

MSR Rotator Calibration and Verification

1. Required Tools

Gather the following tools prior to beginning the calibration:

- Digital laser tachometer (included in the MSR Rotation Rate Calibration Kit, AKMSRCAL)
- Potentiometer adjustment tool (included in the MSR Rotation Rate Calibration Kit, AKMSRCAL)
- Traceable, digital voltmeter (can use a potentiostat on site if not available)
- Traceable DC voltage source (at least 0 – 5 RPM) (can use a potentiostat on site if not available)
- Phillips screwdriver (included in the WaveVortex 10 Maintenance Toolkit, AK01WV10TK1)

2. Calibration Procedure



STOP:

Ensure the Brush contacts have been adequately worn prior to calibration. Run the MSR Rotator, without an electrode tip installed, at 3200 RPM for at least 2 hours prior to calibration.

1. Switch off power to the rotator and disconnect the power cord.
2. With the power cord disconnected, remove the cover from the control unit (see Figure 2-1).

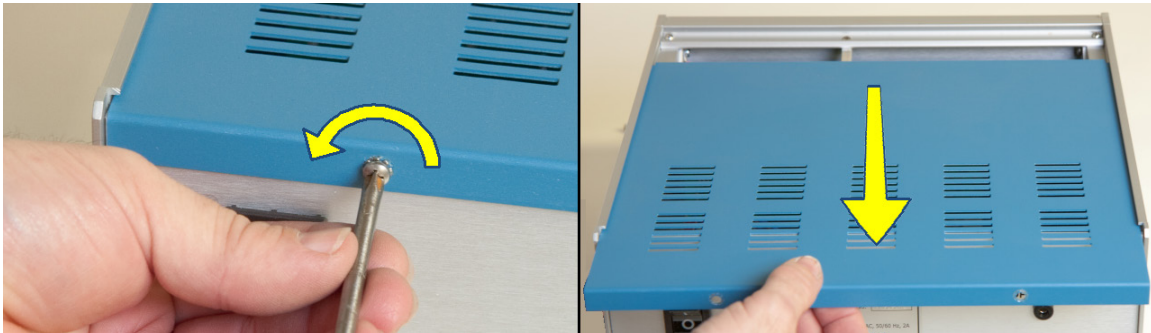


Figure 2-1. Removal of the MSR Rotator Control Unit Cover

3. While the power is switched off, note the positions of the various trimmers located along the top of the main circuit board (see Figure 2-2). A trimmer adjustment tool (or a flathead screwdriver) is required to adjust these trimmers.
4. While the power is switched off, install the tachometer target into the motor coupling on the motor unit. This target should be a metal rod with the appropriate diameter (1/4" or 6.35 mm), which is included with the MSR Rotation Rate Calibration Kit (AKMSRCAL). Many tachometers require that a piece of reflective tape be attached to the end of the shaft, which has already been done to the calibration shaft included with the kit (see Figure 2-3).

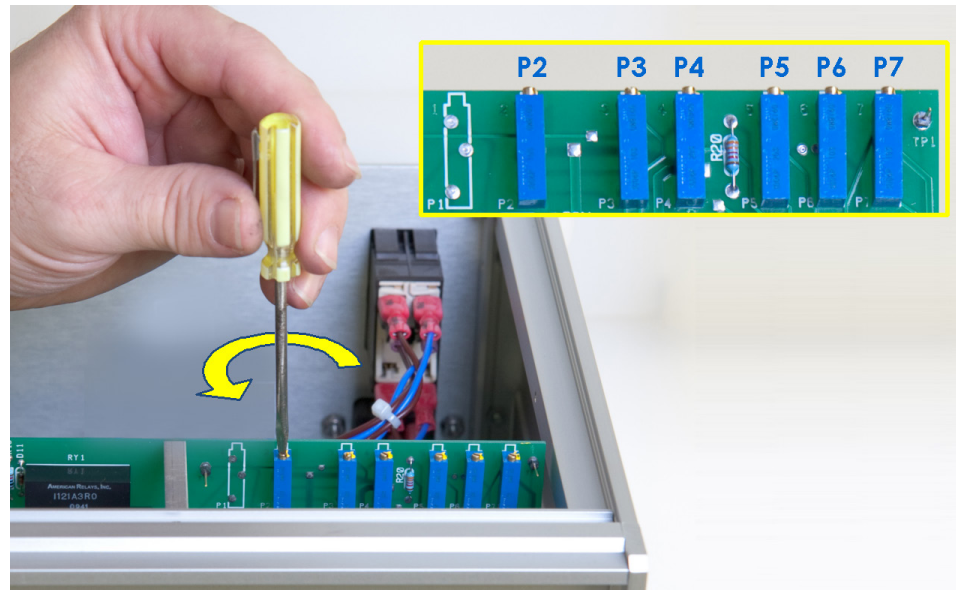


Figure 2-2. Location of the Trim Potentiometers on the MSR Rotator Control Unit Circuit Board

