Model 82404SS

Master Shocker with Scrambler

User's Manual

Lafayette Instrument®

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DESCRIPTION

This Master Shocker combines the four basic functions needed for most aversive stimulation in a single package. The Constant Current Shocker is identical to Lafayette's 82400 Shocker with a current metering circuit. In addition this unit has a scramble capable of handling up to 18 Grids and an Interrupter which, by means of a solid state module, switches the current on and off within one second intervals.

SPECIFICATIONS

- **Voltage Range:** 0-2500 V AC
- **Current Range:** 0-5 mA
- **Internal Resistance**
  - **0-1 mA Output:** 2.3 Megohms
  - **0-5 mA Output:** 400 Kilohms
- **Regulation (0-1 mA Output):** 3% w/50 Kilohm change in subject resistance
- **Meter Accuracy:** 3% of Full Scale (Typical)
- **Interrupter (duty cycle):** 10% to 100% in 10% increments
- **Number of Scrambled Outputs:** 1-18

SHOCK CURRENT CALIBRATION PROCEDURE

WARNING: THIS PRODUCT PRODUCES HIGH VOLTAGES ON ITS OUTPUT.
PLEASE READ THIS PROCEDURE CAREFULLY!!

***Note:** **This procedure supersedes "Initial Checkout" steps 1 through 8 from "82404-SS Instructions."**

1. Turn Power selector fully counter clock-wise to the off position.

2. Unplug the 82404SS Master Shocker from any AC Power Outlet.

3. Place the provided load resistor (10 Kilohms, 5 Watt) across the yellow and black output terminals of the constant output connector.

4. Place a shunt across the initiate terminal.

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5. Plug the Master Shocker into a 115V AC power outlet.

6. Place the interrupter selector switch on 100% (full clock-wise).

7. Adjust the shock level knob fully counter clock-wise, or to its minimum setting.

8. Turn the power selector switch on either 5 mA or 1 mA setting depending on the desired output current. The red power light should turn on.

9. Slowly turn the shock level knob clock-wise to the desired output current.

10. Turn the power selector switch to the off position.

11. Unplug the Master Shocker from the AC power outlet.

12. Remove the load resistor from the output.

OPERATION

1. Connect a load to the shocker either through the direct output (located on the back panel on some models) or through the scrambler. The scrambled output will provide shock levels from 0-1 mA. This scrambler produces a continuous output rather than the chopped shock, which occurs with many mechanical scramblers. For systems using shock grid floors, the grids should be connected in order (1, 2, 3, etc.) to assure good regulation.

   The direct output is not scrambled and is capable of administering a 0-5 mA shock. Shock levels above 1 mA should be considered extremely hazardous and handled with care.

2. When using the direct output please note that if the output leads are twisted together, the capacitance of the leads will cause a slight error in the meter reading. To minimize this error we recommend the use of highly insulated wire such as Belden 8898. If lengths greater than 12 feet are used the wires should actually be separated for the most accurate measurements.

3. To initiate the shock, the Initiate terminals must be shunted. For safety reasons, a low voltage circuit has been used so that no shock hazard exists.

4. Upon initiation, the meter will move slowly up-scale. This is due to a meter damping circuit and does not reflect the output rise time. The full shock level appears immediately at the output terminals.

   Also, when the interrupter is on anything less than 100% the meter may not reach its actual value. Because of this, the shocker was calibrated with the Interrupter on 100% and should always be placed on 100% when selecting a desired shock level. It may also be necessary to place an appropriate resistor

across the output terminals while selecting initial shock levels. In an actual experiment, the shock may be initiated and then quickly terminated before the meter can reach its full reading. This is only due to the internal dynamics of the meter. To demonstrate the instantaneous onset of shock merely connect any neon lamp across the output binding posts. Note that it lights simultaneously with the shunting of the initiate terminals.

5. Set the interrupter at the desire level. This module performs the following function. Once the shock is initiated, current will flow on a continuous basis only if the control is on 100%. As the Interrupter is retarded toward the 10% point the current is switched on and off each second with the ON time equal to the set percentage. For example, if the interrupter is placed on 10%, the current will be on for 100 ms and off for 900 ms for each 1 second cycle.

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APPLICATION AND THEORY

All Lafayette Metered shockers read RMS or root mean square current. This is a common practice; however, occasionally a study will give results in terms of average current, peak current, or peak to peak current. The following table may be used to convert any of these values to any other value by using the given multipliers.

