MODEL 82415IS
ISOLATED SQUARE WAVE STIMULATOR

DESCRIPTION

The Model 82415IS Isolated Square Wave Stimulator is a complete solid state stimulator useful for student as well as research laboratories. The unit is housed in a 10-1/8" x 8-1/4" metal case with controls to regulate stimulus amplitude, duration and frequency. Binding posts are provided for the stimulus outputs. The stimulus output may be set for either single pulse or train stimulation and may be initiated from either a front panel slide switch or remote contact. The stimulus output is electronically isolated from earth ground to reduce the risk of inadvertent shock. WARNING - The stimulus output is hazardous. Creating an electrical path across the chest can be fatal. The instrument should be used by qualified personnel only.

SPECIFICATIONS

Wave Form:	Square Wave
Stimulus Amplitude:	
X1:	0 to 10 Volts (.01 volt resolution)
X10:	0 to 100 Volts (.1 volt resolution)
Stimulus Duration:	
X.01:	.05 to .5 Milliseconds
X.1:	.5 to 5 Milliseconds
X1:	5 to 50 Milliseconds
Events Per Second:	
X1:	1 to 10 Hz
X10:	10 to 100 Hz
X100:	100 to 1000 Hz
Controls:	
Power:	ON/OFF
Mode:	Train/Single
Initiate:	Manual/Remote

OPERATION

1. Connect Model 82415IS Stimulator to a suitable 115V 60 Hz 3-Prong Receptacle. If a 3-Prong Receptacle is not available and an adapter is used, care should be taken to insure that the instrument case is grounded.

2. Turn the power switch ON, noting the onset of the LED power lamp. No warm-up is necessary.

3. Stimulus output is available at the stimulus output binding posts with the black binding post referenced to ground.

4. A contact closure is available at the signal magnet output via a 3-pin Cinch/Jones connector. This contact may be utilized with most event markers. If difficulty is noted with your event marker, please contact Lafayette Instrument Company for an appropriate adapter cable or assistance in making this connection.

5. The stimulus output will occur as soon as the Initiate lever is depressed or contact closure provided at the remote 2-Pin Cinch/Jones connector. If the mode switch is placed on Single, a single pulse would be delivered at this time. If it is placed on Train, a series of pulses will be delivered at the frequency duration, and amplitude selected on the three controls as long as INITIATE is maintained.

6. When selecting stimulus magnitudes, be sure to consider the multiplier value as well as the scale value. Ranges and resolutions of each scale are provided in the specification section.

7. Consult your Minigraph or Physiogrip student manual for correct electrode placement.

8. WARNING: When using the Isolated Stimulator with human subjects, take EXTREME caution not to cross the heart's axis with a stimulating current.

   This will happen if one would touch the ground stimulator output's positive lead to one side of the body (e.g., left hand) while holding the ground lead to the other side of the body (e.g., right hand).

   When using the stimulator with humans, pay attention to where on the body electrodes are placed!

SAMPLE EXPERIMENT

The purpose of this experiment is to assess excitability of nerve fiber by plotting an Excitation Curve. Duration (chronaxie) is expressed in milliseconds on the horizontal coordinate; strength (rheobase) is expressed in voltage on the vertical coordinate.

Prepare graph paper to plot all duration (milliseconds) and amplitude (volts) values obtained during this experiment.

Prepare a separate sheet of graph paper to plot muscle contraction time against each stimulus amplitude and duration obtained during this experiment.

1. Prepare the Minigraph for recording (set sensitivity, balance and calibrate the transducer) and check operation prior to removing frog muscle.

2. On the transducer stand attach a support rod, 76614 Displacement Transducer with 76614-A Muscle Lever, and scale pan with weights.

3. Place a drip bottle in such a way that the tubing is directly above the muscle tissue. Adjust for 1 drop per second and pinch off flow of amphibian Ringer's solution until muscle preparation is in place. Check final alignment later to be sure no solution runs on to the strain gauge of the displacement transducer. (This can cause damage.)

4. Make your frog Gastrocnemius preparation to suspend between the femur clamp and muscle lever, cutting off the nerve close to the muscle. Tie a tourniquet on one leg of the double pithed frog and remove the leg close to the pelvis. Remove the skin as you might remove a stocking, preventing contact of the outside of the skin with the muscle tissue. Cut away the thigh muscle leaving the exposed femur and gastrocnemius (calf) muscle. Remove the lower leg bone (tibio-fibula) and foot, after inserting scissors between it and the gastrocnemius, and slipping the scissors down around the tarsal (ankle) joint. Cut the Achilles tendon below the bulge attached to the tarsals. Fasten the femur securely in the femur clamp. Let the muscle hang freely and rinse with Ringer's solution. Hook the tendon to the muscle lever by placing the tendon hook just above the bulge and through the achilles tendon. (A tendon hook can be made conveniently by bending an insect pin using hemostatic forceps. These pins are very sharp and strong and have worked extremely well. They will not tear, or slip off the tendon even when lifting considerable loads.)