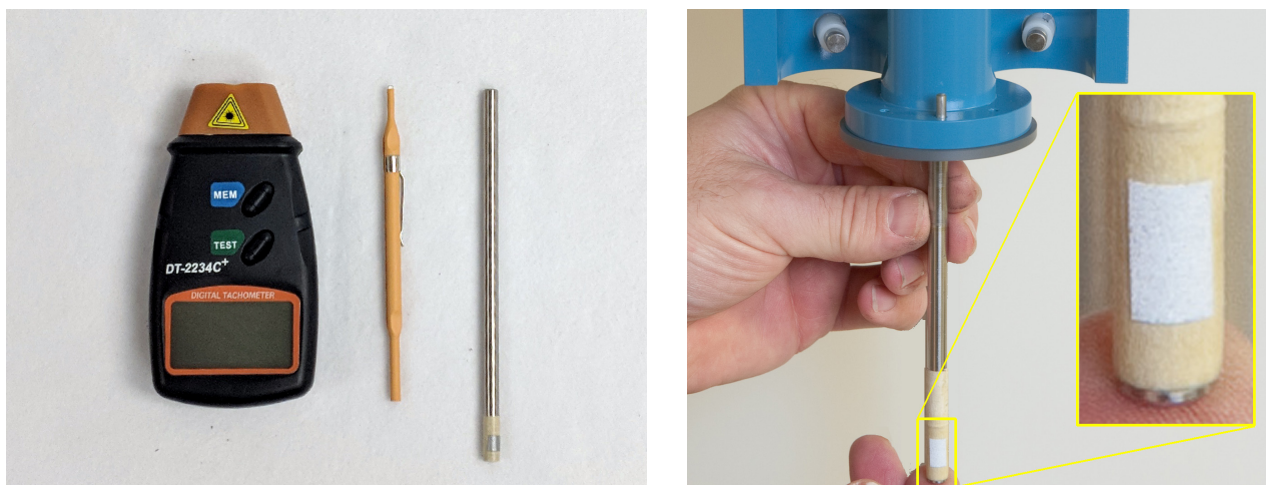


Figure 2-3. MSR Calibration Kit Tools (left) and Installation of Calibration Shaft (right)

5. Turn the rotation rate knob fully counter-clockwise. This is the position which corresponds to a nearly zero rotation rate.
6. Reconnect the power cord and carefully switch on the rotator.
7. Using the tachometer to monitor the actual rotation rate, slowly adjust the rotation rate knob on the front panel until the tachometer indicates a rotation rate of approximately 2800 RPM.



WAIT:

Allow the rotator to rotate at 2800 RPM for one (1) hour before continuing with the calibration process. This waiting period permits all electronic and mechanical components of the rotator system to equilibrate and reach a steady state.

8. After the one hour waiting period, turn the rotation rate knob fully counter-clockwise. This is the position which corresponds to a nearly zero rotation rate.
9. Locate test points **TP2** and **TP3** on the circuit board. These test points are accessible without the need to remove the circuit board from the control unit (see Figure 2-4).

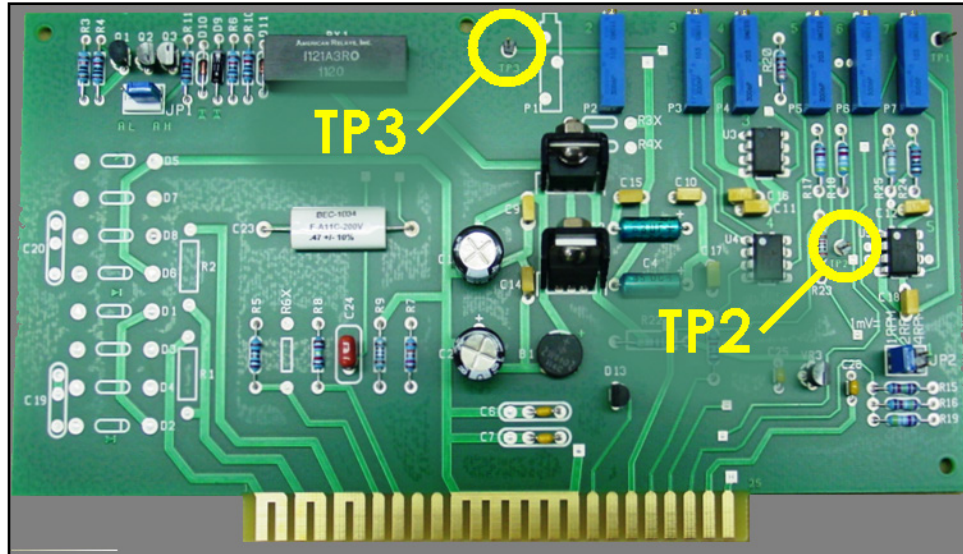


Figure 2-4. Location of Test Points on the MSR Rotator Control Unit Circuit Board

