

SERIAL # \_\_\_\_\_

**MODEL SIU5**  
**STIMULUS ISOLATION UNIT**

**INTENDED USE**

**For converting the nonisolated output of Grass Model S44, S48,  
S88, S11 and S8800 Stimulators to isolated constant voltage.**

**PLEASE  
DO NOT LOSE  
THIS MANUAL**

ONE MANUAL IS SHIPPED  
with each instrument.

No "shortages" recognized.

Additional copies may be  
purchased at cost by owners  
of the instrument, but it is  
necessary to give the exact  
model and serial numbers.

The cost \$ \_\_\_\_\_

**GRASS INSTRUMENT DIVISION**  
**Astro-Med, Inc.** Tel. 401-828-4000  
600 East Greenwich Avenue • West Warwick, RI 02893



Copyright GRASS INSTRUMENT DIVISION OF ASTRO-MED, INC., 1996

Reproduction in whole or in part must not  
be made without the written permission of  
GRASS INSTRUMENT DIVISION

GRASS INSTRUMENT DIVISION  
Astro-Med, Inc. Tel. 401-828-4000  

---

600 East Greenwich Avenue • West Warwick, RI 02893





## **WARNINGS**

### **READ THIS BEFORE OPERATING SIU5**

The output voltage and available current of this Stimulus Isolation Unit when coupled to Grass Stimulators, is large enough to be lethal or cause burns particularly with long durations and high current settings.

The state of the art is such that the potential danger to human and animal subjects from sustained stimulation even at low levels is still not completely understood.

Grass Stimulator Models S9 and SD9 have built-in ground isolation circuits. All other Grass Stimulators should be used in conjunction with Grass Stimulus Isolation Units to reduce the effects of ground leakage currents.

Grass Instrument Division of Astro-Med, Inc. waives any responsibility whatsoever for any injuries incurred to the operator of this instrument or to any animal or human subject as a result of the improper use or abuse of this Stimulator.

# MODEL SIU5 STIMULUS ISOLATION UNIT

## Table of Contents

<b>SECTION 1</b>	<b>SPECIFICATIONS</b>
<b>SECTION 2</b>	<b>DESIGN AND PRINCIPLE OF OPERATION</b> 2.1 Design and Principle of Operation
<b>SECTION 3</b>	<b>STIMULUS ARTIFACT</b> 3.1 What is Stimulus Artifact? 3.2 Sources and Reduction of Stimulus Artifacts
<b>SECTION 4</b>	<b>CONNECTION OF THE SIU5 TO THE STIMULATOR</b> 4.1 Power for SIU5 Operation 4.2 Connection of the SIU5 to the Grass Model S44, S48, S88, S11, or S8800 Stimulators
<b>SECTION 5</b>	<b>OPERATION OF THE SIU5</b> 5.1 Coupling 5.2 Polarity 5.3 Multiply Input Volts By Switch
<b>SECTION 6</b>	<b>APPLICATIONS</b> 6.1 Use of CRO with the SIU5 to Measure Stimulus Volts and Current 6.2 Mixing the Output of Stimulators through Two SIU5s to get True Addition and/or Biphasic Waveform 6.3 Stimulus Isolation with Trains, Pairs, Repetitive or Single Pulses 6.4 Monitoring Large DC Currents while Maintaining Stimulus Isolation 6.5 SIU5 with Grass CCU1 Constant Current Unit 6.6 Use of the SIU5 with Other than Grass Stimulators
<b>SECTION 7</b>	<b>TROUBLESHOOTING AND SERVICE</b> 7.1 Troubleshooting
<b>SECTION 8</b>	<b>CIRCUIT DIAGRAMS</b> 8.1 Explanation of Circuit Diagrams
<b>SECTION 9</b>	<b>SERVICE POLICY WARRANTY</b>



## STIMULUS ISOLATION UNIT MODEL SIU5

Use the Model SIU5 between a Grass Stimulator and the stimulating electrodes to minimize artifact. Excessive stimulus artifact tends to block recording instruments, often obscuring the recording of the response. Isolation of the stimulus signal from ground reference reduces the ground current between stimulating and recording systems (the primary source of stimulus artifact) and provides greater safety for direct human and

animal stimulation. The SIU5 outputs can be connected in series so that stimulus voltage from various sources can be mixed even with the opposite polarities and introduced through a common pair of electrodes. One SIU5 will then be necessary for each stimulus output.

The SIU5 contains a radio frequency (RF) oscillator which is modulated by the Stimulator output. The oscillator is

electromagnetically coupled via an RF transformer to a secondary coil whose impedance is balanced to ground at stimulus frequencies. The secondary voltage is demodulated by diodes and the RF filtered. Finally, the signal size is controlled by a decade attenuator. Input and output waveform are essentially identical, but the output voltage is nearly independent of ground. The output is not directly linear with input.

### SPECIFICATIONS

<b>Isolation</b> _____	2 MHz Transformer
<b>Input</b> _____	Compatible with Grass S44, S48, S88, S11 or S8800 Stimulators
<b>Common Mode Voltage</b> _____	Including RF is reduced approximately 10 to 40 times over the range of 15 to 150 V, and 100 times over the range from 0.015 to 15 V
<b>Output Impedance</b> _____	Approximately 1,000 $\Omega$ with all Stimulators. Combined with the Grass Model CCU1 Constant Current Unit, a constant stimulating current isolated from ground is obtained.
<b>Output Impedance to Ground</b> _____	<i>Capacitive:</i> balanced 25 pF to each output terminal. <i>Conductive:</i> greater than $10^{12} \Omega$ .
<b>Output Waveform</b> _____	Square waves of Grass Stimulators are reproduced with negligible change on direct-coupled (monophasic) operation. Capacity-coupled operation can be selected by means of a switch.
<b>Constant Voltage Ranges</b> _____	0.015 to 150 V in 3 decade ranges
<b>Polarity</b> _____	Reversible by a switch. No ground reference.
<b>Power</b> _____	Powered by stimulus pulses – no additional power source is required. Minimum power is required from stimulator to drive the SIU5 and thus reduces stimulus artifact to a minimum.
<b>Physical Size</b> _____	2.5" x 3" x 7" (6.4 cm x 7.6 cm x 17.8 cm) <i>Weight:</i> 2-1/2 lbs. (1.1 kg)

S240J96B



600 E. Greenwich Ave., W. Warwick, RI 02893 • Tel. 401-828-4000 • Toll-Free Phone: (USA only) 800-343-4039 • Fax 401-822-2430

