VIN - pin 7 connects to -Sense

VIN + pin 12 connects to V_C, pin 11

CL (pin 2) goes to ??

CS (pin 3) goes to + output

INV INP (pin 4) goes to R14, R2R = 2.4K resistor goes to - Sense

2.4K to ground. (Ground)

INV INP (pin 5) to RRbin to pin 6

Also goes to capacitor R15 to Vref GND

Vref (pin 6) goes to 220Ω to NI

pin 8, 9, 10 all connected = V_out, V2, V3

go to power - things

pin 11, 12 connected, goes to ?? (see chart)

pin 13, 14 = Freq comp, goes to cer. disk

then to pin 4 = INV INP

INV INP also goes to \( A \text{ of ADJ} \) pot via some

6.1K resistor

BLUE: RED = 6.1K to pot to + Sense
If \( V \) is not connected, then the output will go too high.

\[ V_A \]

\[ +7.15 \]

\[ 1.5k \]

\[ 22k \]

\[ \text{if } V_c, \quad 5.4V \]

\[ \text{if } 0, \quad 2V \]

\[ \frac{0 - 2}{R} + \frac{7.15 - 2}{5} + \frac{0 - 2}{15} = 0 \]

\[ - \frac{2}{R} + 1.03 - 1.13 = 0 \]

\[ \frac{2}{R} = 0.9 \]

\[ R = 2.21k \]

\[ A \]

\[ +5V \]

\[ \frac{5 - x}{2.2} + \frac{7 - x}{5} + \frac{0 - x}{15} = 0 \]

\[ 2.27 - \frac{x}{2.2} + 1.4 - \frac{x}{5} - \frac{x}{15} = 0 \]

\[-.45x \]

\[-.2x \]

\[-.07x \]

\[-3.67 = .72x \]

\[ 5, \quad V = x \quad \text{well that's closer.} \]
Control voltage divider:

\[ V_A = 0 \rightarrow 5\text{v} \]
\[ V_+ = 2.04 \rightarrow 5.61\text{v} \]
\[ V_{\text{out}} = 0 \rightarrow 12\text{v} \]

Feedback voltage divider:

\[ \frac{7.15 - 2.04}{R_1} + \frac{0 - 2.04}{R_2} + 0 - 2.04 = 0 \]

\[ \frac{5.11}{R_1} - \frac{2.04}{R_2} = 2.04 \]
\[ \frac{1}{R_1} = 0.40 + \frac{0.40}{R_2} \]

\[ \frac{7.15 - 5.61}{R_1} + \frac{0 - 5.61}{R_2} + 12 - 5.61 = 0 \]

\[ \frac{1.54}{R_1} - \frac{5.61}{R_2} = -6.39 \]
\[ \frac{1}{R_1} = \frac{3.14}{R_2} + \frac{4.15}{6.89} = 0.40 + \frac{0.40}{R_2} \]

\[ \frac{3.24}{R_2} = 0.79 \]
\[ R_2 = 4.55 \]
\[ R_1 = 10k \]
\[ R_1 = 10.4k \]
\[ R_2 = 7.1k \]
for $0 < 2.4V$

\[ \frac{1}{R_1} = 0.40 + \frac{0.40}{R_2} \]

\[ \frac{7.15 - 2}{R_1} + \frac{0.2}{R_2} + \frac{0.2}{1} = 0 \]

\[ \frac{5.15}{R_1} - \frac{2}{R_2} = 2 \]

\[ \frac{1}{R_1} = 0.39 + \frac{0.39}{R_2} \]

\[ \frac{7.15 - 5}{R_1} + \frac{0.5}{R_2} + \frac{24-5}{1} = 0 \]

\[ \frac{2.15}{R_1} - \frac{5}{R_2} + 19 = 0 \]

\[ \frac{1}{R_1} = \frac{2.33}{R_2} - 8.84 = 0.39 + \frac{0.39}{R_2} \]

\[ \frac{1.94}{R_2} = 9.23 \]

\[ R_2 = 0.21 \]

\[ R_1 = 0.45 \]