10. Connect the black lead of the digital voltmeter to one of the two black banana jacks (DC common) on the front panel of the control unit. In the next several steps of the procedure, the red lead on the voltmeter is connected to various test points, but the black lead should remain connected to the DC Common jack on the front panel.
11. Connect the red lead of the digital voltmeter to test point **TP3** on the circuit board. Adjust trimmer **P3** until the voltmeter reads $0.0000\text{ VDC} \pm 0.0005\text{ VDC}$.
12. Connect the red lead of the digital voltmeter to test point **TP2** on the circuit board. Adjust trimmer **P2** until the voltmeter reads $0.0000\text{ VDC} \pm 0.0005\text{ VDC}$.
13. Keep the red lead of the digital voltmeter connected to test point **TP2** on the circuit board. Adjust trimmer **P3** until the voltmeter reads approximately 0.0125 VDC . At this point, the motor should be rotating at a very slow rate. The direction of this slow rotation should be counterclockwise when looking down on the motor unit from above.
14. Turn the rotation rate control knob very slowly until the motor comes to a complete stop. Adjust trimmer **P7** until the rotation rate display on the front panel reads 0000 ± 1 .
15. Connect the red lead of the digital voltmeter to the OUTPUT signal jack on the front panel. Confirm that the signal level at this jack is $0.000\text{ VDC} \pm 0.001\text{ VDC}$.
16. Using the tachometer to monitor the actual rotation rate, slowly adjust the rotation rate knob on the front panel until the tachometer indicates a rotation rate of $3000\text{ RPM} \pm 1\text{ RPM}$.
17. Slowly turn the rotation rate control knob counterclockwise until the motor comes to a complete stop.
18. Switch off power to the rotator and disconnect the power cord.
19. Use a small (5/64") hex key to loosen the hex screws in the motor coupling and remove the shaft from the rotator.
20. Use the hex key to securely retighten the hex screws into the motor coupling.
21. Close the clamshell doors on the brush chamber and secure the latch.
22. Secure the enclosure around the rotator motor unit (see Figure 2-5).

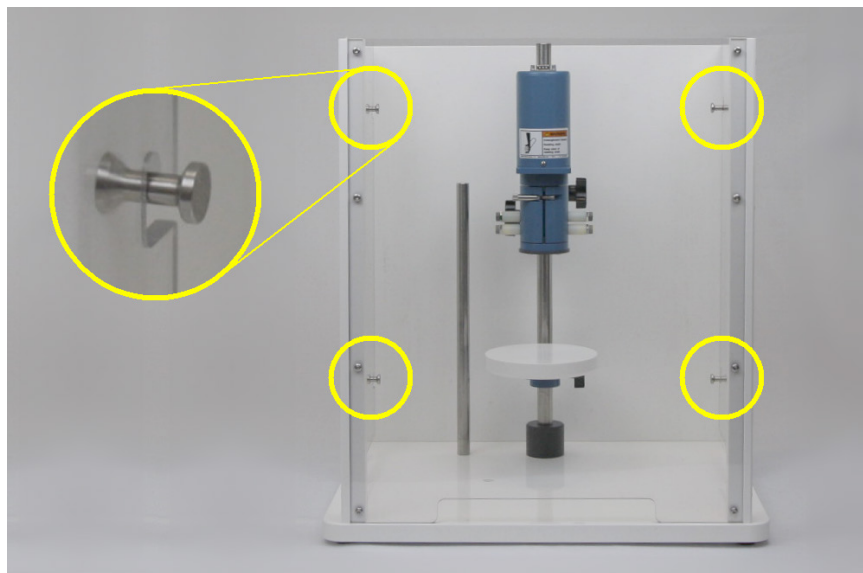


Figure 2-5. Secure Position of the MSR Rotator Enclosure

23. Turn the rotation rate knob fully counter-clockwise. This is the position which corresponds to a nearly zero rotation rate.
24. Reconnect the power cord and carefully switch on the rotator.
25. Slowly turn the rotation rate control knob fully clockwise to the fastest rotation rate. The rotation rate display on the front panel of the control unit should read approximately 10050 *RPM*. Adjust trimmer **P4** until the rotation rate display on the front panel of the control unit reads 10050 \pm 10 *RPM*.
26. Turn the rotation rate knob fully counter-clockwise. This is the position which corresponds to a nearly zero rotation rate.
27. Switch off power to the rotator and disconnect the power cord.
28. Replace the cover on the control unit (see Figure 2-6).