## DESIGN AND PRINCIPLE OF OPERATION

### Section 2.1

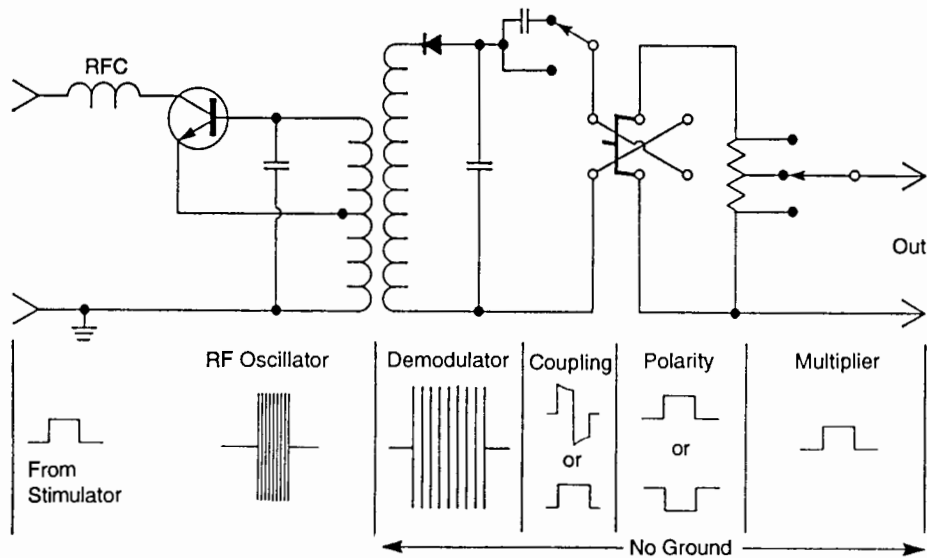
## 2 DESIGN AND PRINCIPLE OF OPERATION

### 2.1 Design and Principle of Operation

2.1.1 The Grass SIU5 Stimulus Isolation Unit is a transistorized radio frequency circuit designed to be connected in series with the output of a S44, S48, S88, S11, S8800 and other similar Stimulators and stimulating electrodes to isolate the stimulus from ground, thus reducing stimulus artifact. The carrier

frequency of the oscillator in the SIU5 is modulated by the output voltage of the stimulator. The secondary coil of the SIU5 is isolated from ground. At this point, the signal is rectified and demodulated to reproduce the original stimulator square wave form. A multi-position decade attenuator, a polarity switch and direct-coupled, capacity-coupled switch are included on the front panel. See Figure 2.1.1.

2.1.2 The SIU5 is driven directly by the stimulator output (150 volts maximum) and does not require any additional power source.



SIMPLIFIED SIU5 CIRCUIT  
FIGURE 2.1.1

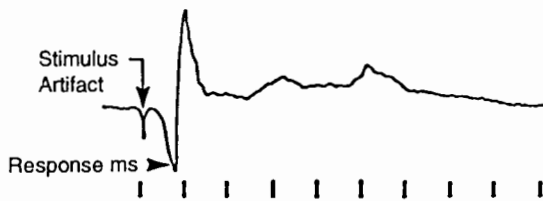
# STIMULUS ARTIFACT

## Sections 3.1 - 3.2

### 3 STIMULUS ARTIFACT

#### 3.1 What is Stimulus Artifact?

3.1.1 When a stimulus pulse is introduced to a preparation to evoke a response, an electrical artifact appears in the recording instrumentation as the result of the speed of the stimulus current to the recording electrodes. This artifact precedes the evoked response in time as indicated in the CRO record of Figure 3.1.1. The delay between stimulus artifact and the evoked response is dependent upon stimulation parameters and the characteristic properties of the preparation.

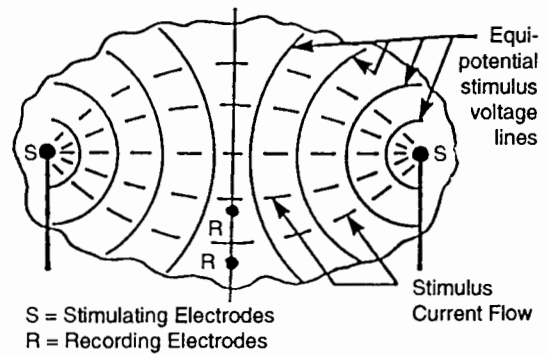


STIMULUS ARTIFACT  
FIGURE 3.1.1

3.1.2 Some stimulus artifact is desirable to establish the time of stimulation. However, excessive stimulus artifact may obliterate the display of the desired response as is often the case when small evoked potentials are sought after a stimulus pulse of excessive amplitude or duration.

#### 3.2 Sources and Reduction of Stimulus Artifacts

3.2.1 Excessive stimulus artifact results when the recording electrodes unavoidably measure the field of distribution of the stimulus voltage through the preparation. The size of the stimulus and proximity of the recording and stimulating electrode pairs contribute to the artifact amplitude. See Figure 3.2.1.



STIMULUS VOLTAGE FIELD DISTRIBUTION  
FIGURE 3.2.1

NOTE: For optimum recording results, use independent stimulating and recording electrodes and keep recording electrodes perpendicular to stimulus current flow, if possible.

## STIMULUS ARTIFACT

### Section 3.2

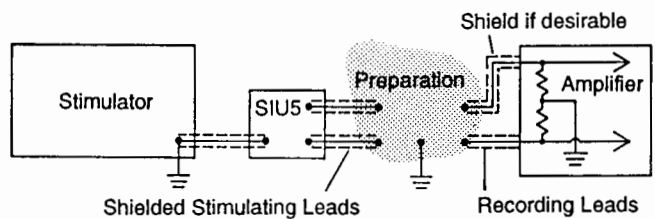
3.2.2 To alleviate stimulus artifact:

- a. Isolate the stimulus pulse from ground and thereby reduce the circulating ground currents between the stimulator, preparation and recording instrument.
- b. Space stimulating and recording electrodes as far from each other as possible and position them for maximum cancellation of field effects.
- c. Use as small a stimulator pulse with as short a duration as is possible (approximately 0.1 milliseconds).

3.2.3 If the field distribution pattern of stimulus current causes substantial stimulus voltage between the recording electrodes, the resulting artifact cannot be avoided.

3.2.4 The use of series resistors can create a constant current rather than a constant voltage source independent of changes in electrode impedance. Connect resistors in series with both output terminals of the SIU5. The magnitude of the resistors should be at least five times that of the electrode impedance.

3.2.5 The characteristics of the SIU5 permit the shielding of stimulating and recording electrodes leads, thus reducing the capacitive coupling between recording and stimulating leads. (See Figure 3.2.5.)



