SERVICE MANUAL

VERSATONE®

BI-DIRECTIONAL DOPPLER ULTRASOUND INSTRUMENT

MODEL D9

SERIAL NUMBER N915

MEDASONICS
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WARRANTY AND FACTORY SERVICE INFORMATION

FULL WARRANTY

MedSonics, Inc. warrants that your MedSonics VERSATONE Model D9 is free from defective material and workmanship. Our obligation under this warranty is limited to the repair of instruments returned to us, transportation charges prepaid, within one year after delivery to the original purchaser. Specifically, we agree to service and/or adjust any instrument as required if returned for that purpose and to replace or repair any part which, upon our examination, is proved to have been defective. This warranty does not apply to batteries, or equipment damaged through shipping, tampering, negligence or misuse, including liquid immersion and autoclaving. THE FOREGOING WARRANTIES ARE EXCLUSIVE AND ARE IN LIEU OF ALL OTHER WARRANTIES (whether written, oral or implied). MedSonics is not liable for consequential damages.

This service manual is intended for use as a guide to technically qualified personnel when evaluating instrument malfunctions. It is not to be construed as authorization to perform warranty repairs. Unauthorized service will void the warranty. Instruments requiring warranty repairs must be shipped, postpaid, to the factory. MedSonics also provides prompt, factory service for out of warranty repairs. Where possible, we suggest using the original carton and packing to insure the safe return of any instrument.

If you have questions about your VERSATONE® D9 instrument or its service please call the Service Manager collect. The toll-free phone number is (800) 227-8076, in California call collect (415) 965-3333. Ship returned items and address correspondence to:

Service Manager
MedSonics, Inc.
P.O. Box M
Mountain View, California 94042

CONTENTS

WARRANTY AND SERVICE INFORMATION 2
INTRODUCTION 4
THEORY OF OPERATION 5
MAINTENANCE 7
TROUBLESHOOTING 9
TYPICAL DC VOLTAGES 11
CALIBRATION 14
PHOTOGRAPH OF VERSATONE INTERIOR 15
CIRCUIT BLOCK DIAGRAM 16
AMPLIFIER CIRCUIT DIAGRAM 17
AMPLIFIER P.C. ASSEMBLY 18
POWER SUPPLY CIRCUIT DIAGRAM 19
POWER SUPPLY P.C. ASSEMBLY 20
ELECTROCAUTERY CUT-OUT CIRCUIT DIAGRAM 21
ELECTROCAUTERY CUT-OUT P.C. ASSEMBLY 22
CHART RECORDER OUTPUT CIRCUIT DIAGRAM 23
CHART RECORDER OUTPUT P.C. ASSEMBLY 24
HARNESS ASSEMBLY 25
PARTS LIST 26

INTRODUCTION

This Service Manual pertains to the MedSonics Bi-directional VERSATONE® Doppler instrument, Model D9. The D9 is the central unit of an ultrasound system that uses the Doppler effect to detect Bi-directional blood flow within the body. By processing the positive and negative shifts of the Doppler frequency, the Model D9 detects and separates the sounds of blood flowing towards the probe tip from those associated with blood flow away from the probe tip. Bi-directional operation requires the use of MedSonics "P90" series of plug-in probes. Any of MedSonics non-directional "P80" series of probes can also be used with the VERSATONE Model D9.

This manual provides sufficient information to enable a trained electronics technician to troubleshoot and repair the VERSATONE Model D9. The plug-in probes cannot be serviced in the field and therefore this manual contains no information on them. Should a probe malfunction, the entire probe assembly including the plug-in unit, the connecting cable, and the transducer must be returned to the factory for service.

Before attempting to service the VERSATONE Model D9, it is necessary that the technician become familiar with the operation of the instrument by reading the operating instructions booklet. If a copy of this booklet is not available, one can be obtained free of charge by calling or writing the MedSonics Service Manager.

