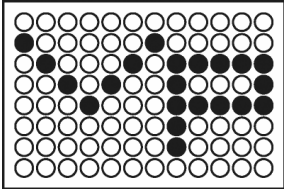


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V&P SCIENTIFIC, INC.
*Innovators in Liquid Handling,
Arraying and Mixing*

TECHNICAL NOTE #86

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**OPERATION AND CARE MANUAL
FOR THE V&P SCIENTIFIC**

VP 707C2H

**LINEAR SHUTTLE MAGNETIC LEVITATION
STIRRER* AND HEATING BLOCK**

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09/02/2003

*US patent #6,357,907

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INITIAL SETUP

CAUTION!!!!

Be advised that the Linear Shuttle Levitation Stirrer has a very strong magnetic field. Individuals with pacemakers should not get closer than 12 inches to the magnetic dipole. Remove all magnetic influenced tools and objects from the immediate area to prevent them from being pulled onto the magnets or from striking individuals as they are pulled onto the magnets. Keep credit cards, watches and other magnetic sensitive items at least 1 foot from the Linear Shuttle magnetic field.

- Carefully remove internal packing and plastic wrapping material. Remove Plexiglas safety shield.
- The Shuttle Stirrer weighs ~ 111 lbs. Because of the weight and size of the Stirrer unit, please have at least two individuals lift the unit from the shipping container by grasping it under the base plate.
- Connect the round plug of the cable harness to the power supply. Connect the 5-pin plug to the motor and tighten the attachment screws. Connect the RS232 plug on the cable harness to your computer's serial port and tighten the attachment screws. Connect the power supply to a 115 V outlet.
- Turn the power supply on. The factory installed motor memory program is preset at 3.5 cycles/minute. The Stirrer unit will run at this setting when the power is turned on.
- Turn the power switch off when the Shuttle opening is ~2 inches to the right of the magnet dipole (see cover photo and Figure 4).
- Remove Shuttle door and slide the Heating Block into Shuttle via groove # 5 (See Figure 1). Replace Shuttle door.
- Attach the thermocouple cord and power cord to Watlow Control.
- Attach thermocouple cord and power cord to Standoff rod as shown in the cover photo. Make sure the cord is high enough it does not touch the deck.

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OPERATION

SOFTWARE INSTALLATION:

Exit all programs on the computer. Insert the V&P Scientific/Animatics CD into the drive. Installation of the Animatics control program should start automatically. If the program fails to automatically launch, then browse to your CD-ROM drive and double click on Setup.exe. Once installation is completed, restart your computer.

The HELP FILE in the Animatics Folder is a great resource for assistance in customizing the control program. Sample programs are also available in this folder.

USING THE ANIMATICS PROGRAM TO CHANGE SHUTTLE SPEED:

Connect the motor to a computer loaded with the Smart Motor Interface software via the RS 232 cable. Turn the motor on. Under the File Menu, select "Retrieve Program from Motor". See Table 1 for a list of the factory installed command lines. PLEASE NOTE: Lines 1-24 and 26-39 are machine command codes which include acceleration, deceleration and starting velocity commands that should NOT be changed. The velocity setting for the factory installed program is 200,000 (Line #25: V= 200000) and will produce 3.5 complete cycles/minute of the Shuttle through the magnetic dipole or 7 lifts and drops of the levitation balls/minute. Save this file as "Default Program – 7 Lifts per Minute".

To double the default velocity, change V= 200000 to V= 400000 in Line #25.

This will increase speed ~2 fold to 7 cycles/minute or 14 lifts/minute.

Once the new speed is established, save the file under a new name. After saving the modified file, send it to the motor by clicking on the shortcut key labeled: "T". The program will be scanned for errors. If no errors are found it will be compiled and sent to the motor. If there are any problems, the software will tell you what to do.

To test the downloaded program remove power from the motor, wait for the LED's to go out and restore the power. The program will always be executed upon power up. In this case, the motor will move back and forth in accordance with the program you have sent it. It is fully stand-alone now and will operate without the host computer.

As an alternative to powering down the motor you can issue the "Z" command which completely resets the SmartMotor as if it were newly powered up.

