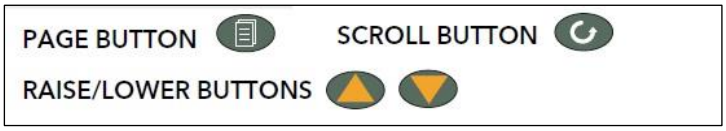
NANODAC Tuning Quick Guide R1

The first step is to open up the Supervisor level. This will allow full access to the controller's configuration.



1. Turn on the controller and/or verify it is at the main screen
2. Press the page button, the first button on the left side
3. Highlight 'Login' by using the arrow buttons and press the Scroll Button, second button in from the left. See Section 3.3.7 in the manual.
4. Select 'Engineer' access and press Scroll button.
5. Press the down arrow 3 times to select 'Numeric' and press Scroll.
6. Enter 100 as the password using the Arrow & Scroll buttons. Then Press Page when complete.
7. The confirmation box will appear. Highlight 'Yes' to confirm.

Now the Auto tune can be initiated through the controller's configuration.

1. At the main screen, press the page button to access the top level menu.
2. Highlight 'Loop' in the Configuration Menu and press the Scroll Button.
3. Select Loop 1 and press the Scroll Button.
4. Highlight 'Tune' in the Loop Menu and press the Scroll Button.
5. Highlight 'Tune Enable'. 'On' initiates the Auto Tune. You must log out of Engineer to start Auto Tune. Legend changes to 'Off' when Auto Tune is Complete. Set to 'Off' manually, to stop the tuning process.
6. 'State' will display the progress of the Auto Tune. Verify that it is 'Running'.
7. See Section 4.6.3 & B2.4.5for more Tuning Information

Log out of the Engineer level after Setting Tuning Enable.

1. At the main screen, press the page button to access the top level menu.
2. Highlight 'Logout' by using the arrow buttons and press the Scroll

Manual tuning should be performed only after it has been determined that the Auto Tune process has not provided adequate control for the process. When changing PID settings, allow some time for the changes to take effect by observing the process and tracking the oscillation time between dwells if applicable.

1. At the main screen, press the page button to access the top level menu.
2. Highlight 'Configuration' by using the arrow buttons and press the Scroll Button.
3. Highlight 'Loop' in the Configuration Menu and press the Scroll Button.
4. Highlight 'PID' in the Loop Menu and press the Scroll Button.
5. The Proportional Band 'PB', Integral Time 'Ti', and the Derivative Time 'Td' will be located in this menu. See Section B2.4.6 in the manual for complete instructions.

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Proportional Band Setting (P):

1. Adjust the set point to the desired temperature.
2. Set the Proportional Band (P) to 75% of the set point temperature to start.
    a. Ex: 120°F Desired Temperature would be P = 90
3. Set the Integral and Derivative (I and D) to 'off'.
4. Apply a normal heating load or demand on the system.
    a. Ex: Open several hot water faucets or wash down hoses
5. Watch the Process Variable (PV – actual measured outlet temperature) and verify that there is a stable temperature. The Process Temperature will most likely be sluggish in response and offset, high or low, from the set temperature. See Figure 1 for a visual example. If the PV does not have these characteristics then multiply P by 2 and observe until it does.

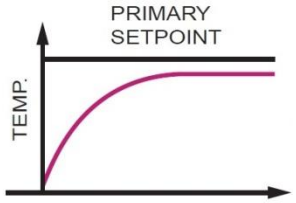

Figure 1: High P Value (Stable but Offset)

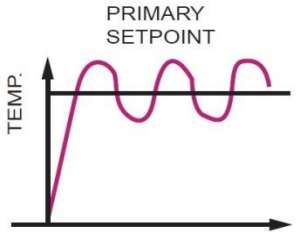

Figure 2: Low P Value (Large Oscillations)

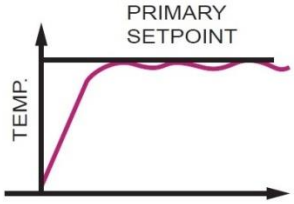

Figure 3: Ideal P Value (Minimal Oscillations)

6. Once a stable High P value has been observed, divide the P value by 2 and observe the PV, Process Temp.
    a. Ex: Stable @ P = 90 (Figure 1) Divide P by 2 so P = 45
7. Repeat step 6 until oscillations are noticeable and then multiply P by 1.5.
    a. Ex: Stable @ P = 45 (Figure 1) Divide P by 2 so P = 22. PV now resembles Graph 2
8. Observe the Process Temp, PV, to see if it matches Graph 3
    a. Ex: Multiply P by 1.5 to get PV value to resemble Figure 3
9. Adjust the P value between the 2 Figure 1 and Figure 2 values until an ideal P value is achieved as shown in Figure 3.
    a. Note: There should be a minimal PV deviation and the dwell time between oscillations should be several minutes.
10. Observe the process at startup to ensure that the Temperature rises to the set point with minimal overshoot.

Integral Time Setting (I):

1. Track the length of time in between oscillations in seconds and multiply that by 5/8. This will be the starting Integral value.
    a. Ex: 1 minute oscillations = 60 seconds; I = 60 seconds x 5/8 = 38
2. Track the performance of the Integral by changing the heating load conditions.
3. To increase the response time of the offset reduce I value by 0.5x and to reduce the response time increase by 0.5x.
    a. Ex: Sluggish recovery after heating load change, 38 x 0.5 = 19; I = 38 – 19 = 19
4. From a cold start, test and verify that the Integral Time allows maximum elimination of offset with minimum overshoot. If not completely satisfied, fine-tune the value, up or down, as needed and test until correct.

Derivative Time Setting (D):

1. Use the oscillation time from before and divide it by 10 to enter the Derivative value.
    a. Ex: 1 minute oscillations = 60 seconds; D = 60 seconds / 10 = 6
2. If the system is very dynamic the D value may remain at zero.
3. Make 25% changes with D to adjust. Increase if the response is still sluggish and decrease if oscillations are at a quick rate.

Final Notes:

1. Make slow methodical changes and track the PID settings w/ any high/low cyclic temps as well as oscillation times.
2. Track temperature changes and recovery times during heat load changes as well to ensure minimal overshoot.
3. Decrease the Integral if overshooting occurs. Decrease the Derivative accordingly as well if on.
4. Systems with quick PV changes may benefit from a low P (0.2) & higher I (1.5-10) or high P (1.5 x set point) & low I (2-10).