ILLUSTRATED DESCRIPTION

FRONT PANEL

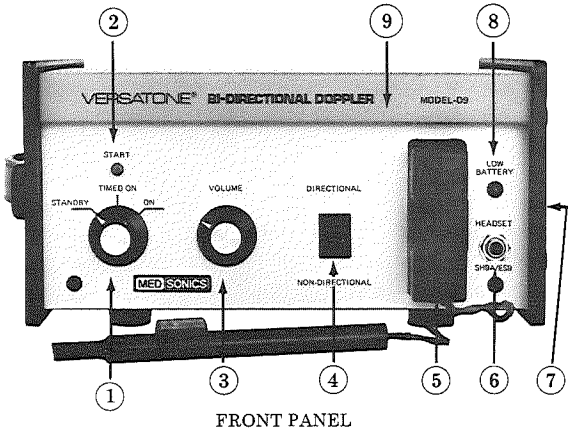
1. Power Switch: Three positions — *ON*, *OFF* and *TIMED-ON*.
2. Start Button: Push to start timed operation when power switch is in *TIMED-ON* mode.
3. Volume Control: Affects the loudspeaker or headphones.
4. Mode Switch: Two-position switch permits selection of *DIRECTIONAL* or *NON-DIRECTIONAL* mode of operation.
5. Probe Receptacle: The probe units are designed to plug into this receptacle.
6. Headset Jack: MedSonics headphones Model SH9A may be plugged into this jack for private listening.
7. Loudspeaker: Operates whenever the instrument is turned on, except when headphones are plugged in.
8. Low Battery Indicator: When the battery pack has been nearly exhausted, the low battery indicator light comes on and a beeping sound is generated.
9. Storage Space Cover: Lift cover for access to space for storing the power cable, probe instructions and small accessories.

REAR PANEL

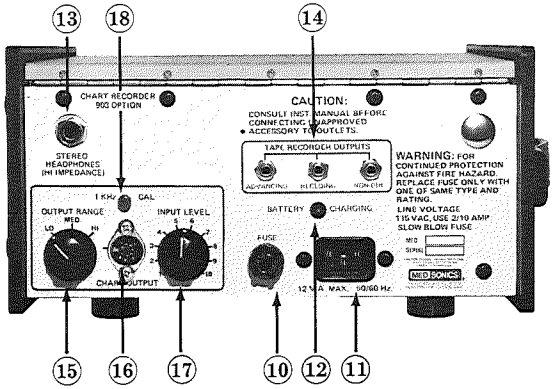
10. 2/10 Amp Slow-Blow Fuse: (3AG) Power cable should be disconnected before removing fuse. Use 1/10 amp slow-blow fuse for 220-volt units.
11. Power Cable Receptacle: A detachable 7-foot, 3-wire grounded power cord is provided with the VERSATONE *Bi-directional*, and is used to recharge the internal battery pack.
12. Battery Charging Indicator: This light is on whenever the battery pack is receiving a charge.
13. Stereo Headphones: MedSonics headphones Model SH9A may be plugged into this jack for two-channel "stereo" listening.
14. Tape Recorder Outputs: Three jacks: One for Doppler sounds of flow advancing toward probe, one for those receding, and one for non-directional flow sounds. Use Part No. HW1069 cable, which can be connected to most tape recorders.

When Option 903 (Chart Recorder Output) is installed, items 15 through 18 are present.

15. Output Range Selector (903 option): Permits selection of a Low, Medium or High range of output voltage to match chart recorder being used.
16. Chart Output (903 option): Provides output signal for chart recording, on a single or dual channel graphic recorder.
17. Input Level (903 option): Sets the input levels from the probe to the zero-crossing detector.
18. 1 KHz CAL (903 option): Applies internal test oscillator to each channel to check recorder calibration, channel balance and zero flow baseline.



FRONT PANEL



REAR PANEL

THEORY OF OPERATION

INTRODUCTION

The MedSonics Bi-directional Doppler Model D9 has three primary assemblies: The Phase Shift Module, the Main Amplifier Board, and the Power Supply Board. In addition, there are three (internal) options available: Electrocautery Cut-out (Option 901), 230 volt operation (Option 902), and a Chart Recorder Output Circuit (Option 903). (The 903 Option was made standard equipment on models produced after March 22, 1977.) These options can easily be added or removed as required by service personnel.

Options 901, 903, and the Power Supply Board plug into the Amplifier Board. The Phase Shift Module is wired directly to the main Amplifier Board. For identification and location of these items, see the photo on page 15. The Doppler signal can be traced through its entire process on the circuit block diagram (page 16). Detailed circuit diagrams and printed circuit layouts are provided on pages 16-25.

