

Wave Motion Actuator

Instruction Manual for Model 9620

PRODUCT INCLUDES

- Actuator
- Arm and Rod Assembly
- 12V-1A DC Power Supply
- Manual

OPERATING PRINCIPLE

The stepper motor in the Actuator rotates the arm up and down from the horizontal position to produce pulses or sinusoidal periodic waveforms when the rod is attached to the Wave Motion Demonstrator. The rod attaches to a bar on the WMD magnetically. The amplitude of the waveform excitation can be adjusted by moving the rod in or out on the rod of the WMD and/or by changing the effective length of the arm by connecting the rod in a different hole. Each pulse has duration of 0.25 s. In addition to single pulses produced each time the button is pressed, dual pulses separated by a known 0.50 s can be produced by pressing the button twice in quick succession. The frequency of the sinusoidal periodic waveform can be varied continuously from 0.1 to 2 Hz, and the selected frequency is shown on the LCD display.



OPERATING INSTRUCTIONS

1. Attach the arm to the shaft of the stepper motor of the Actuator using a Philips screwdriver.
2. Attach the rod to the arm using the screw provided using the hole in the arm farthest from the motor shaft. Note: The small magnet at the other end of the rod should be facing away from the Actuator.
3. Attach the other end of the rod to a rod of the Wave Motion Demonstrator magnetically.
4. Apply power to the Actuator by plugging the power supply into a convenient 110V/220V outlet and inserting the barrel plug into the mating jack of the Actuator located just below the frequency control knob. Note: The LCD display should now show RES/Red, PER/Grn, and PUL/Blu prompting you with the switch functions. To turn the unit off, simply remove the power supply barrel plug from the Actuator.
5. Press and release the Red RESET button to move the arm to the horizontal "home" position. Note: After any selected function, the arm should return to this "home" position. If it does not, then the RESET button can be used to bring it "home".
6. To produce a single pulse excitation, press and release the PULSE button. Note: The minimum separation between these single pulses will be about 1.2s.
7. To produce a dual pulse excitation separated by 0.50s, press and release the PULSE button in quick succession. Note: In order for this to work, the button must be pressed twice, the second time within 0.25s after the first button pressing is released.
8. To generate a sinusoidal periodic excitation, press and release the PERIODIC button. The selected frequency will be displayed and can be adjusted prior to starting the motor. To start the motor, press the PERIODIC button again. The motor will run continuously and again the frequency can be adjusted while it is running. To stop the periodic excitation, press the PERIODIC button the third time, and the motor should stop when it reaches the "home" position.
9. Adjust the amplitude of the excitation by moving the Actuator rod along the rod of the WMD and/or by connecting the Actuator rod to a different hole in the arm to change the effective length of the arm. Note: Generally, the amplitude of the excitation should be at its maximum when generating pulses, but the excitation amplitude should be less when producing periodic waveforms, especially when exciting resonant modes.

APPLICATIONS

The Actuator makes the following phenomena easy to demonstrate:

- Theoretical laws of wave propagation including the propagation velocity
- Reflections from terminations (boundary conditions) and wave interference (superposition)
- Standing waves and resonant frequencies with open or clamped terminations

Propagation Velocity

The User's Manual for the Wave Demonstrator has the specifications needed to calculate the expected velocity of wave propagation. Using the Actuator to produce a double pulse, the propagation velocity may be measured by counting the bars ($\frac{1}{2}$ inch/bar) between pulses with the known 0.50s separation. Or the Actuator can be used to produce a periodic waveform and the measured length of the period in bars may be multiplied by the displayed frequency to determine the velocity ($v = f \cdot \lambda$).

Note: The bars can easily be counted on a snapshot of the excited Wave Demonstrator.

Superposition of Waves

A pulse generated by the Actuator will be reflected from an open-line termination with the same polarity or from a clamped-line termination with a reversal of polarity. The Actuator can then be used to produce a second pulse to meet the returning pulse from an open or clamped line to demonstrate constructive or destructive interference and the property of wave superposition.

Standing Waves

From the length of the line, the velocity of propagation, and the line termination (clamped or open), the frequencies expected to generate resonant standing waves can be determined. Then the Actuator can excite the Wave Demonstrator at the calculated frequency to demonstrate that a resonant standing wave is generated. Or the periodic frequency can be varied looking for the frequencies that cause resonant standing waves, and then those experimentally determined frequencies can be compared to theory.

CARE AND MAINTENANCE

The unit is designed to operate safely over long periods for the typical range of classroom temperatures. The case and display may be cleaned of finger prints using a damp cloth. Note: The labels on the Actuator will be damaged by alcohol, so if it is used to dampen the cloth, care must be taken to avoid the labels.

PRODUCT END OF LIFE DISPOSAL INSTRUCTIONS

This electronic product is subject to disposal and recycling regulations that vary by country and region. It is your responsibility to recycle your electronic equipment per your local environmental laws and regulations to ensure that it will be recycled in a manner that protects human health and the environment. To find out where you can drop off your waste equipment for recycling, please contact your local waste recycle/disposal service or the product representative.

The European Union WEEE (Waste Electrical and Electronic Equipment) symbol on the product or on its packaging indicates that this product **must not** be disposed of in a standard waste container.



LIABILITY

This product has been designed for educational purposes. Use in research, medical, commercial, or industrial applications is prohibited. Any use of this product outside of its intended purpose is done so at the risk of the end user, who shall assume full liability, and fully indemnify A. U. Physics Enterprises and its agents, for any and all damages resulting from such prohibited use.

WARRANTY

The Wave Motion Actuator is warranted by A. U. Physics Enterprises for a period of one year from the date of purchase. This warranty covers any defects in workmanship or materials. It does not cover accidental damage, damage as a result of operator error, negligence, or abuse.

CONTACT INFORMATION

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