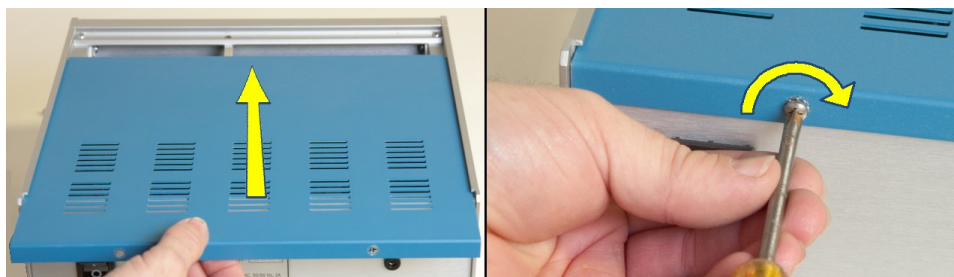


Figure 2-6. Installation of the MSR Control Unit Cover

3. Verification Procedure

Following calibration (see Section 2. Calibration Procedure), verify the input to and output from the MSR Electrode Rotator.

Prior to verifying the calibration, it is necessary to verify the input ratio of the MSR Rotator. Determine the setting for the input rotation rate ratio (1, 2, or 4 *RPM/mV*) by carefully examining the position of jumper **JP2** on the circuit board (see Figure 3-1). From the production facility, Pine Research MSR Rotators are set to the 1 *RPM/mV* input ratio.

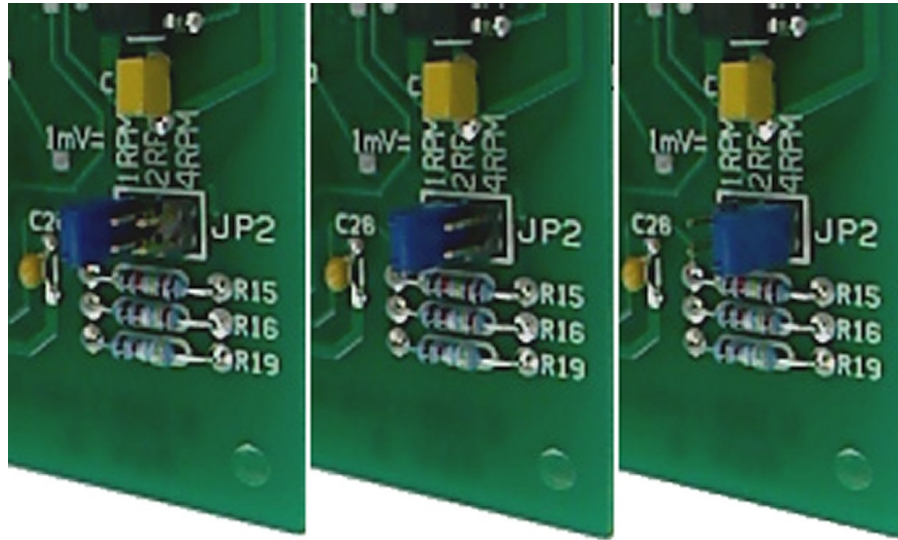


Figure 3-1. Input Ratio Setting Jumper on the MSR Rotator Control Unit Circuit Board

3.1 Verification of Input Signal

1. Using a DC voltage source, apply $1.000 \pm 0.001 VDC$ to the rotation rate INPUT signal and observe the reading on the front panel display. The proper reading will depend upon the position of jumper **JP2** as follows:
 - a. If **JP2** is set for $1 RPM/mV$, the display should read $1000 \pm 1 RPM$.
 - b. If **JP2** is set for $2 RPM/mV$, the display should read $2000 \pm 1 RPM$.
 - c. If **JP2** is set for $4 RPM/mV$, the display should read $4000 \pm 1 RPM$.
2. Record the tachometer reading and control unit display readings (see Table 3-1).
3. Repeat steps 1-2 for a series of voltage inputs (see Table 3-1).
4. Disconnect the voltage source from the INPUT jacks on the front panel.