SHIELDING ELECTRODE LEADS  
FIGURE 3.2.5



## CONNECTION OF THE SIU5 TO THE STIMULATOR

### Sections 4.1 - 4.2

#### 4 CONNECTION OF THE SIU5 TO THE STIMULATOR

##### 4.1 Power for SIU5 Operation

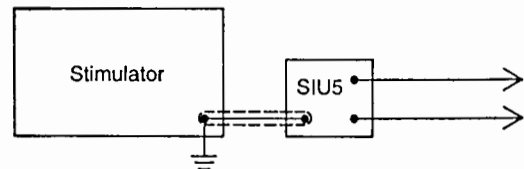
4.1.1 The SIU5 receives power for operation from the stimulus. No additional power source is required. Each SIU5 is coupled to the front of its companion stimulator with a cable provided which is specific for each model stimulator. See Figure 4.2.1.

4.1.2 On all Grass Stimulators, it is necessary to set the VOLTS multiplier switch to the X10 or X1 positions. See Section 5.3.1. NOTE: Never connect a ground to either of the output terminals of the SIU5 when stimulating. To do so would defeat the purpose of stimulus isolation.

4.1.3 The maximum power output obtainable from the SIU5, when driven with a S44, S48, S88, S11, or S8800 Stimulator, is approximately 5 watts when the total impedance measured at the electrodes is equal to the output impedance of the SIU5 (1000  $\Omega$ ).

#### 4.2 Connection of the SIU5 to the Grass Model S44, S48, S88, S11, or S8800 Stimulators

4.2.1 Connect one of the connectors on the cable provided to the output on the front of the Stimulator and the other connector to the SIU5 input. There are two outputs on the S88, S11 and S8800 (S1 and S2); therefore, two SIU5s are required to isolate both outputs. See Section 6.3. Set the Stimulator VOLTS multiplier switch according to the suggestions in Section 5.3.1.



CONNECTION OF THE SIU5 TO THE STIMULATOR  
FIGURE 4.2.1

## OPERATION OF THE SIU5 Sections 5.1 - 5.2

### 5 OPERATION OF THE SIU5

#### 5.1 Coupling

5.1.1 **Direct Coupled:** When the COUPLING switch is in the DIRECT position, a DC output voltage is sustained for a DC input voltage and the monophasic square wave from the stimulator is preserved.

COUPLING

DIRECT



CAPACITY

5.1.2 **Capacity Coupled:** When the COUPLING switch is in the CAPACITY position, a capacitor is introduced in series with the output. A biphasic pulse appears at the output. The effective energy of the negative and positive components of the pulse are equal in coulombs, if they are averaged over a sufficiently long period of time. Each component does not necessarily possess the same peak voltage or current.

Electrode polarization caused by an unequal discharge of current in one direction in preference to another (e.g., DC) results in an unequal migration of ions to and from the electrode. This condition is minimized by the equal negative and positive components of a biphasic wave. Biphasic stimulation is preferred, particularly during long-term electrode implants or short pulse stimulation, to reduce the formation of gas bubbles and toxic electrolytic deposits.

### 5.2 Polarity

5.2.1 The POLARITY switch determines the polarity of the SIU5 output, independent of a ground reference, providing no grounds have been attached to the stimulating electrodes or their leads. In the NORM (normal) position, the red OUT terminal is positive with respect to the negative black OUT terminal. In the REV (reverse) position, the black OUT terminal is positive with respect to the negative red OUT terminal.

POLARITY

NORM.



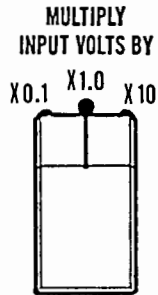
REV.

## OPERATION OF THE SIU5

### Section 5.3

#### 5.3 Multiply Input Volts By Switch

5.3.1 The MULTIPLY INPUT VOLTS BY switch is intended to permit gross attenuation of the stimulus voltage delivered to the preparation. Since the SIU5 is designed to be placed close to the preparation, this switch is in a convenient location. The VOLTS dial on the stimulator may be used as the "fine" stimulus voltage control.



To obtain minimum stimulus artifact, use the minimum voltage possible from the stimulator, and adjust for maximum output voltage on the SIU5. The minimum input voltage required to produce a 1:1 relationship in output voltage is approximately 10 volts (1.5 volts in older models).

For stimulation procedures requiring low voltages, set the stimulator VOLTS multiplier to the X10(SIU) position and set the SIU5 MULTIPLY INPUT VOLTS BY switch to the X0.1 position to divide the stimulus voltage by 10 times. The following chart lists preferred SIU5 and stimulator settings for various SIU5 output voltage ranges. "Fine" control of voltage is made using the VOLTS dial on the stimulator.

Stimulus Volts required from SIU5	Stimulator range switch	SIU5 range switch
15 to 150	X10(SIU)	X1
1.5 to 15	X10(SIU)	X0.1
0.15 to 1.5	X10(SIU)	X0.01
0.015 to 0.15	X1	X0.01

PREFERRED SIU5/STIMULATOR SETTINGS  
FOR OUTPUT VOLTAGE RANGES  
TABLE 5.3.1

5.3.2 The relationship between the stimulator VOLTS dial and the SIU5 open circuit voltage is not linear. The Stimulus Isolation Units are factory adjusted so that the VOLTS dial on the stimulator reads the correct value at the high end of the scale with open circuit at the SIU5 output.

5.3.3 The voltage setting on any stimulator is not an accurate indication of the output voltage or current. The voltage or current at the output will vary with the load. For precise current or voltage measurements, monitor the output with a CRO. See Section 6.1.1.

## APPLICATIONS Section 6.1

### 6 APPLICATIONS

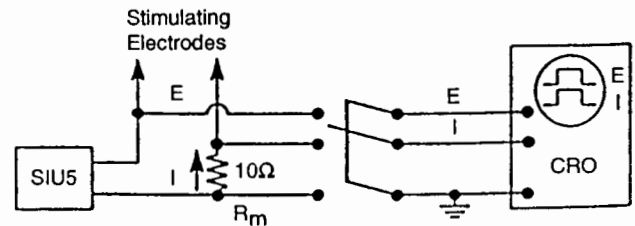
#### 6.1 Use of CRO with the SIU5 to Measure Stimulus Volts and Current

6.1.1 CRO monitoring of instantaneous stimulus current can be accomplished by monitoring the voltages generated across a series resistor with a CRO. Use a series resistor whose value is very small relative to that of the stimulating electrodes and construct a circuit as shown in Figure 6.1.1. According to Ohm's Law then:

$$I = \frac{E}{R}, \text{ or}$$

$$\text{Stimulating Current} = \frac{\text{Measured Voltage (Oscilloscope)}}{\text{Measuring Resistance (R}_m\text{)}}$$

When a 10Ω resistor is used as shown, each milliampere of stimulus current results in a voltage drop of 10 mV across this resistor. With the CRO calibrated for a sensitivity of 10mV/cm, each centimeter of deflection on the tube face equals one milliampere of stimulating current. If the CRO cannot be calibrated as low as 10 mV/cm, use a higher resistance to correspond to the sensitivity of the CRO. Figure 6.1.1 shows the stimulus electrode voltage being monitored on Channel 1 and the current being monitored on Channel 2.