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TABLE 1 Default Command Lines from Motor Control Program

Line #	Command
<u>1</u>	<u>KP=42</u>
<u>2</u>	<u>KI=28</u>
<u>3</u>	<u>KD=550</u>
<u>4</u>	<u>KL=20</u>
<u>5</u>	<u>F</u>
<u>6</u>	<u>LIMH</u>
<u>7</u>	<u>LIMD</u>
<u>8</u>	<u>AMPS=300</u>
<u>9</u>	<u>E=500</u>
<u>10</u>	<u>MV</u>
<u>11</u>	<u>A=500</u>
<u>12</u>	<u>V=100000</u>
<u>13</u>	<u>G</u>
<u>14</u>	<u>PRINT("MOVING CLOCKWISE - PRESS LIMIT SWITCH",#13)</u>
<u>15</u>	<u>TWAIT</u>
<u>16</u>	<u>PRINT("LIMIT SWITCH WAS PRESSED",#13)</u>
<u>17</u>	<u>WAIT=4000</u>
<u>18</u>	<u>AMPS=1000</u>
<u>19</u>	<u>MP</u>
<u>20</u>	<u>D=-20</u>
<u>21</u>	<u>G</u>
<u>22</u>	<u>TWAIT</u>
<u>23</u>	<u>O=0</u>
<u>24</u>	<u>PRINT("HOMING COMPLETE!",#13)</u>
<u>25</u>	<u>V=200000</u>
<u>26</u>	<u>A=100</u>
<u>27</u>	<u>WHILE 1</u>
<u>28</u>	<u>TWAIT</u>
<u>29</u>	<u>P=0</u>
<u>30</u>	<u>G</u>
<u>31</u>	<u>TWAIT</u>
<u>32</u>	<u>P=0</u>
<u>33</u>	<u>G</u>
<u>34</u>	<u>TWAIT</u>
<u>35</u>	<u>P=0</u>
<u>36</u>	<u>G</u>
<u>37</u>	<u>LOOP</u>
<u>38</u>	<u>END</u>
<u>39</u>	<u>END</u>

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Table 2 lists the approximate cycles or lifts per minute at different velocity settings. Use this table to record your custom settings for different experiments.

TABLE 2 Conversion from Velocity to Cycles or Lifts per Minute

<u>Velocity Setting (V)</u>	<u>Cycles/Minute</u>	<u>Lifts/Minute</u>
<u>57,137</u>	<u>1</u>	<u>2</u>
<u>200,000</u>	<u>3.5</u>	<u>7</u>
<u>400,000</u>	<u>7</u>	<u>14</u>
<u>600,000</u>	<u>10.5</u>	<u>21</u>
<u>800,000</u>	<u>14</u>	<u>28</u>

Top speed: V= 3,200,000

LOADING AND UNLOADING MICROPLATES

To load and unload microplates, turn the power switch off when the Shuttle opening is ~2 inches to the right of the magnet dipole (see cover photo and Figure 4). Load a microplate onto left loading position of the heating block. Slide the heating block with microplate into a set of the grooves on the Shuttle.

Standard 2 ml Deep Well Blocks: If using the 2 ml blocks, slide the heating block into groove #5. The 2 ml block will slide into groove #6 (see Figure 1). Place the second 2 ml block onto the right loading position of the heating block and slide into the Shuttle (see Figure 2A). The two 2 ml blocks and heating block are locked in place by sliding the Shuttle door over the end of the Shuttle (see Figure 2B).

4 ml Deep Well Blocks: If using the 4 ml blocks, slide the heating block into groove #2. The 4 ml block will slide into groove #4 (see Figures 1 and 3). The heating block with the 4 ml blocks can also be placed into groove #1. In this position, the 4 ml block will slide into groove #3. However, care should be exercised as in this position the balls will come completely out of the wells at a very rapid speed if not held in place with a sturdy cover or sealing mat.

To unload the Shuttle, reverse the process. Loading and unloading works best with the Shuttle within the dipole as shown in Figure 1.

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ADJUSTING LEVITATION HEIGHT

Adjusting the levitation height of balls in the microplate is accomplished by changing the shims under the Shuttle. Additional shims are provided to raise the Shuttle height and thereby lower the height the ball is levitated in the well. Depending upon the viscosity, surface tension and volume of the sample liquid in the wells, the levitation height can be adjusted up or down. To change the shims, use an Allen wrench to remove the bolts from inside the Shuttle and add more or thicker shims under the Shuttle position to lower the height of the levitation ball. To increase the levitation height, use a thinner shim. **NOTE: If you use a thinner shim or no shim, the balls may be pulled out of the wells.**

Use extra care when stirring the 4 ml deep well microplates as the extra height allows the balls to accelerate faster and may eject liquid out of the top of the wells. We suggest that you operate at very slow Shuttle speeds ~2 cycles/minute and seal the top of the wells.

