

Dual Channel Blood Vessel Stimulator

Operating Manual & Schematics

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Introduction

The DUAL CHANNEL BLOOD VESSEL STIMULATOR is a dual channel current regulated power supply. Each channel is capable of delivering 0 to 1.0 ma in 0.1 ma steps, and has a voltage compliance of 0 to 8 volts. In addition, input power can be switched from 120 VAC to individual internal battery supplies. All outputs are floating. An alarm circuit is activated when the output circuit is open, when the output voltage rises above 5 volts, or when the battery voltage falls below proper operating level.

Seperate charger circuits allow for one channel to be charging while the other is in use. Moreover, when a given channel is charging, it may still be used for stimulating in the AC to DC conversion mode.

All output current settings may be calibrated by adjusting controls on the back panel of the unit. Each channel features current regulation via feedback loops of 741 operational amplifiers. Voltage for each channel is read from high impedance voltage follower circuits that avoid loading down the output signal. Shorted output or open circuit conditions do not harm the unit.

Isolation between channels is achieved by using seperate transformers and regulator modules. Both channels share a common audio alarm by means of an optically coupled isolator.

Operation

- I. Operation from 120 VAC (AC to DC conversion mode).
 - A. Turn all switches to OFF (down).
 - B. Connect line cord to 120 VAC grounded outlet.
 - C. Turn POWER switch to ON.
 - D. Check that the AC pilot lamp is on.
 - E. Connect the output leads from the desired channel to the vessel stimulating electrode and reference electrode. The red banana plug is positive and ordinarily connected to the stimulating electrode. The black banana plug is negative and ordinarily connected to the reference electrode.
 - F. Turn the CHANNEL ONE and/or CHANNEL TWO switch ON. This connects the banana jacks to the power supply. Turning the POWER switch ON has already put both channels in a standby mode.
 - G. Dial the desired current on the CURRENT LIMITER switch. Each step is 0.1 ma.
 - H. Read the current meter and verify that the correct current is flowing. If no current is flowing and the alarm is sounding, there is probably an open connection in the output circuit (consult the "problem" section of this manual for additional tips).
 - I. Record the compliant output voltage.

II. Operation from internal battery supplies (battery mode).

A. Turn CHANNEL ONE BATTERY and/or CHANNEL TWO BATTERY switches ON.

The battery switches override the POWER switch. The POWER switch must be ON if either channel is being run in the AC to DC conversion mode. Operation may be mixed - that is, one channel on battery and the other in the AC to DC conversion mode. If only battery power is desired, the POWER switch may be left off. Since there is no specific indicator telling that the batteries are on, it is important that the battery switch be in the OFF position when the channel is not being used. This will prevent unnecessary battery drainage.

B. Follow steps E. through I. in part I.

Charging

- A. Turn CHARGER POWER switch ON.
- B. Turn CHANNEL ONE CHARGER and/or CHANNEL TWO CHARGER switches ON.
While one channel is charging, the other may be used in either battery mode or AC to DC conversion mode. The channel that is charging may still be operated in the AC to DC conversion mode while charging is taking place. In addition, both channels may be simultaneously charging and operating in the AC to DC conversion mode.
- C. Maximum charging time is 10 hours. The charger must be turned off at this time. There is no automatic float mode.

Alarm System

An audio alarm indicates an open output circuit, high out resistance that demands more than 5 volts compliance, or weak batteries. Once the alarm sounds, check the O.C. (open circuit) indicators to determine which channel is at fault. A faulty connection or failure of the bond at the stimulating electrode are common causes for an open circuit. Battery failure can be determined by temporarily switching from battery mode to AC to DC conversion mode. If the alarm turns off, it is probably a battery problem. CHANNEL ONE or CHANNEL TWO switches may be temporarily turned OFF to suppress the alarm while corrections are being made.

Calibration

I. Calibration with external current meter.

- A. Connect a 3000 ohm resistor, a current meter and the outputs of the power supply in series.
- B. Step the CURRENT LIMITER switch one step at a time. Each time the current may be adjusted by turning the corresponding potentiometer on the back panel.
- C. Repeat the above for the other channel.

II. Calibration with the front panel current meter.

- A. Connect a 3000 ohm resistor across the outputs of the power supply.
- B. Repeat steps B. and C. above only read the current on the front panel meter.

* Any resistance may be used so long as the compliant voltage is less than 5 volts. Recall that $V = I \times R$.

III. The voltmeter.

- A. Because current is regulated and voltage is compliant, the voltmeter is the primary indicator of a change in circuit impedance. Two scales are provided for improved reading. The more sensitive scale is obtained by depressing the 5 VOLT SCALE PUSH button.