CRO MONITORING  
FIGURE 6.1.1

6.1.2 It is not possible to maintain stimulus isolation when this method is used, since the input of most CROs is referred to ground. When stimulus isolation is necessary, measure current periodically during the experiment as shown in Figure 6.1.1; then, by using the three-pole switch, isolate the measuring circuit as shown. If "before stimulus" and "after stimulus" measurements are identical and none of the dial settings have been altered, it can be assumed that the current has remained at a fixed value between measurements.

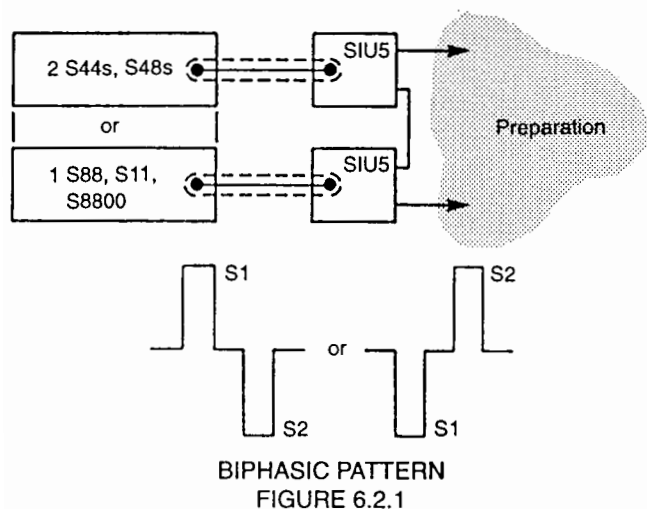
6.1.3 If stimulus isolation is not required, use circuit shown in Figure 6.1.1 without the three-pole switch, but wired as if the switch were in the monitor position. This permits continuous current monitoring. The CRO should be operated with one input terminal grounded.

## APPLICATIONS

### Section 6.2

#### 6.2 Mixing the Output of Stimulators through Two SIU5s to get True Addition and/or Biphasic Waveform

6.2.1 **Outputs less than 15 volts:** Stimulator S1 and S2 outputs can be mixed and introduced into the same pair of electrodes by connecting two respective SIU5s in series. Figure 6.2.1 illustrates the outputs of two SIU5s connected in series to one pair of electrodes. Polarity reversal of either S1 or S2 is also possible without any further consideration if the MULTIPLY INPUT VOLTS BY switch on the SIU5 *is not in the X1 maximum position*. In this case, the outputs of the SIU5s may be connected in series (preferred), or in parallel. Polarity reversal of the stimulus can only be accomplished by the POLARITY switch on the SIU5.



6.2.2 **Outputs over 15 volts:** When the MULTIPLY INPUT VOLTS BY switch on the SIU5 has to be in the highest range position (X1), some restrictions to mixing outputs apply:

- a. **Same polarity** — no restrictions.
- b. **Opposite polarity from two SIU5s:**
  1. Connect SIU5s *in series only*.
  2. Electrodes (or total load) of impedance over 25,000  $\Omega$  — no restrictions.

For electrodes (or total load) of less impedance than in (2), connect a parallel resistor (about 2,000  $\Omega$ ) across the output terminals of both SIU5s. There will be loss of maximum voltage output from the SIU5s because of this loading in proportion to the total electrode or load resistance and the source impedance of the SIU5s (1,000  $\Omega$ ). Maximum voltage with this system could be as low as 50 volts or less.

6.2.3 **Do not** try to mix PSIU6 and SIU5 isolation. Additional information and operating details are further discussed in the specific Stimulator Manual.

## APPLICATIONS

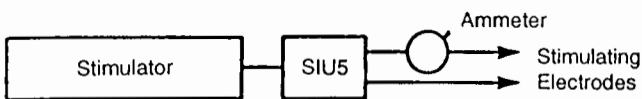
### Sections 6.3 - 6.5

#### 6.3 Stimulus Isolation with Trains, Pairs, Repetitive or Single Pulses

6.3.1 Like or unlike trains, pairs, repetitive or single pulses can be introduced through stimulating electrodes without a ground reference by varying Stimulator and Stimulus Isolation Unit connections. Consult the appropriate Stimulator Manual for details.

#### 6.4 Monitoring Large DC Currents while Maintaining Stimulus Isolation

6.4.1 When stimulating with DC (not pulses), the stimulating current can be monitored, maintaining stimulus isolation, by inserting a DC ammeter in series with one of the stimulating electrodes. When using a milliammeter or microammeter, it should be placed in series with the stimulating electrodes. Stimulus isolation can be maintained if the meter is isolated from ground. See Figure 6.4.1. For further discussion, consult the appropriate Stimulator Manual.

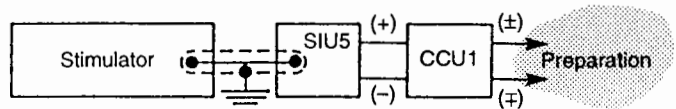


MEASURING DC CURRENT  
FIGURE 6.4.1

6.5.1 The current waveshape from the CCU1 is always accurate, but monitoring the voltage waveform across the preparation will provide an inaccurate and distorted representation of the actual stimulus delivered. If monitoring the current is desired, it is best to do this by placing a small resistor in series with one stimulating electrode and monitoring the voltage drop across it.

#### 6.5 SIU5 with Grass CCU1 Constant Current Unit

6.5.1 The wide variation of electrode impedances, generally employed, render it extremely difficult to maintain a constant current to the preparation when a constant voltage source is used. When constant current is desired, connect a Grass CCU1 Constant Current Unit in series between the SIU5 and electrodes. See Figure 6.5.1. Since the current levels will be limited by the power output of the SIU5, set the SIU5 MULTIPLY INPUT VOLTS BY switch to its maximum setting (X1), and the Stimulator to 150 volts, then make the current adjustment on the CCU1. Refer to the CCU1 Instruction Manual.



SINGLE SIU5 AND CCU1 CONNECTION  
FIGURE 6.5.1

NOTE: When electrode impedance is  $1M\Omega$  or higher, constant current with accurate wave shape into the preparation itself is very difficult to achieve because the total output current is significantly divided among stray parallel resistances and shunt capacitances of the electrodes.