If $R_2 = 2.4k$

Then need $R_1 = 5.1k$

and $R = 11.4k$

so center value of pot + resistor = 11.4k
\[
\frac{6 - 2}{R} + \frac{7.15 - 2}{5} + \frac{0 - 2}{11.7} = 0
\]

\[
\frac{-2}{R} + 1.03 - 0.17 = 0
\]

\[
\frac{2}{R} = 0.86
\]

\[
R = 2.32 \text{ K}
\]

\[
\frac{5 - x}{2.32} + \frac{7.15 - x}{5.00} + \frac{0.0 - x}{11.7} = 0
\]

\[
2.16 - 0.43x + 1.43 - 0.26x - 0.09x = 0
\]

\[
1.72x = 3.59
\]

\[
x = 4.99 \text{ perfect.}
\]
1. To test suggest use bench power supply to provide 0 to 5V control.

2. Connect +5 to +out and -8 to -out on Power- one.

3. Connect -out to ground at bench supply. (for both power supplies!)

4. Replace 220Ω R13 with 5.0K resistor

5. Add 11.7K resistor at R20

6. Attach 0-5V control voltage through a 2.3K resistor at R13 or R20, at end which is next to "R13" or "R20" label.

7. Replace 6.1K R12 with 10.4K

8. Attach 5.1K resistor between other end of R13 (away from "R13" label) and R14 (at the end next to the R14 label).

That's it!

2.3 K

5.0 K

5.1 K (5.0 K)

11.7 K

10.4 K
For 0-12V

\[ \frac{7.15}{R_1} + \frac{0.5}{R_2} + \frac{12.5}{1} = 0 \]

\[ \frac{2.15}{R_1} - \frac{5}{R_2} + 7 = 0 \]

\[ \frac{1}{R_1} = \frac{2.33}{R_2} - 3.26 = 0.39 + \frac{0.39}{R_2} \]

\[ \frac{1.94}{R_2} = 3.65 \]

\[ R_2 = 0.53 \]

\[ R_1 = 0.89 \]

\[ R_{14} \text{ is } \text{Yellow - Purple(?) - Red} = 4.7 \text{K} \]

\[ R_{12} \text{ is } \text{Red - Red - Red = 2.2K} \text{ pot is 2K} \]

\[ \sqrt{R_2} = 4.7 \text{K} \]

\[ R_1 = 7.39 \text{K} \]

\[ R = 8.87 \text{K} = 7.9 \text{K} + 1 \text{K} \]

\[ V = 1 \text{K} \]

7. Replace 2.2K R12 with 7.9K

8. Attach 7.9K resistor between (etc.)

heat tape 5a 8.12V
2.4Ω
two 4.8Ω
50°C 24V
### 24V Supply

- **R13**: 218.5Ω (originally 218.2Ω)

### 12V Supply

- **R13**: 218.2Ω

### After Adjusting Pot:

- Control V off: 24V supply, V_{out} = 23.99

### Control V on:

<table>
<thead>
<tr>
<th>V_{on}</th>
<th>V_{out}</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.00</td>
<td>24.00</td>
</tr>
<tr>
<td>4.50</td>
<td></td>
</tr>
</tbody>
</table>

### T= 30th July

<table>
<thead>
<tr>
<th>VAC</th>
<th>TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 \times 10^{-3} mbar</td>
<td>8:30 AM 26 July</td>
</tr>
<tr>
<td>52.5 \times 10^{-3} mbar</td>
<td>9:30 AM 21 July</td>
</tr>
<tr>
<td>91.0 \times 10^{-3} mbar</td>
<td>9:30 AM 22 July</td>
</tr>
<tr>
<td>135 \times 10^{-3} mbar</td>
<td>1:30 PM 23 July</td>
</tr>
</tbody>
</table>

- **Initialisation**: Pump Time = 10 - 60 sec?

### Run Pump at Lowish Voltage

Set Heat tape V using:

\[ P_{Time} = (T_{Set} - T_{Fine}) \times 200 \text{ W/°C} \]

Heat tape \( R_t = \frac{12V}{5A} = 2.4 \Omega \)

\[ V_{Tape} = \sqrt{P_{Time} \times R_{Tape}} \]