FRONT END

The (potted) plug-in probe assembly contains the RF oscillator and the receiver/phase-shift/demodulator portion of the circuit. Power required by the probe electronics is +12V and ±7V.

The signals from the plug-in probe to the Phase Shift Module are of the current-drive form, and cannot be seen with a typical scope voltage probe. The Phase Shift Module accomplishes the job of completely separating the "up-shifted" advancing signal from the "down-shifted" receding signal. Overall channel separation should typically be 30 dB or better at any frequency 60 Hz – 13 kHz.

MAIN AMPLIFIER BOARD (Circuit Diagram Page 16)

The audio outputs of the Phase Shift Module are fed to preamplifier sections A4a and A4b on the main amplifier board. The gain of these preamplifiers is varied by Volume Control P2, Sections A&B, located on the front panel. Both outputs from the phase shift circuit (prior to the volume control) are also available at the rear panel at J5 and J6 for tape recording. Diode pairs CR4 and CR5; CR6 and CR7 located at the outputs of the preamplifiers are for peak limiting of large transients caused by excessive motion of the Doppler probe.

The outputs of preamplifiers A4a and A4b pass through Directional Switch S1 (amplifier) on the front panel, then to Stereo Headset Jack J7 on the rear panel. The preamplifier outputs are also fed to the other side of S1 through an adder circuit A4c and inverter A4d. Switch S1 permits the operator to search for the vessel during the nondirectional mode and then switch to directional mode to determine the direction flow dynamics. The nondirectional signal is also available at the rear panel for tape recording (J9). Transistor Switch Q8 is biased on to allow the advancing signal to pass on to the output circuits that drive the internal speaker. If the user wishes to hear the receding signal from the speaker, then the microswitch located on the Directional Probe itself must be depressed. This switch activates Q3, Q4 and Q5, turns transistor Q8 off and turns Q7 on – now allowing the receding signal through to the speaker.

When a nondirectional probe of the "P80" series is used, its output comes in through J1-8 and is detected by CR1 and CR2. RFI filter L1, C3 is to reduce interference from strong, nearby radio transmissions in the FM-TV band. The resultant low level audio signal is amplified by Q1 and fed to the input of A1 at pin 3. The high frequency response of A1 is tailored by each of the P80 series plug-in probes by an RC filter within the probe PC assembly (through J1-11, 12 to ground). The gain of the amplifier and its low frequency response is also set in the same manner through J1-13, 14. The output of A1 is fed to the inputs of both A4a and A4b. (There is no provision for altering the frequency response of the Bi-directional probes. Usable, directional response extends from below 100 Hz to above 12 kHz.)

Also included on the main amplifier PC board are the positive and negative 7V DC power supplies. The +7 volt supply is developed by Regulator A2 and its output is set with P1. To obtain –7 volts, A3 is used as an inverter. The adjustments for this supply will be covered in the Calibration Section (page 14).

POWER SUPPLY BOARD (Circuit Diagram Page 16)

The basic power supply circuit is a full wave rectifier providing approximately +20V DC, unregulated. Power transistor Q10 provides a constant, nominal 100 ma to charge the battery pack. Ten nickel cadmium batteries rated at 1.2V each are combined in series to produce a total of 12V nominal. Individual cells in this battery pack may be replaced, but after a number of years it would be best to order a replacement battery pack. The VERSATONE battery pack can be recharged while the instrument is on with little loss of charging current. To accomplish this, Q9 is turned on whenever the VERSATONE is ON, which causes Q10 to conduct more current. The ON-charging current is adjustable by P4.

A low current programmable operational amplifier (A1) is used as a voltage comparator in a battery overdischarge protection circuit. Mercury battery B1 provides a reference voltage at pin 3, and while the voltage at pin 2 remains more positive than pin 3, the comparator output will be low. When the battery pack voltage drops below 10.4V, the trigger level at pin 2 (set by P1) then drops below that of pin 3 and the comparator output will be a positive value, turning Q1 on and Q3 off. This will turn off Q4 and the VERSATONE, preventing further discharge of the battery pack. The VERSATONE will remain off until the power cord is reattached bringing the voltage back up on pin 2 as well as charging the battery pack. **NOTE:** The NiCad battery pack voltage will experience a spontaneous recovery after the protection circuit shuts the VERSATONE off.

