperature, increasing the temperature will result in a decrease in the reset number, i.e., a longer time constant; conversely decreasing temperature will demand a shorter time constant, i.e., an increase in the reset setting.</p>
<p>What happens to the system gain as the temperature increases?</p>	<p>It normally increases. Consequently, if the sensor sensitivity is relatively constant, you can normally increase the controller gain with increasing temperature.</p>