Problems

1. Pilot lamp does not go on when POWER switch is turned ON.
 - a. Check fuse.
 - b. Check line cords and source AC.
 - c. Consider bad indicator light.
2. Current selected does not match current on meter.
 - a. The current meter will read zero in an open circuit condition (see below).
 - b. Check calibration.
3. Current reads correct but there is no output voltage.
 - a. Shorted output leads.
 - b. Defective voltmeter.
4. There is no output current or voltage.
 - a. Check that either the POWER switch or one of the BATTERY switches is on. If operating off batteries, consider dead batteries.
 - b. Check that CHANNEL ONE and/or CHANNEL TWO switches are on.
 - c. Check that the CURRENT LIMITER switch is set somewhere other than 0 .
5. Open circuit.

In the open circuit situation four events occur. The alarm sounds, the open circuit indicator lights, the voltage rises to 8 volts, and the current drops to 0 .

 - a. Turn OFF the CHANNEL ONE or CHANNEL TWO switches to suppress the alarm while making necessary corrections.

6. Short circuit.

In the short circuit situation the voltage drops to zero but the current holds to the preset level.

- a. Correct short.

7. Rising voltage.

- a. Rising resistance in a defective electrode.

8. Dropping voltage.

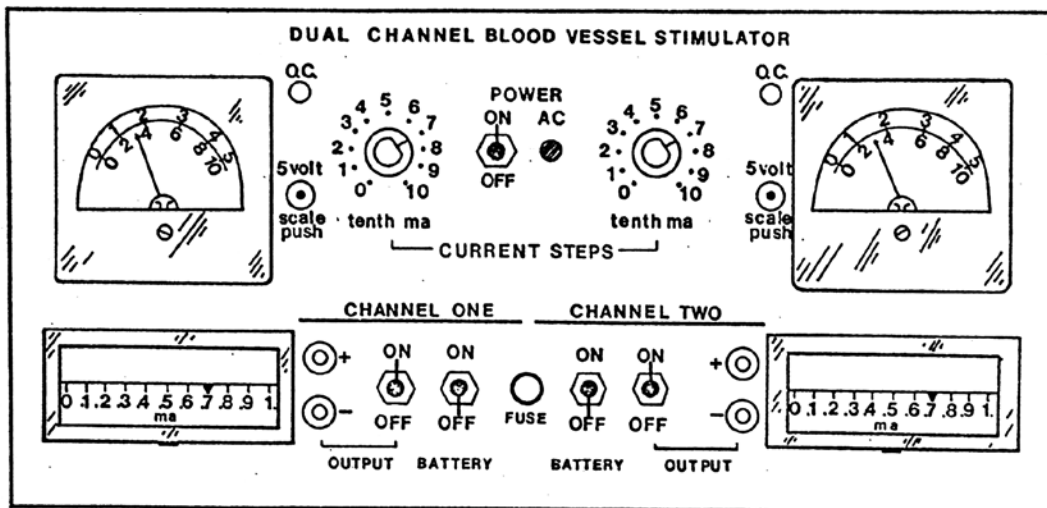
- a. Decreasing resistance - wet sponges, saline, insulation breakdown.

9. Decreasing current.

- a. Battery failure.
- b. Internal circuit failure.

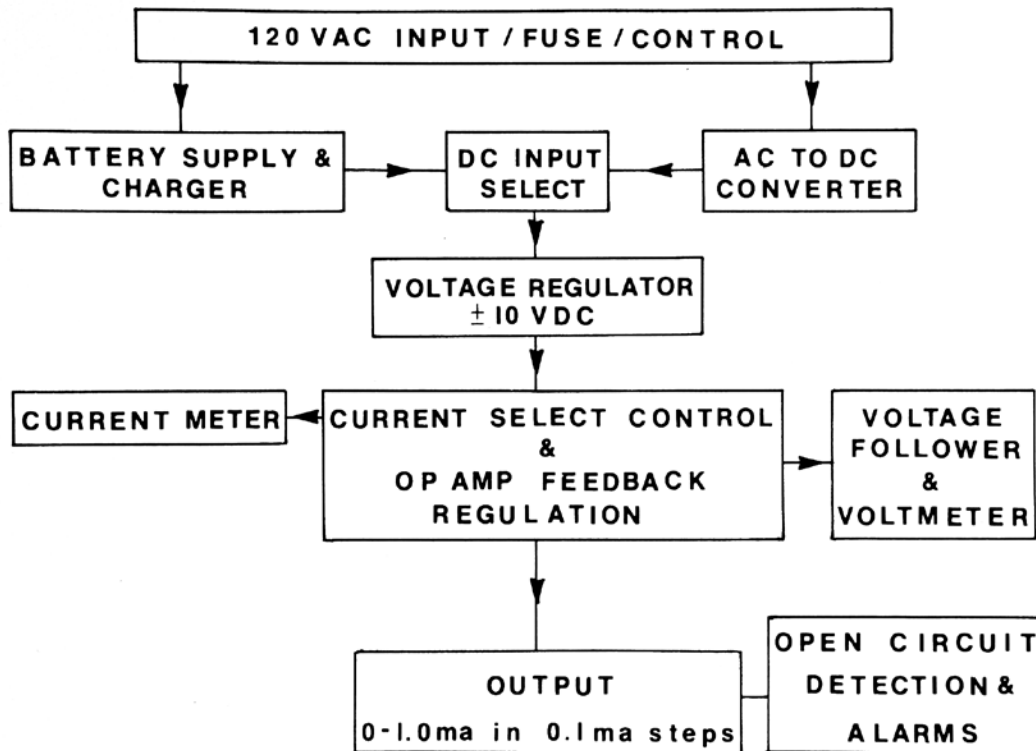
10. Increasing current.