## APPLICATIONS

### Sections 6.5 - 6.6

6.5.2 To get constant current, symmetrical biphasic pulses with isolation from ground, proceed as follows:

- a. Connect one SIU5 to the Stimulator output. (See Figure 6.5.2.)
- b. Connect second SIU5 to the output of another Stimulator, or to the second output on an S88, S11 or S8800.
- c. Connect the red OUT terminal from the SIU5 to the red IN (+) terminal on the CCU1.
- d. Connect the black OUT terminal on the SIU5 to the black IN (-) terminal on the CCU1.
- e. Connect the second SIU5/CCU1 pair in the same pattern.
- f. Connect the black OUT (-) terminal on one CCU1 to the black OUT (-) terminal on the second CCU1.
- g. Connect the red OUT (+) terminal on one CCU1 to the red OUT (+) terminal on the second CCU1.

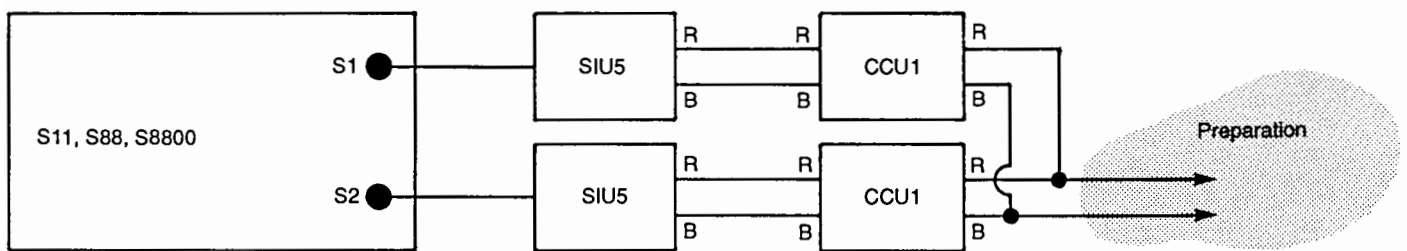
- h. Connect one electrode lead to red OUT (+) terminal of one CCU1.
- i. Connect second electrode lead to the black OUT (-) terminal of the second CCU1.
- j. Set the SIU5 POLARITY switches on both SIU5s to NORM.

The second CCU1 must be of opposite polarity for biphasic pulses. To avoid current cancellation, the S1 and S2 pulses should not overlap.

### 6.6 Use of the SIU5 with Other than Grass Stimulators

6.6.1 Current of 120 mA is necessary to power the SIU5 with a 1 kΩ load at maximum SIU5 output. Use a power source of 150 volts or less.

6.6.2 The input impedance of the SIU5 will vary with the output load on the SIU5. With no load at the SIU5 output, the input impedance is approximately 2 kΩ. With a 1 kΩ load at the SIU5 output, the input impedance is approximately 1 kΩ.



TWO SIU5s AND CCU1s CONNECTION  
FIGURE 6.5.2

# TROUBLESHOOTING AND SERVICE

## Section 7.1

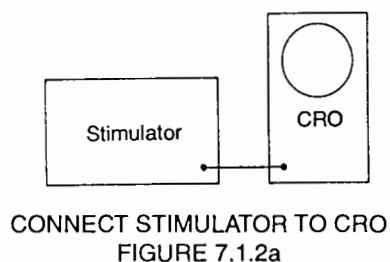
### 7 TROUBLESHOOTING AND SERVICE

#### 7.1 Troubleshooting

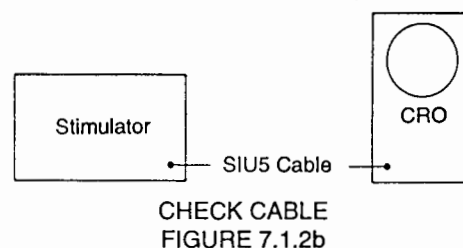
7.1.1 The SIU5 is completely transistorized and requires no fuses for operation. Experience indicates that with a passive device, such as the SIU5, it is unlikely that service will be necessary. Factory service is available and recommended if adjustments are necessary on the instrument. However, make certain that the defect is in the SIU5 and not the Stimulator or accessory equipment.

7.1.2 If a malfunction in the SIU5 is suspected, first be sure the waveform from the stimulator output meets specifications.

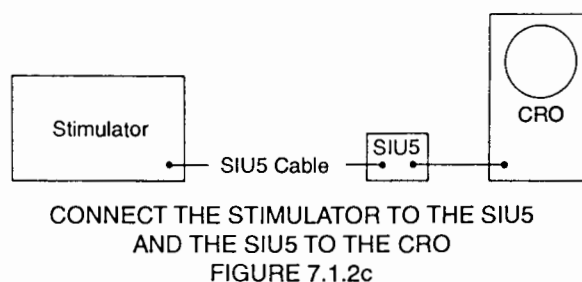
- Connect the output from the Stimulator directly to the input of the CRO. Observe the waveform. If the output from the Stimulator does not meet specifications, refer to the Stimulator Manual. If the stimulator output does meet specifications, proceed to Step b.



- Check the cable between the Stimulator and the SIU5 by connecting the CRO to the SIU5 end of the cable. The waveforms observed should be the same as with the Stimulator itself. If not, the cable is probably defective. Contact Grass Instrument Division of Astro-Med, Inc. If waveforms are normal, proceed to Step c.



- Couple the Stimulator and SIU5 as suggested in Section 4 and connect the output from the SIU5 to the input of the CRO. Observe the waveform with no load on output. If this waveform appears normal, load the SIU5 output with its specified output impedance (i.e., 1,000  $\Omega$  with the S44, S48, S88, S11, or S8800). Amplitude should be approximately 1/2 open circuit amplitude. If 1/2 circuit is not observed, call the Technical Support Services Department at Grass Instrument Division of Astro-Med, Inc.