5. Start the drip to keep the muscle bathed during the investigation. One drop every one or two seconds will do. Put the electrodes in place or fasten one copper wire near the femur, and the other near the tendon. Use light wire. Check that the wire will not interfere with the free contractions of the muscle. Connect the other ends of the wires to the stimulus output terminals and fasten securely. DO NOT TURN ON STIMULATOR AT THIS POINT. This prevents accidental shock during further assembly.

6. "Load" the muscle with a 20 gram weight (scale pan plus 10 grams). The muscle should be GENTLY stretched by adjusting the support lever on the displacement transducer.

7. Connect the event marker leads to the signal magnet terminals on the stimulator. Turn on the power.

8. Set the Mode switch to single. A stimulus output is achieved by pushing the initiate lever downward. Only one stimulus of present duration (time) and amplitude (strength, volts) is generated no matter how long you depress this switch.

   Set Duration on 25 and multiplier on X1. This gives an impulse of 25x0.1 milliseconds ($2.5x10^{-3}$ seconds) of duration.

   Set Amplitude on 40 volts. The muscle will receive a 40 volt "shock" for the above duration when the "INITIATE" switch is depressed.

9. Stimulate the muscle. If no contraction is recorded increase the duration and/or the amplitude until a contraction is recorded.

10. DETERMINATION OF RHEOBASE (rheo-. Gr. "current" +-base, M.E. "lowest") What is the lowest (minimal) voltage, or minimum electricity to stimulate the tissue being studied? WITHOUT CHANGING THE DURATION SETTING resulting from step 9 above, DECREASE the amplitude (volts) five (5) or so volts at a time, stimulating the tissue at each voltage selected. As you notice a decrease in the height of contraction on the chart recording, decrease the voltage in smaller steps. STOP as soon as all contraction ceases. Label voltages on recorded chart. Label duration.

11. Now you will investigate if the tissue will respond to this stimulus if the duration is increased. DO NOT CHANGE THE VOLTAGE SETTING. Increase the DURATION with the use of the Duration Control now and Multiplier Selector switch in small increments of one (1) or so milliseconds. Stimulate the muscle at each setting. Increase the duration until a contraction is again recorded. Label the chart as before. Indicate voltage and duration for the recorded contraction.

12. Repeat instruction 11 by reducing the AMPLITUDE (volts) until no contraction shows on the kymogram. Increase the DURATION of the stimulus at the lowered voltage to see if you can bring back a recordable response. Label the volts and duration on your chart for the new contraction.

13. If you were able to get a renewed contraction with the longer stimulus, reduce the voltage again, followed by increases in duration. Stimulate the tissue at the lower Amplitude (constant) and increments in duration until a contraction is again recorded. Label volts and duration for the contraction.

14. With further reductions as needed in Amplitude (volts) followed by several increases in Duration (time) for EACH VOLTAGE, you will reach a point at which the voltage is too low to cause a contraction, no matter how long the stimulus is continued. This is the RHEOBASE value of electricity, expressed in volts, to stimulate the nerve/muscle tissue.

15. DETERMINATION OF CHRONAXIE (chrono-, Gr. "time" + -axie "value"): What is the shortest duration in milliseconds for a stimulus to elicit a response (contraction) in the tissue begin studied? Set the AMPLITUDE to TWICE the Rheobase voltage. WITHOUT CHANGING THE VOLTAGE set the Duration Multiplier to .01 and the Duration control now fully counterclockwise. Stimulate the muscle. Increase the Duration gradually, stimulating the tissue at each setting. Increase Duration until muscle contracts. The minimum duration needed to cause the contraction is the CHRONAXIE value of time, expressed in milliseconds (at twice the rheobase voltage). Label duration and 2X-Rheobase-voltage value used on your chart.

16. Prepare a data table from your chart labels. Enter in your table the values of AMPLITUDE (volts) and DURATION (milliseconds) at which the nerve/muscle tissue responded by contraction.

17. Plot the Rheobase and Chronaxie values on a graph. Show Voltage values on the vertical axis and milliseconds on the horizontal axis. For each contraction shown on the chart, locate the point on the graph where, for each contraction, the Voltage and Milliseconds lines intersect. Connecting the points as shown in the example creates an EXCITATION CURVE.

    UTILIZATION TIME is the shortest duration of a stimulus with maximum amplitude ever necessary to cause the muscle to contract.

18. Indicate the following clearly on the excitation curve:
    a. Rheobase voltage (low volts - long duration)
    b. Chronaxie (minimum stim. duration at 2X rheobase volts)
    c. Utilization time (shortest duration - maximal volts)

19. Turn off Stimulator. Discard muscle tissue unless you are continuing to another investigation. Rinse with clear water, wipe clean and dry all instruments and metal objects used. Salt water (Ringer's solution) is very corrosive!