GIVEN	DESIRED UNITS			
	RMS	AVERAGE	PEAK	PEAK TO PEAK
RMS	1.00	0.90	1.40	2.80
AVERAGE	1.10	1.00	1.60	3.10
PEAK	0.71	0.64	1.00	2.00
PEAK TO PEAK	0.35	0.32	0.50	1.00

For example to convert 4 mA PEAK TO PEAK to RMS, you would multiply 4 * 0.35 = 1.44 mA. That is to produce 4 mA Peak to Peak with any Lafayette Shocker the Subject Current level should be set at 1.44.

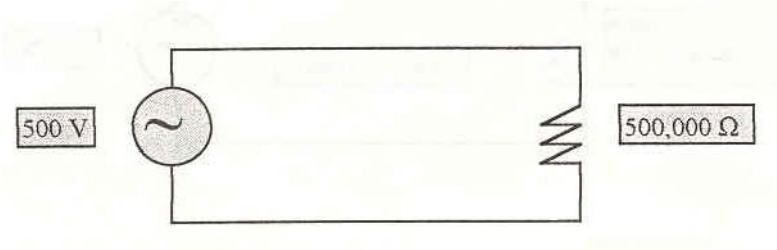
The Lafayette shocker, which you have purchased, is known as a Constant Current shocker. The theory behind its operation is as follows. For any given voltage source, the current flow through a parallel resistor is given by the formula; I = E/R where:

I = Current (Amperes)

E = Voltage (Volts)

R = Resistance (Ohms)

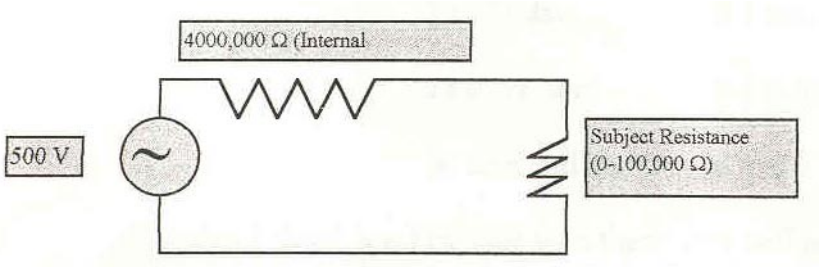
For example, suppose we have the following circuit:



The current flow through the resistor would be given by I = E/R or I = 5,000/500,000 = 1/1,000 Ampere or 1 Milliampere (mA)

Suppose now that we wish to place an animal in place of the fixed resistor. We know that if the animal's feet are dry and it is undisturbed we have a subject resistance of 100,000 ohms; however, if the animal's feet become urine soaked and it is disturbed, the subject resistance drops to approximately 0 ohms.

We wish to produce a 1 mA shock and thus construct the following shocker based on the fact that the current is constant throughout a series circuit.

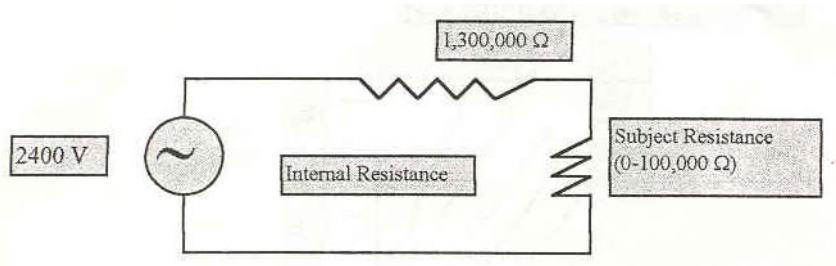


The current is equal to 500/500,000 (400,000 + 100,000) or 1 mA when the animal is unexcited; however, when the subject's resistance drops to 0 ohms, the current is equal to 500/400,000 or 1.2 mA.

The quality of a shocker is called regulation and is defined by:

$$\% \text{ Regulation} = \frac{1 \text{ initial} - 1 \text{ final}}{1 \text{ initial}} \times 100$$

In this case the % Regulation is equal to [(1.0 – 1.2)/1.0] x 100 or 20%. This design would not be considered very satisfactory. Below is the equivalent circuit for the Lafayette Shocker (A615, A615C).



When the subject's resistance equals 100,000 ohms the current flow is 1 mA. When the subject's resistance equals 0 ohms the current flow is 1.04 mA. In this case the % regulation is 4%, well within reasonable specifications. The higher internal resistor clearly gives better regulation; however, the transformer voltage must be boosted slightly to compensate for the higher resistance. 2500 volts has been found to be an optimum value and is thus incorporated in the Lafayette shocker.