## CIRCUIT DIAGRAMS

### Section 8.1

## 8 CIRCUIT DIAGRAMS

### 8.1 Explanation of Circuit Diagrams

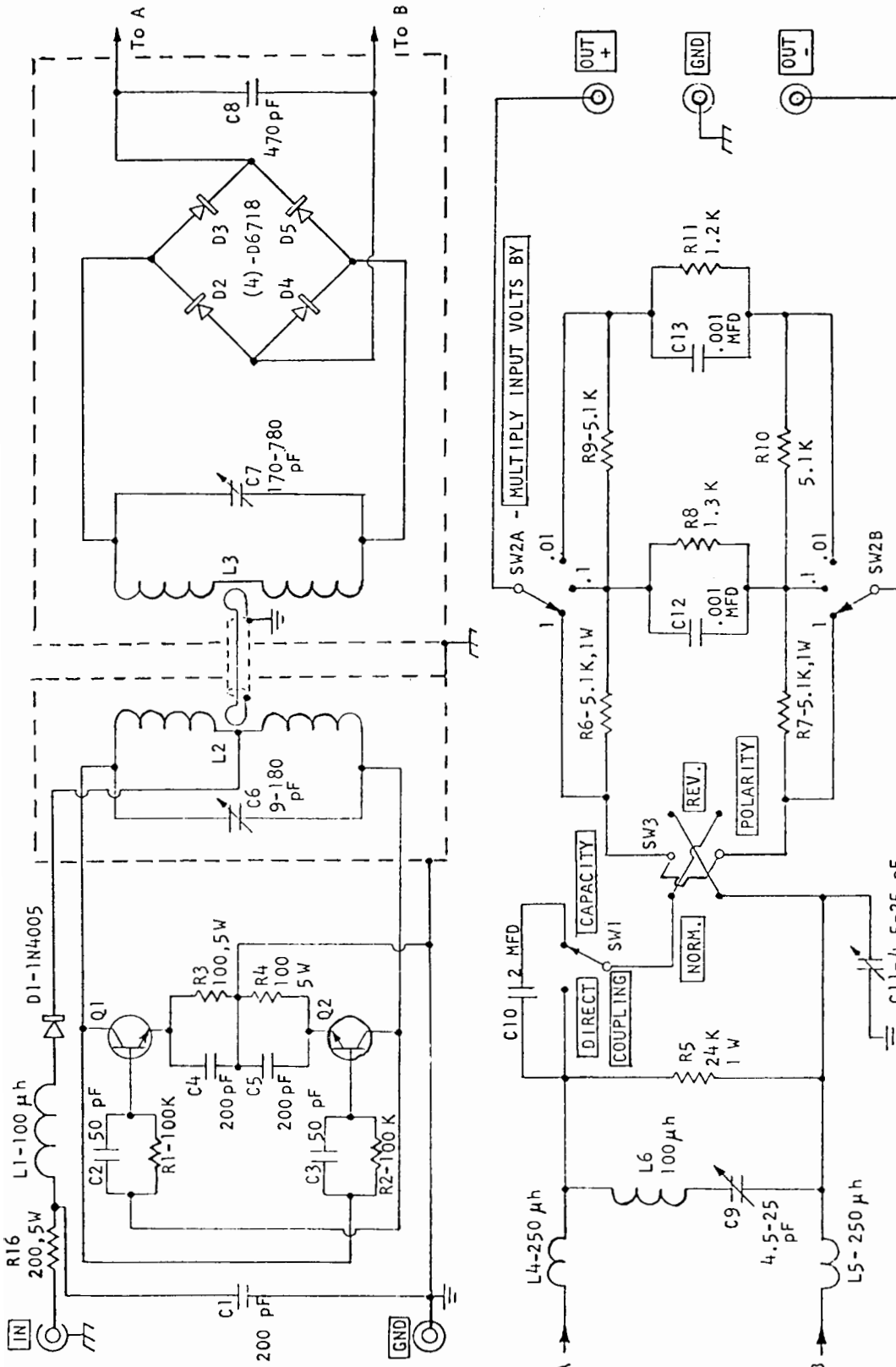
8.1.1 This manual contains all of the circuit diagrams with values of components for all models which have evolved from the basic design. The succession of design changes are indicated by the last letter subscript and are in alphabetical order. For instance, the basic design SIU5 is followed with a letter subscript such as A, B, C, D, etc. as in SIU5E which represents a change from the SIU5E. There may have

been minor changes in a few components within any model with the same subscript letter. The circuit presented here with a certain subscript letter would be the last one prior to the introduction of a more substantial change such as when the SIU5F supersedes the SIU5E. The last subscript circuit in this manual is the latest one available at the date of publication.

To identify the appropriate circuit, check the last letter subscript of your instrument model number and identify with the circuit print with exactly the same model number.

# CIRCUIT DIAGRAMS

## Section 8.1



Resistor values in ohms and 1/2 W unless otherwise noted.

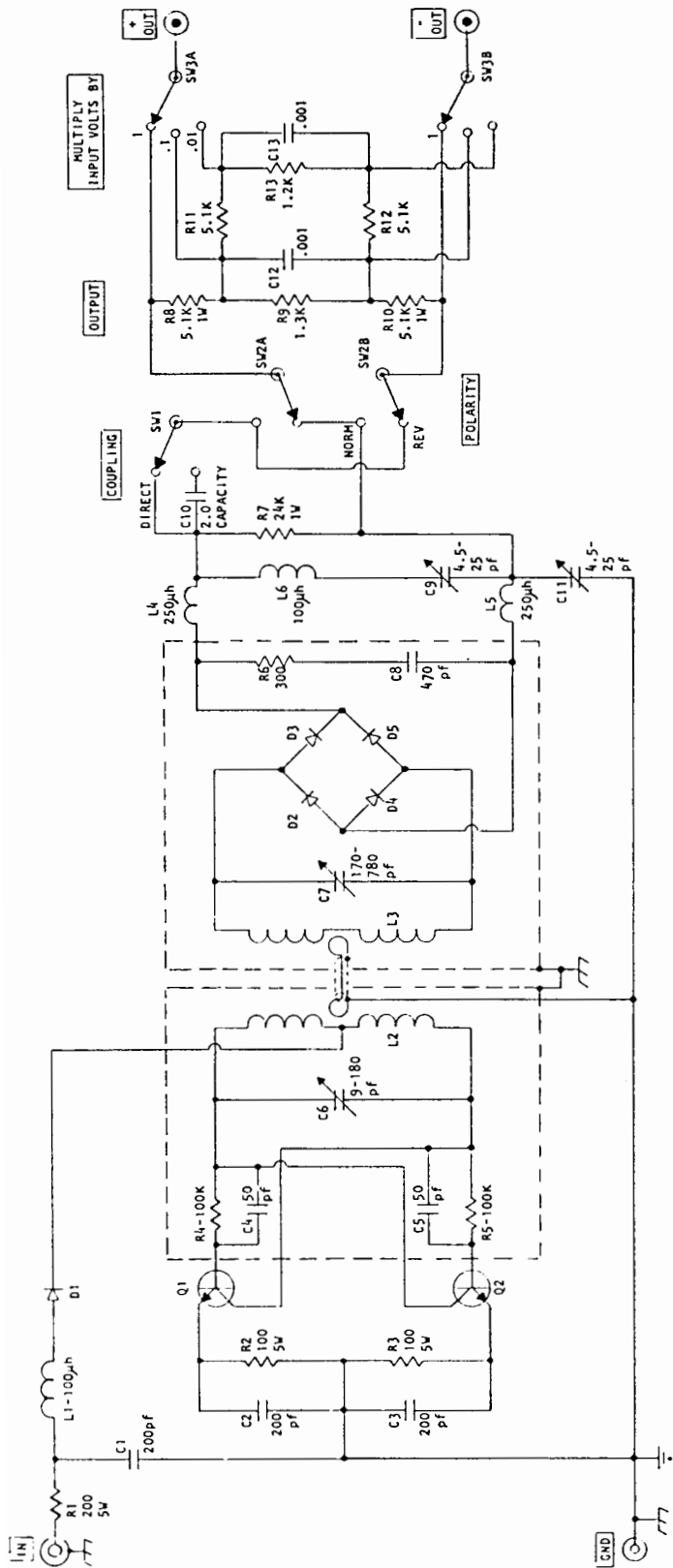
MODEL SIU5A STIMULUS ISOLATION UNIT CIRCUIT DIAGRAM - #50295-1  
(Part 1 of 1)