Input Signal (V)	Expected Rotation Rate (RPM)	Tachometer Reading (RPM)	Control Unit Display Reading (RPM)
0.100	100 ± 2.0		
0.200	200 ± 2.0		
0.500	500 ± 5.0		
1.000	1000 ± 10.0		

Table 3-1. MSR Rotator Input Signal Verification



INFO:

For a good calibration, the Tachometer Reading will be equal to the Expected Rotation Rate (within the stated tolerance) and to the Control Unit Display Reading as a function of the applied input signal.

3.2 Verification of Output Signal

Verify the calibration at the several different rotation rates.

1. Prepare the MSR Rotator by connecting it to its power supply, adjusting the power switch to the on position, applying a piece of reflective tape to the shaft.
2. Connect the voltage carrying lead (typically red lead for a digital voltmeter, or the Working/Working Sense leads of a potentiostat) to the OUTPUT port on the MSR Control Unit. Connect the ground/common lead (typically black lead for digital voltmeter, or the Counter/Reference leads of a potentiostat) to the black port on the MSR Control Unit.
3. Set the rotation rate of the MSR Rotator by turning the knob to the desired rate (see Table 3-2).
4. Record the tachometer reading and output voltage measurement.
5. Repeat steps 3-4 for a series of voltage inputs (see Table 3-2).

MSR Control Unit Display Reading (RPM)	Expected Rotation Rate (RPM)	Tachometer Reading (RPM)	Output Signal (V)
100	100 ± 2.0		
200	200 ± 2.0		
500	500 ± 5.0		
1000	1000 ± 10.0		
2000	2000 ± 20.0		
5000	5000 ± 50.0		

Table 3-2. MSR Rotator Output Signal Verification



INFO:

For a good calibration, at each rotation rate, the rotation rate display on the front panel, the rotation rate indicated by the optical tachometer, and the rotation rate indicated at the OUTPUT jack on the front panel should all agree to within one percent (1.0 %). The readings noted during this step should be recorded in a log book or on a certification sheet.

4. Finalization

After completing calibration and verification tasks, turn the MSR Control unit power switch to the off position and disconnect the power supply. Remove the shaft with reflective tape. Use the screwdriver to secure the panel to the top of the control unit. Make final notations in a calibration record, as appropriate.

5. Support

After reviewing the content of this user guide, please contact Pine Research Instrumentation should you have any issues or questions with regard to the use of the instrument, accessories, or software. Contact us anytime by the methods provided below.

Online

Our website has a contact form which allows technical support requests to be sent directly to Pine Research. Visit www.pineresearch.com/contact.

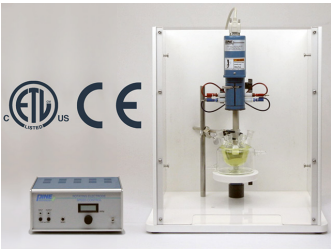
E-mail

Send an email to pinewire@pineresearch.com. This is the general sales email, and our team will ensure your email is routed to the most appropriate technical support staff available. Our goal is to respond to emails within 24 hours of receipt.

Phone

Our offices are located in Durham, NC in the eastern US time zone. We are available by phone Monday through Friday from 9 AM EST to 5 PM EST. You can reach a live person by calling +1 (919) 782-8320.

MSR Rotator Calibration and Verification

	Serial Number _____	Certification Technician _____
	Tachometer Make, Model, and SN _____	Tachometer Calibration Date _____
	Voltmeter Make, Model, and SN _____	Voltmeter Calibration Date _____

Control Unit Display and Output Signal Verification

Blue LED Display Reading (RPM)	Expected Rotation Rate (RPM)	Tachometer Reading (RPM)	Output Signal (V)
100	100 ± 2.0		
200	200 ± 2.0		
500	500 ± 5.0		
1000	1000 ± 10.0		
2000	2000 ± 20.0		
5000	5000 ± 50.0		

Control Unit Input Signal Verification

Input Signal (V)	Expected Rotation Rate (RPM)	Tachometer Reading (RPM)	Blue LED Display Reading (RPM)
0.100	100 ± 2.0		
0.200	200 ± 2.0		
0.500	500 ± 5.0		
1.000	1000 ± 10.0		



- The rotation rate for this unit is certified to be within $\pm 1\%$ of the displayed value on the control unit from 200 – 10,000 RPM and ± 2 counts of the displayed value from 100 – 200 RPM.
- This calibration is valid only for the control unit and motor unit whose serial numbers match as specified above. The control unit and motor unit must be calibrated together.



- Each rotating electrode type used with this rotator has a unique maximum rotation rate.
- Never exceed the maximum rotation rate for a given rotating electrode type.
- Use extreme caution when rotating electrodes > 2000 RPM.
- Always put the enclosure window in position before rotating an electrode.