This will reactivate the VERSATONE for a very short time after which it will again switch off. The resulting periodic "popping" of a unit left on indefinitely is a normal occurrence and calls further attention to the fact that a battery charge is needed.

With S2 in the center, "TIMED-ON" position, the VERSATONE will remain on for a specific length of time (one minute is nominal) when activated by push-button S1 (front panel). This time can be changed if desired by varying P2 on the power supply PC board. S1 turns on transistor Q2 and Q4. This puts a charge on C3 that slowly discharges to ground through R14, P2, R15, and R16 at a rate set by P2.

Dual operational amplifier A2 is used as a visual and audible low battery warning circuit. One of the op-amps, A2a, is wired as a voltage comparator using CR4 to establish a reference voltage. The comparator voltage is set at the factory by adjusting P3 so that the comparator turns on when the battery voltage drops below 11.5V DC. The output voltage from this comparator energizes "Low Battery" LED-1 on the front panel, and turns on A2b. A2b is used as an astable, assymmetrical multivibrator pulsing the base of Q7 approximately every 15 seconds and allowing the 2 kHz output of A3 to be injected into the audio power amplifier A5, located on the main amplifier PC board. The 2 kHz tone can then be heard from the speaker and is an audible warning that the battery pack needs recharging. There is usually several minutes warning before the battery protection "cut-out" circuit takes over. The 2 kHz output from A3 drives complimentary pair Q5 and Q6. This output is then shifted negative, doubled to −12V DC, and the ripple is heavily filtered.

ELECTROCAUTERY CUT-OUT (Option 901)

The electrocautery cut-out circuit is essentially a low frequency wide band rf amplifier and transistor switch. Transistors Q1 and Q2 are in cascode as a high gain rf amplifier whose output is detected by CR3 and CR4. Diodes CR1 and CR2 are used to clip very high level rf signals. Capacitor C6 rolls off the upper frequency limit at about 1 MHz. Switching transistors Q3, Q4, and Q5 are effectively a squelch circuit that deactivates the buffer transistor Q2 on the amplifier circuit board thus preventing the electrocautery interference from reaching the headset jack and speaker.

220/50-60 Hz OPERATION (Option 902)

If so desired the power transformer can be wired for 220V AC operation by removing jumpers W-1 and W-3 and adding jumper W-2. The VERSATONE can be ordered wired this way by requesting Option 902.

CHART RECORDER (Option 903)

NOTE: READ OPERATING INSTRUCTIONS BEFORE ATTEMPTING SERVICE

The Chart Output is a frequency to voltage conversion circuit of the zero-crossing type. The average value of the changing Doppler frequency is converted to a varying DC voltage for observation on a monitor oscilloscope or for permanent recording on a strip chart recorder. The chart recorder circuit will be covered in five sections. The first section is the voltage to frequency conversion circuit, then the direction switch, the output, calibration, and the calibration timing circuit. The frequency to voltage circuits for the advancing and receding channels are identical so it will only be necessary to describe the operation of the advancing channel.

The input signal is low level audio direct from the output of the phase shift module, and is amplified by A1b. Operational amplifier A3 is wired as a Schmidt trigger and its threshold level is set by one half of P4, located on the rear panel of the D9. P4 is a matched dual potentiometer. The output of A3 is differentiated and triggers monostable multivibrator Q5 and Q7. Transistor Q6 is used to speed up the charging of timing capacitor C19. Potentiometer P5 is the calibration adjustment, and sets the width of the monostable output pulse. Transistor Q8 drives A4c, a three-pole active filter circuit. Potentiometer P6 is adjusted for zero DC offset of A4c. The advancing output signal is routed to the output connector (rear panel) through terminal 15 and the output attenuator switch (rear panel).

Both advancing and receding signals are fed to the direction-selecting switch shown in Detail A, page 23. Transistor Q15 is normally "on", allowing the advancing signal to be present at pin 7 of the output connector (the "Probe Select" output line). When the microswitch on the P92 probe handle is depressed, the direction switch in Detail A is activated. Transistor Q15 turns off, Q14 turns on, which provides the receding signal to pin 7 of the output connector. Both Advancing and Receding chart signals are fed to differential amplifier A4b and its output is the "Combined Output" at pin 6 of the output connector. The levels of all four outputs: Advancing, Receding, Probe Select, and Combined are simultaneously set by the rear panel "Output Range" 3-position switch.