- a. Internal circuit failure.

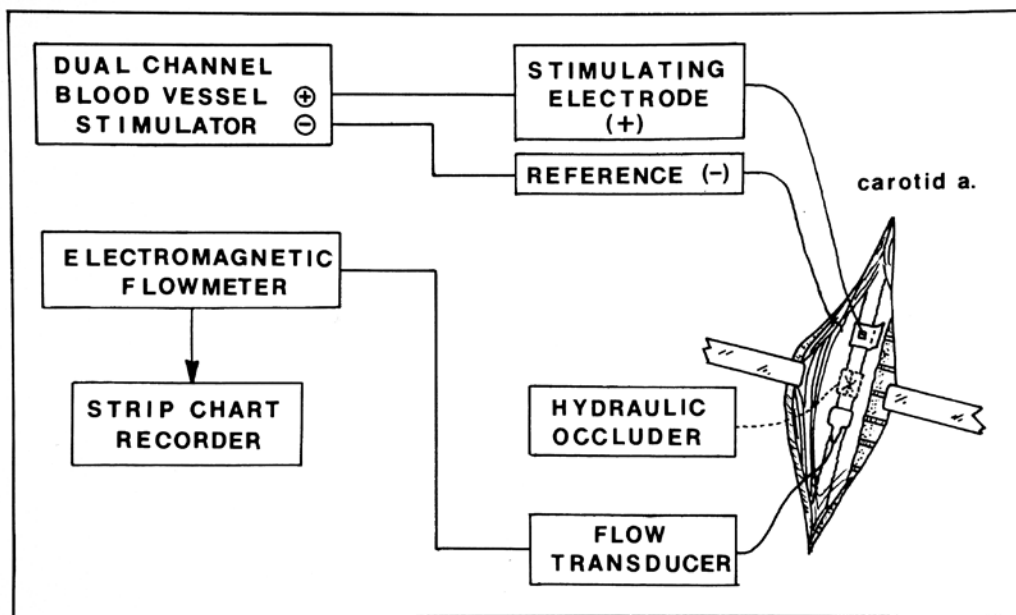


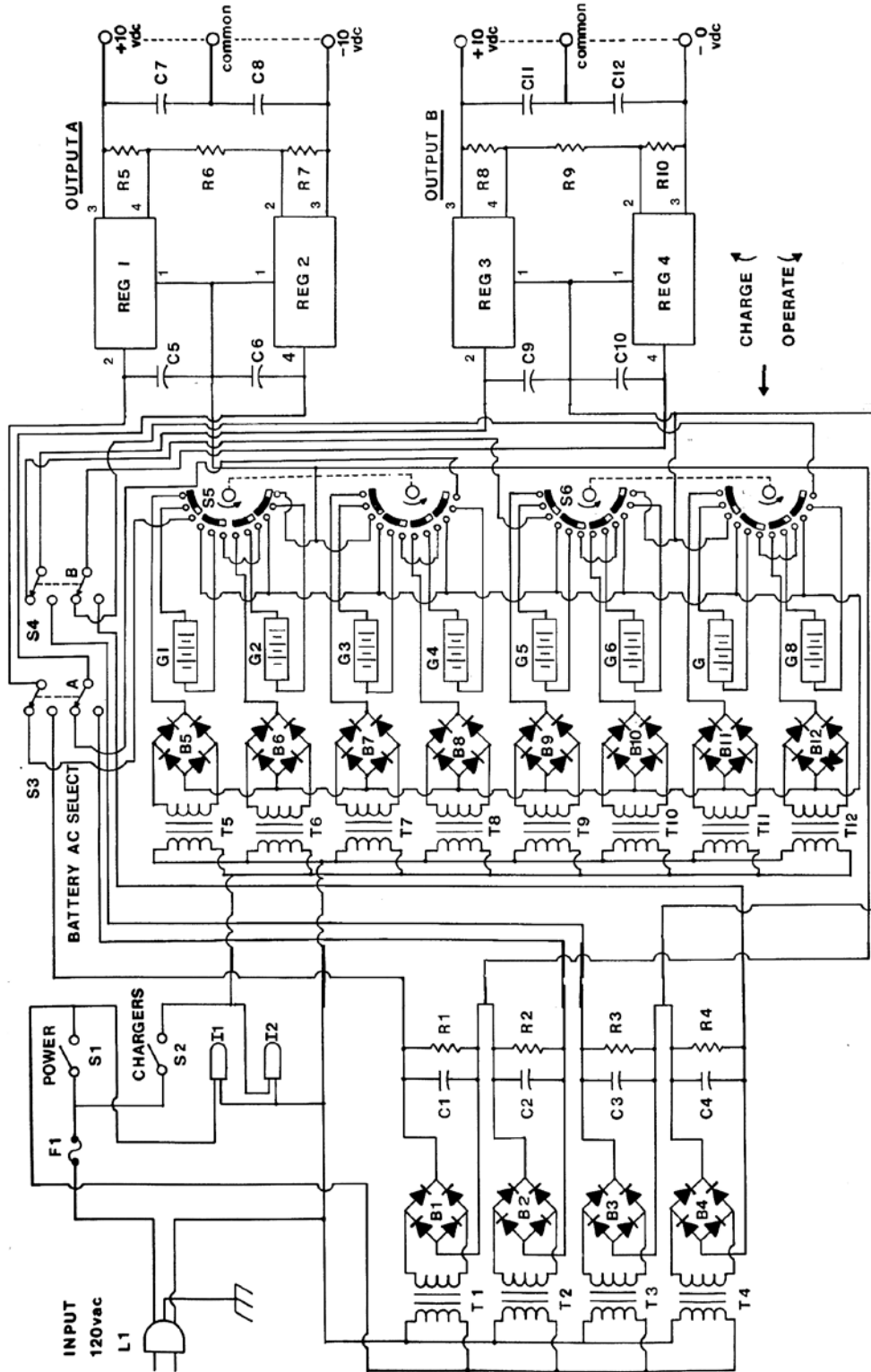
Calibration adjustments are made on the back of the unit.