TEMPERATURE CONTROL FOR HEATING BLOCK

The Shuttle Heating Block is designed to operate between 21°C and 90°C. It has a 180 watt heating element that is controlled by a Series 93, Watlow Microprocessor-Based Temperature Control. The Series 93 Users Manual is in Appendix A and contains detailed instructions for advanced operation. A 121°C safety fuse has been installed in the heating block to prevent damage by overheating. To set the desired temperature, press the up or down arrows on the display to increase or decrease the temperature setting (seen in bottom display window on the Watlow Control (see cover photo)). The Watlow Control is capable of more sophisticated control features such as ramping the temperature. We recommend you read the Series 93 Users Manual for these advanced features very carefully before making any changes. The V&P factory settings for the Watlow Control are attached in Appendix B.

Although the Heating Block will be at the temperature shown in the top display window (the actual temperature of the heating block), the specimens in the microplate wells will be 3°C to 8°C below this temperature depending upon how good of a heat transfer condition you provide and the volume of liquid in the wells. We recommend that you measure the temperature in your wells (using a thermocouple in the well) to determine your conditions and settings, (time to achieve desired temperature and temperature setting of heating block to achieve desired temperature in the wells).

CARE

When not in use, turn the power switch off. Do not place the power supply in a humid chamber with elevated temperatures. Do not place stirrer in a chamber with temperatures above 50°C. The Heating block is insulated from the lead screw and motor so the heat will not harm these items. Condensation may build up inside the Shuttle when it is heated so use care and remove the condensation before it drips onto the lead screw. Keep the lead screw adequately greased at all times. Periodically check the Levitation magnets for a build up of magnetic debris on the surface. Remove any magnetic debris with a dry cloth. The Linear Shuttle motor is a DC Brushless Servo Motor and requires no maintenance.

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| **WARRANTY**

There is a one year warranty against defective parts. We will replace or repair the defective part and not charge a labor fee. Damage to the machine caused by user is not covered.

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~~3. Have 2 people grasp under the base plate and lift it from the shipping container to where you want to place it.~~

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4. Connect the power supply to a 115 V outlet

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The motor has a 3.5 cycle/minute program in it's memory and will run when the light turns from red to green.

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6. Turn power supply off so shuttle stops when it is ~2 inches to right of the magnetic dipole (see cover photo).

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For help in making your own programs ~~for the motor~~, see the help file and the examples folder, ~~located~~ on the ~~ed-rom~~. ~~We have a~~ simple program already installed with acceleration and deceleration components incorporated in it. DO NOT CHANGE THE ACCELERATION AND DECELERATION COMPONENTS. The velocity setting for this program is 133,333 and will produce 3.5 complete cycles/minute of the Shuttle through the magnetic dipole (7 lifts and drops of the levitation balls/minute).

This velocity is the default velocity for the system and it will run even without connecting to the computer. The memory is stored in the motor/control module. ~~Just turn on the power switch and the Shuttle will automatically run at 3.5 cycles/minute.~~

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~~With the motor running and connected to a computer with the software program running (smart motor interface), t~~

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type the commands directly into the dark blue terminal window (smart motor terminal) of the Animatics software, all commands must be in upper case. To double the default velocity type:

V= 266666 <enter>

This will increase speed ~2 fold or to 7 cycles/minute. To double the velocity again,

type:

V=533332<enter>

This will increase speed ~2 fold to ~14 cycles/minute. We do not recommend that you go faster than this speed.

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you can disconnect or turn off the computer and the motor will continue to run at that speed. When you turn the motor off, the program will default to the factory setting of 3.5 cycles/minute.

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Velocity Value	Motor Rev/min
1	0.00186
26881.7	50
53763.4	100
80645.2	150
107526.8	200
268817.2	500
537634.4	1000
806451.6	1500

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into the bottom groove on the shuttle (the 4ml block will slide into the second groove).		
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When not in use, turn the power switch off. Do not place the power supply in a humid chamber with elevated temperature. Do not place stirrer in chamber with temperatures above 50°C. Periodically check the Levitation magnets for a build up of magnetic debris on the surface. Remove any magnetic debris with a dry cloth. The Linear Shuttle motor is a AC Brushless Servo Motor and requires no maintenance.		
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