Transistor Q21 is the 1 kHz calibration oscillator. Its frequency is trimmed with P7.

Quad operational amplifier A5 is used to turn on the calibration oscillator at a predetermined rate as shown in the timing diagram detail. When S1 is depressed, A5a is turned on, activating Q16 which turns on the oscillator. Transistor Q17 and Q20 then ground the inputs of A2 and A3, preventing the incoming signal from entering these circuits. Switch S1 also turns on A5b as shown in Diagram b, which turns on Q19 and applies the 1 kHz calibration signal to multivibrator Q5 and Q7. The trigger that turns on A5d is delayed by A5c, then A5d applies the calibrate signal to multivibrator Q1 and Q3. The Instruction Booklet shows how the calibration signals appear at the four chart outputs.

MAINTENANCE AND OPTION INSTALLATION

SERVICE ACCESS

CAUTION: There are power line voltages within the instrument. The NiCad battery pack is capable of very high discharge currents should a direct short occur. Access and repair should be undertaken only by an authorized, competent, trained electronic technician. Remove power cord from AC receptacle on the rear panel. Disconnect Leads from the battery pack.

To gain access to the printed circuit board, first remove the accessory tray located under the hinged cover. To do this remove the five screws labeled "A" through "E" (see Fig. 1). If the VERSATONE has the chart recorder (Option 903) as indicated by the controls at the rear panel, then remove screw "F". The accessory tray may still be partially held down by the silicon rubber used as a vibration damping material. Pry the tray out, trying not to remove the rubber that adheres to the tray or chassis. The location of the circuit boards is shown in the photograph on page 15 . For convenience, it may be necessary to remove the hinged cover. To do this, remove the four screws located along the top of the rear panel.

AMPLIFIER BOARD

To gain access to the component side of the amplifier board, carefully remove the five front panel screws (one located inside top center). The front panel is partially held in place by silicon rubber damping material and must be pulled or pried away from the chassis. Most component replacement and trouble-shooting can take place without removing the amplifier board. If it is necessary to remove this board, begin by removing the screw from the angle bracket on the lower edge of the board, and the two screws on the bottom of the black connector bracket (see photo page 15). Next remove the two flat head screws from the aluminum bar and lift the amplifier circuit board away from the chassis. If the VERSATONE is equipped with the chart recorder circuit, be sure to unplug it from the main amplifier board before attempting to remove it.

POWER SUPPLY

As shown in the photograph (page 15) the component side of the circuit board is readily accessible. To gain access to the foil side of the power supply circuit board, unplug the battery leads. Remove the single nut from the rear center of the circuit board and unscrew the nylon screw holding Q10 to the left side of the chassis. Now unplug the power supply from the amplifier board and lift the power supply clear of the VERSATONE (disconnect transformer wires, if necessary).

CHART RECORDER CIRCUIT BOARD (Option 903)

To gain access to the chart recorder printed circuit board, unplug the 9-pin connector from the amplifier board. Next remove the screw holding the right corner

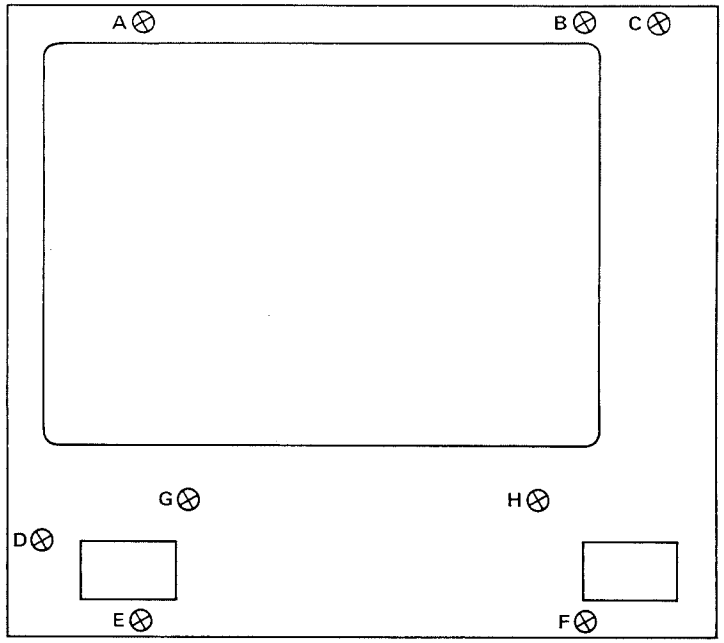


FIGURE 1
ACCESSORY TRAY LAYOUT

of the board to the chassis. To gain access to the rear control panel, remove the two screws on the top of the panel (if not already removed), and the lower screw from the 7-pin output connector.