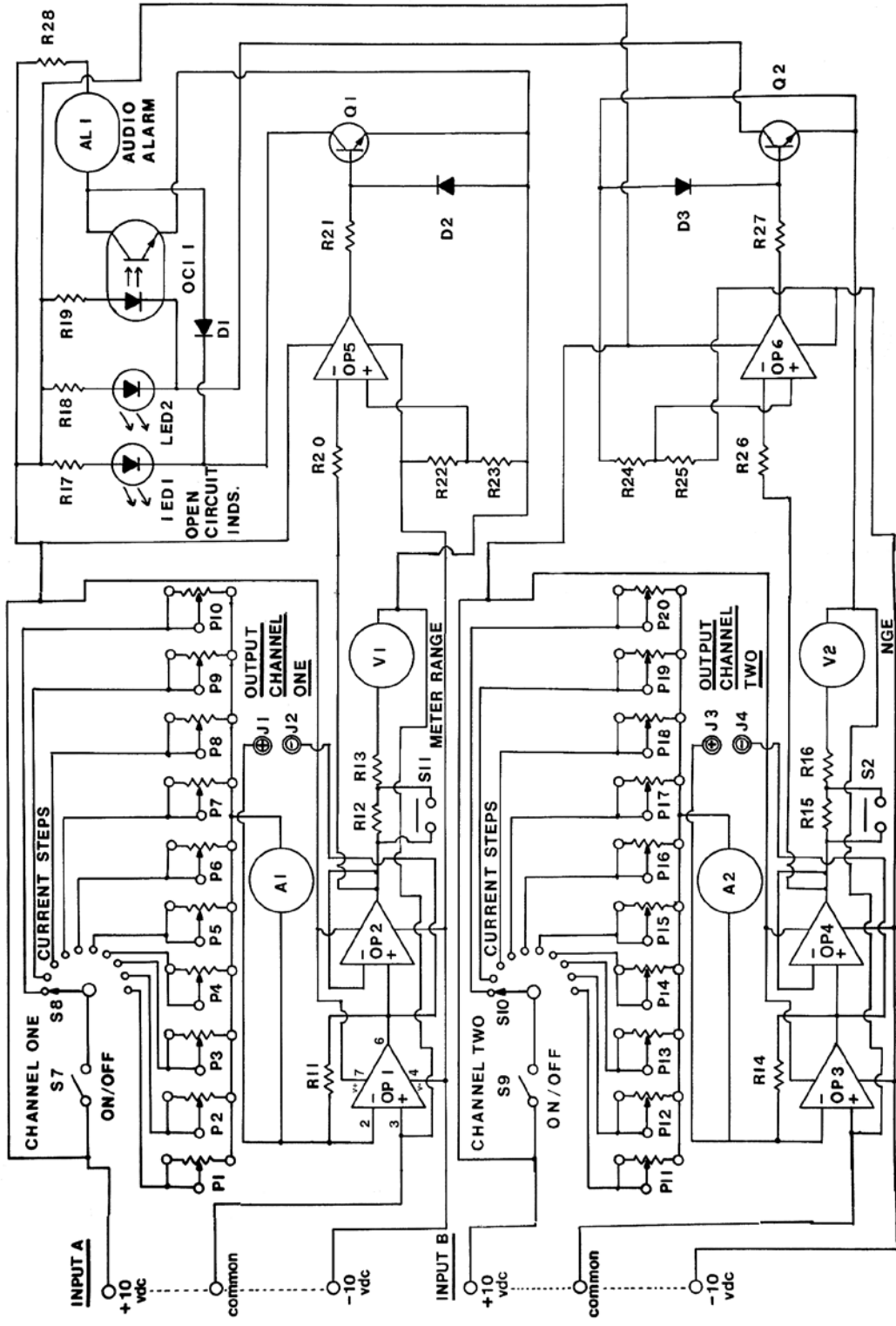




ONE CHANNEL







Parts List

A1, A2	1.0 ma meter.
AL 1	5 volt, 10ma, 1 KHz alarm.
B3-B4	Full-wave bridge rectifier, 20 volts, 500ma.
B5-B12	Full-wave bridge rectifier, 10 volts, 250ma.
C1-C4	2000uf capacitor, 15 volt, electrolytic.
C5, C9	.33uf disk capacitor, 15 volt.
C6, C10	2uf disc capacitor, 15 volt.
C7, C11	0.1 microfarad capacitor, 15 volt.
C8, C12	1.0uf disc capacitor, 15 volt.
D1-D3	0.1 amp silicon diode.
F1	2 amp fuse.
G1-G8	6 volt, 1 amp hour gel-cell battery.
I1, I2	120 VAC neon pilot lamp.
J1-J4	Banana jacks.
L1	120 VAC grounded line plug.
LED 1, LED 2	5 volt, 20ma LED
OCI 1	FCD 810 optically coupled isolator.
OP 1 - OP 6	741 operational amplifiers.
P1, P2, P11, P12	100k ohm potentiometer.
P3, P4, P13, P14	50k ohm potentiometer.
P5-P10, P15-P20	25k ohm potentiometer.
Q1, Q2	General purpose NPN transistor, gain 50, collector current max. 500ma, Vce = 25 volts.
R1-R4	10k ohm resistor (5%, 1/2 watt).

R5, R8	5k ohm resistor. (All resistors 5%, $\frac{1}{4}$ watt)
R6, R9	7.23k ohm resistor.
R7, R10	7.77k ohm resistor.
R11, R14	1 meg ohm resistor.
R12, R13, R15, R16	50k ohm resistor.
R17-R19	480 ohm resistor.
R28	330 ohm resistor.
R22-R25	10k ohm resistor.
R20, R21, R26, R27	4.7k ohm resistor.
REG 1, REG 3	UA78MG adj. voltage regulator (Fairchild).
REG 2, REG 4	UA79MG adj. voltage regulator (Fairchild).
S1, S2, S7, S9	SPST toggle switch, 3 amp rated.
S3, S4	DPDT toggle switch, 3 amp rated.
S5, S6	2 section, 2P4T rotary switch and matching knob.
S8, S10	10P1T rotary switch and matching knob.
S11, S12	Momentary make push button, 500ma rated.
T1-T4	120 VAC primary, 10 VAC secondary transformer, 500ma minimum.
T5-T12	120 VAC primary, 6 VAC secondary transformer, 150ma fixed.
V1-V2	Voltmeter with 5 volt and 10 volt scales, full scale = 100 μ a