THIS PRINT IS ISSUED WITH THE UNDERSTANDING THAT ANY CHANGES OR REPAIRS TO THIS INSTRUMENT NOT SPECIFICALLY AUTHORIZED IN WRITING BY GRASS INSTRUMENT DIVISION OF ASTRO-MED, INC. WILL VOID THE WARRANTY AND ABSOLVE GRASS INSTRUMENT DIVISION OF ASTRO-MED, INC. FROM ANY AND ALL RESPONSIBILITIES REGARDING DAMAGE TO PROPERTY, OPERATING PERSONNEL, SUBJECTS AND/OR PATIENTS SUBSEQUENTLY CAUSED BY THIS INSTRUMENT.



# CIRCUIT DIAGRAMS

## Section 8.1



SWITCH	FUNCTION	DEVICE	TYPE NO.
SW1	COUPLING	D1	1N4005
SW2	POLARITY	D2, 3, 4, 5	1N3070
SW3	MULTIPLY INPUT VOLTS BY	Q1, 2	2N5657

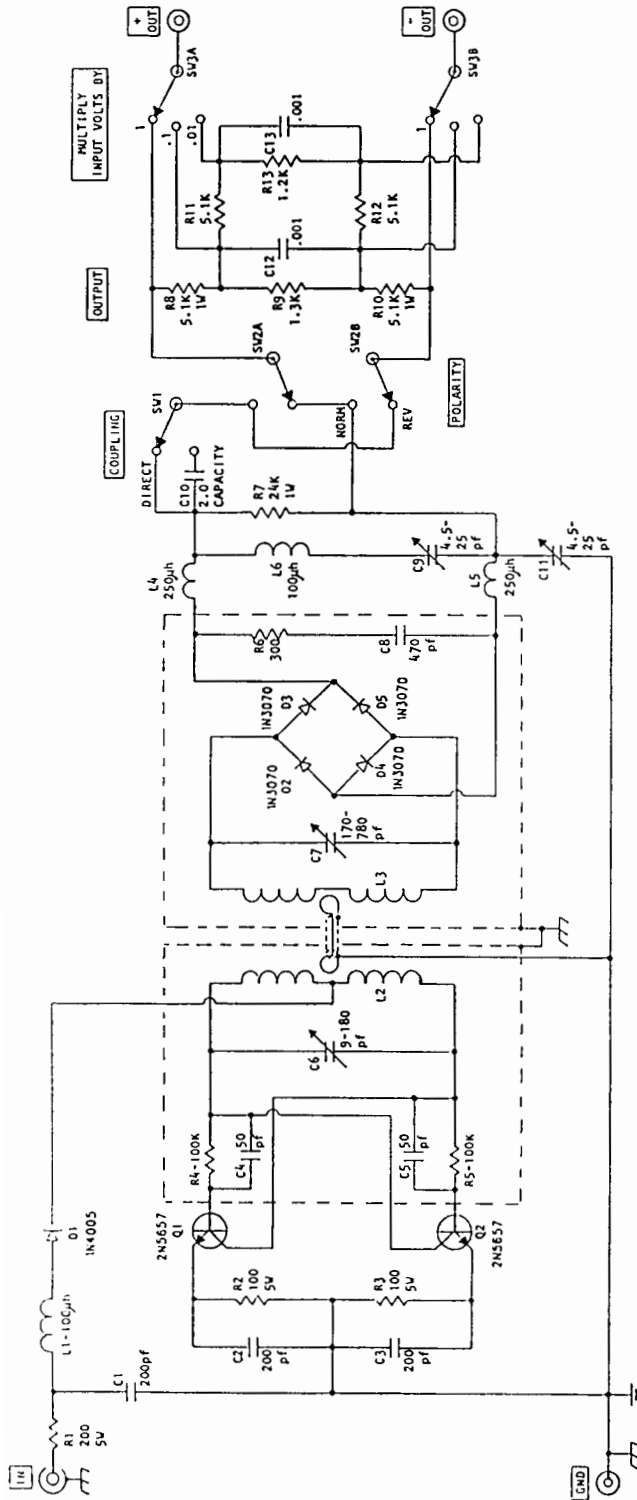
SYMBOLS	
	SCREWDRIIVER ADJUST
	KNOB ADJUST
	REAR CHASSIS CONTROL
	FRONT PANEL CONTROL
	PRINTED CIRCUIT CONTROL
	FUSE
	VARIABLE RESISTOR
	RESISTOR
	CAPACITOR
	SIGNAL DIODE
	ZENER DIODE
	LIGHT EMITTING DIODE
	BIPOLAR OR FET TRANSISTOR
	INTEGRATED CIRCUIT
	CIRCUIT FUNCTION AS INDICATED
n.c.	NORMALLY CLOSED
n.o.	NORMALLY OPEN
	CIRCUIT GROUND
	CHASSIS GROUND
K	1,000 OHMS
M	1,000,000 OHMS
$\bar{Z}_{IN}, \bar{Z}_{OUT}$	INPUT OR OUTPUT IMPEDANCE

MODEL SIU5C STIMULUS ISOLATION UNIT CIRCUIT DIAGRAM - #50295-3  
(Part 1 of 1)

THIS PRINT IS ISSUED WITH THE UNDERSTANDING THAT ANY CHANGES OR REPAIRS TO THIS INSTRUMENT NOT SPECIFICALLY AUTHORIZED IN WRITING BY GRASS INSTRUMENT DIVISION OF ASTRO-MED, INC. WILL VOID THE WARRANTY AND ABSOLVE GRASS INSTRUMENT DIVISION OF ASTRO-MED, INC. FROM ANY AND ALL RESPONSIBILITIES REGARDING DAMAGE TO PROPERTY, OPERATING PERSONNEL, SUBJECTS AND/OR PATIENTS SUBSEQUENTLY CAUSED BY THIS INSTRUMENT.