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COMMON CURRENT LEVELS

Although there are wide of individual differences between animals, the following shock levels have generally been found suitable for albino rats.

1 to 27 days 0.1 to 0.4 mA

23 to 59 days 0.3 to 0.6 mA

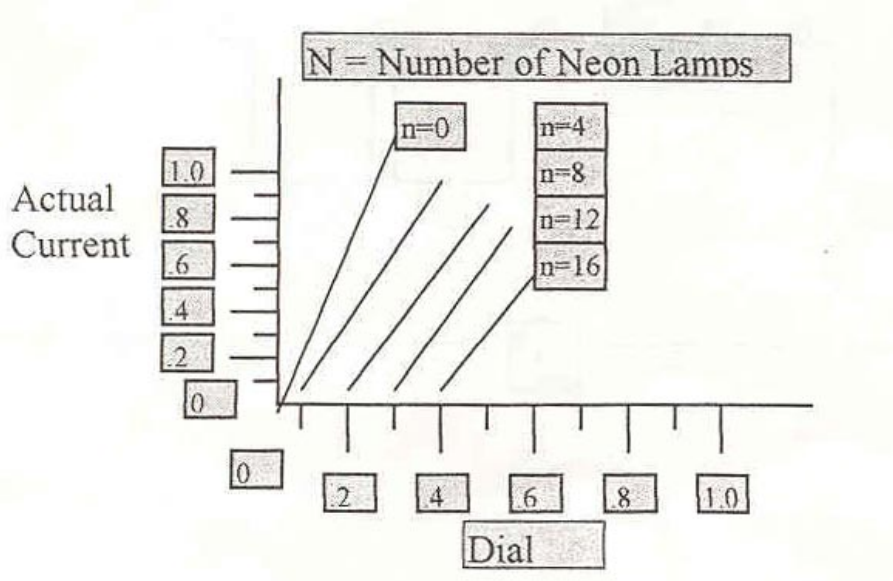
60 days and above 0.4 to 0.8 mA

The 5 mA shock level capable with these units will produce sever shock and is generally not used for simple conditioning. Please handle with extreme caution.

NEON SCRAMBLING

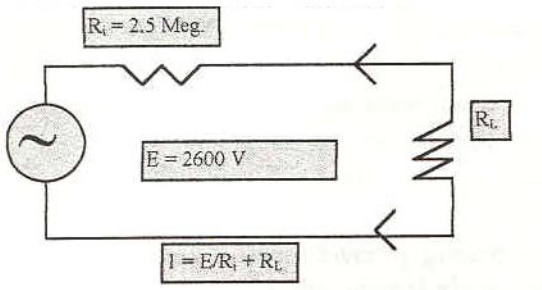
Many shockers including the A615C have incorporated neon scramblers. The main advantages of neon scrambling over most mechanical methods is that a noiseless trouble-free signal is produced without the "chopped" pattern often found with other units. The following graph has been drawn to help you correct for the use of neons. For example, if you were using a 16 grid chamber and desired a 0.5 mA shock level, it would be necessary to set the shocker on approximately 0.83 mA

Note: Current levels exceeding 1.5 mA should not be neon scrambled. We recommend NE-2E or NE-2 lamps.



THEORY OF NEON GRID SCRAMBLING

A TYPICAL SHOCK SYSTEM:



WHERE:

R1 = Fixed Resistance of Internal Current Limiter

RL = Load Resistance (neons and/or subject)

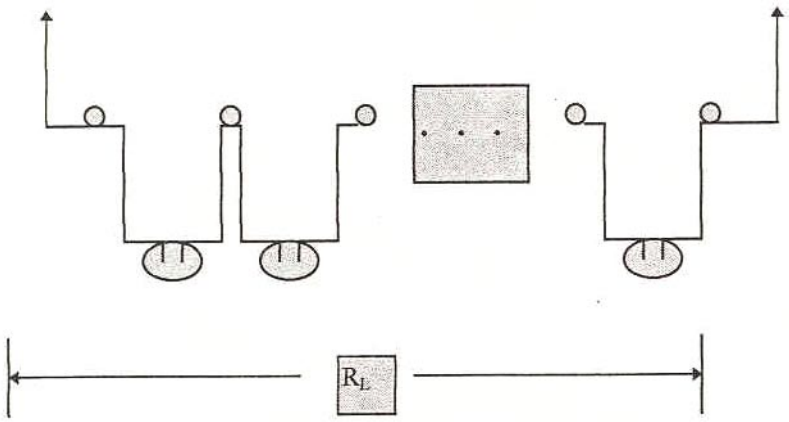
E = Source Voltage of the Shocker

I = Current

THEORY:

If the internal resistance of the shocker (R1) is much greater then the load resistance of the subject (RL) than relatively small changes in the load resistance (RL) will result in negligible changes in current (I) giving the appearance of constant current.

In neon scrambling, RL is made up of neons in series. In Lafayette chambers, there are 18 grid bars thus requiring 17 neons which at 50k ohms each provide a total RL of 850k ohms. A typical circuit is illustrated below.



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At a current setting of 1 mA with no load other than the neons a voltage of 50V can be read across each neon and they glow brightly. When an animal is placed on the grid this circuit is altered. Let's assume the animal reaches across 6 grid bars (5 neons). The total resistance of the neons beneath the animal would normally be 250K ohms; however, if the animal's resistance is low in comparison, for example 50k ohms, the total voltage drop across the grids will only be 50 volts or approximately 10 volts per neon. This voltage is not sufficient to keep the neons energized so they can extinguish. When the neon goes out its resistance goes very high (approximately 100 Megohms) so that the current flow is negligible. Thus, the animal receives the full 1 mA of current.

As the animal crosses fewer or greater number of bars, this process takes place instantaneously with the animal always receiving full stimulation, which is held constant by the mechanism described above.

ASSUMPTION

This system holds only so long as RL remains relatively small; i.e. the change in the number of bars crossed at any one time is relatively small.

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Ordering Information:

All phone orders must be accompanied by a hard copy of your order. All must include the following information:
1) Complete billing and shipping addresses
2) Name and department of end user
3) Model number and description of desired item(s)
4) Quantity of each item desired
5) Purchase order number or method of payment
6) Telephone number

DOMESTIC TERMS
There is a $50 minimum order. Open accounts can be extended to most recognized educational institutions, hospitals and government agencies. Net amount due 30 days from the date of shipment. Enclose payment with the order; charge with VISA, MasterCard, American Express; or pay COD. We must have a hard copy of your order by mail or fax. Students, individuals and private companies may call for a credit application.

INTERNATIONAL PAYMENT INFORMATION
There is a $50 minimum order. Payment must be made in advance by: draft drawn on a major US bank; wire transfer to our account; charge with VISA, MasterCard, American Express; or confirmed irrevocable letter of credit. Proforma invoices will be provided upon request.

RETURNS
Equipment may not be returned without first receiving a Return Goods Authorization Number (RGA).

When returning equipment for service, please call Lafayette Instrument to receive a RGA number. Your RGA number will be good for 30 days. Address the shipment to: Lafayette Instrument Company, 3700 Sagamore Parkway North, Lafayette, IN 47904, U.S.A. Shipments cannot be received at the PO Box. The items should be packed well, insured for full value, and returned along with a cover letter explaining the malfunction. Please also state the name of the Lafayette Instrument representative authorizing the return. An estimate of repair will be given prior to completion ONLY if requested in your enclosed cover letter. We must have a hard copy of your purchase order by mail or fax, or repair work cannot commence.

WARRANTY
Lafayette Instrument guarantees its equipment against all defects in materials and workmanship to the ORIGINAL PURCHASER for a period of one (1) year from the date of shipment, unless otherwise stated. During this period, Lafayette Instrument will repair or replace, at its option, any equipment found to be defective in materials or workmanship. If a problem arises, please contact our office for prior authorization before returning the item. This warranty does not extend to damaged equipment resulting from alteration, misuse, negligence or abuse, normal wear or accident. In no event shall Lafayette Instrument be liable for incidental or consequential damages. There are no implied warranties or merchantability of fitness for a particular use, or of any other nature. Warranty period for repairs or used equipment purchased from Lafayette Instrument is 90 days.

DAMAGED GOODS
Damaged equipment should not be returned to Lafayette Instrument prior to thorough inspection.

When a shipment arrives damaged, note damage on delivery bill and have the driver sign it to acknowledge the damage. Contact the delivery service, and they will file an insurance claim. When damage is not detected at the time of delivery, contact the carrier and request an inspection within 10 days of the original delivery. Please call the Lafayette Instrument Customer Service Department for a return authorization for repair or replacement of the damaged merchandise.

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