# CIRCUIT DIAGRAMS

## Section 8.1



MODEL SIU5D STIMULUS ISOLATION UNIT CIRCUIT DIAGRAM - #50295-4  
(Part 1 of 1)

THIS PRINT IS ISSUED WITH THE UNDERSTANDING THAT ANY CHANGES OR REPAIRS TO THIS INSTRUMENT NOT SPECIFICALLY AUTHORIZED IN WRITING BY GRASS INSTRUMENT DIVISION OF ASTRO-MED, INC. WILL VOID THE WARRANTY AND ABSOLVE GRASS INSTRUMENT DIVISION OF ASTRO-MED, INC. FROM ANY AND ALL RESPONSIBILITIES REGARDING DAMAGE TO PROPERTY, OPERATING PERSONNEL, SUBJECTS AND/OR PATIENTS SUBSEQUENTLY CAUSED BY THIS INSTRUMENT.

**GRASS  
TELEFACTOR**

An Astro-Med, Inc. Product Group

**FOR INFORMATION**  
fax, phone, write  
or e-mail:

***Customer Service***

for ordering instruments,  
chart paper, recording  
accessories and catalog  
and quotation requests.

***Instrument Applications***

for technical assistance.

***Technical Support  
Services***

for troubleshooting  
advice, repair and  
replacement service.

*Please identify the model  
and serial number of your  
instrument.*

# SERVICE

**HERE'S WHAT TO DO**

**OUR WARRANTY IS FOR ONE YEAR**

**WE HAVE PROMPT, EFFICIENT FACTORY SERVICE  
TO BACK IT UP**

However, our warranty does **not** cover transportation costs if repairs become necessary. Universities and hospitals have Purchasing and Receiving Departments that must be informed.

**A PURCHASE ORDER NUMBER OR AUTHORIZATION  
IS NECESSARY.**

Therefore, we urge you to contact them before contacting us.

**IF, "Instrument was damaged in transit"**

- a. Save packaging materials for inspection by carrier's agent,
- b. Obtain a joint inspection report from the carrier who delivered the instrument,
- c. Report full details immediately to Grass-Telefactor, An Astro-Med, Inc. Product Group

**IF, "It doesn't work"**

- a. We can **ADVISE** a solution to your problem but we need all the facts, including model and serial number of the instrument and symptoms of the instrument malfunction.
- b. We can **REPLACE** damaged or malfunctioning units.



X381J99

600 East Greenwich Avenue, West Warwick, RI 02893 • Tel. 401-828-4000 • Toll-Free Phone: (USA only) 877-472-7779 • Fax 401-822-2430  
e-mail: techserv@astro-med.com

**GRASS  
TELEFACTOR**

An Astro-Med, Inc. Product Group

## ONE-YEAR LIMITED WARRANTY

JULY 1995

### SUPERSEDES ALL PREVIOUS WARRANTIES

**GRASS-TELEFACTOR DIVISION, An Astro-Med, Inc. Product Group WARRANTS** this instrument to the original purchaser (who is the same end user) only. The warranty is not transferable. Material, workmanship and performance as specified are guaranteed:

1. if the *GRASS-TELEFACTOR* seal (when present) is not broken,
2. if there is no evidence of abuse, attempted repairs or modifications without Grass-Telefactor authorization,
3. only if genuine Grass-Telefactor replacement parts are used,
4. only if the instrument is used for its specified uses,
5. if the instrument has not been resold or used in a larger system incorporating non-Grass-Telefactor products not approved by Grass-Telefactor for compatibility.

**THIS WARRANTY IS BINDING FOR ONE YEAR** from date of initial delivery and is limited to: servicing and/or replacing any instrument or part thereof (except batteries and expendable supplies) returned to the factory for that purpose with transportation charges prepaid and which to the company's satisfaction are found to be malfunctioning.

#### WARRANTY DISCLAIMERS

Any implied warranties arising out of this sale, including but not limited to the implied warranties of merchantability and fitness for a particular purpose, are limited in duration to the above one (1) year period. Grass-Telefactor shall not be liable for loss of use of the instrument or other incidental or consequential costs, expenses or damages incurred by the purchaser.

Some states do not allow the exclusion or limitation of implied warranties or consequential damages, so the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights, and you may also have other rights that vary from state to state.

#### DAMAGE UPON ARRIVAL

Each instrument leaves our plant after rigorous tests and performs as specified. The instrument may receive rough handling and damage in transit. The shipment is insured against such

damage. The buyer must report in writing immediately any concealed or apparent damage to the last carrier. Report any damage also to us, and issue an order for replacement or repair. Our invoice for such service will then be evidence in the claim. Hold all packaging material.

#### MALFUNCTIONS OCCURRING WITHIN WARRANTY PERIOD

Our prices include replacement of malfunctioning parts, modules and even complete instruments when all conditions of sale are met and if we decide it necessary. It does not include:

1. provide for any transportation charges,
2. provide for services not performed or authorized by us,
3. provide for the cost of repairing instruments which have obviously been abused, modified, or subjected to non-intended uses or to unusual environments for which they have not been designed.

We will discuss by phone or letter suspected malfunctions or aspects of instrument

operation which may be unclear. Advise us of the nature of the malfunction before returning an instrument for repair. Many times a simple suggestion will solve the problem without returning anything. In the case of a malfunction properly diagnosed by Grass-Telefactor as being within a "plug-in" module, circuit board or other part which can readily be replaced without impairment of the instrument fidelity by a procedure which does not require a service man, then it is the responsibility of the owner to make such replacement under the direction of the company with a suitable replacement furnished by the company under the terms of the warranty. The owner has the responsibility for the return or to bear the cost of the replaced unit when requested.

#### WARRANTY ON SPECIFICATIONS

Grass-Telefactor reserves the right to make changes in design and specifications without notice and without any obligation to install such changes in units previously purchased.

Grass-Telefactor warrants each instrument to satisfy printed specifications available to the purchaser on formal request thirty days prior to date of scheduled delivery. Specifications are the average of typical measurements made on production units under controlled conditions. Statistical variations in individual units due to normal component variations are to be expected and should not alter the intended use of the instrument. However, when parameter characteristics are critical, tolerances are specified and guaranteed. Operating characteristics can be expected to change slightly from printed specifications with age and long term use.

Unless the exact tolerances of any parameter of any instrument are specified on the purchase order and specifically agreed to by Grass-Telefactor it is assumed that our standard production tolerances will satisfy all contractual responsibility.

X314G95



600 East Greenwich Avenue, West Warwick, RI 02893 • Tel. 401-828-4000 • Toll-Free Phone: (USA only) 877-472-7779 • Fax 401-822-2430