ELECTROCAUTERY CUT-OUT (Option 901)

The electrocautery circuit board is mounted to the front of the main amplifier circuit board with two screws (photo page 15). Unplug the 5 pin plug from the amplifier board, unsolder the antenna lead and the 901 option can be moved clear of the chassis for service.

BATTERY PACK

To remove the battery pack for repair or replacement, disconnect the leads from the positive and negative terminal connectors and remove the four corner screws from the bottom of the chassis (see photo page 15). Lift the battery pack up and slide it out from under the speaker. In some cases, it may be necessary to

remove the power supply board and/or the 903 option to be able to remove the battery pack.

SPEAKER

To replace the speaker remove the four screws which secure the small rubber feet and the end panel. This gives access to the speaker fasteners.

PREVENTATIVE MAINTENANCE

Listed below is the recommended preventive maintenance program for the D9:

Six Month Intervals:

A. INSPECT

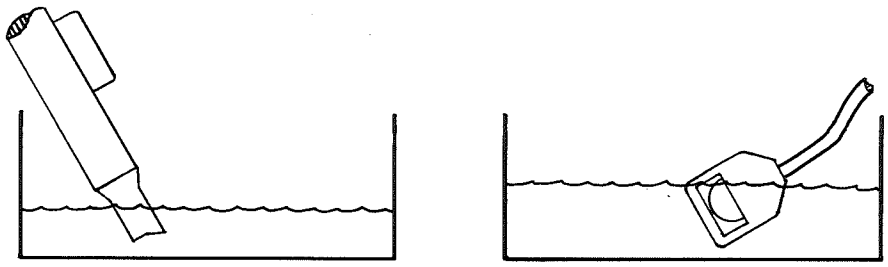
1. The power cord — for wear or damage.
2. Probe wires — for wear or damage.
3. Probe transducer — for cracks, chips or damaged faceplate area.
4. Probe PC fingers — for contamination or damage. Clean carefully with solvent as necessary.
5. D9 VERSATONE — for signs of spilled liquids, case damage, control function, loose knobs, etc.

B. VERSATONE TEST

1. Ground connection of power cord — for resistance of less than 0.1 ohms to chassis ground.
2. D9 and Probe — with the use of a healthy subject. It is a good idea to compare the probe to a known working one.
3. Both headset jacks — with an SH9B or equivalent headset over 600 ohms per transducer.
4. The chart output voltages — by depressing the 1 kHz calibrate switch while measuring the four chart outputs with an oscilloscope. (See 903 calibration.) Then test the complete chart circuit with the P90 series probe.

C. PROBE EMERSION TEST

1. Use Hi-Potential Tester Model 3000 AC/DC by Beckman Instrument Co. or equivalent.
2. Adjust tester for 230 VAC.
3. Submerge Doppler probe transducer end ONLY in a small container of water. DO NOT SUBMERGE PROBE SWITCH. (See illustration).



4. Submerge the negative lead of Hi-Pot tester in the same container of water.
5. Connect Hi-Pot test lead to silver foil tape on side of plastic housing of probe plug-in. (If no foil present, use contact PC fingers 29 and 30.)
6. After two minutes, the leakage current should remain less than 20 μa (200 μa for P81).

Every Other Year:

1. Perform all of the steps listed above.
2. Cycle the battery pack — charge the battery pack for 12 hours. Disconnect the power cord, turn D9 on (unplug probe) and leave D9 on for 7 hours. At approximately 7 hours or more, the "low battery" indicator should come on and shortly after that the D9 will completely shut off. Plug in the power cord and recharge the battery pack.
3. Test the audio balance — see "troubleshooting section."
4. Test the electrocautery sensitivity — see "troubleshooting section."

TROUBLESHOOTING

Localize the defective stage of the VERSATONE with the aid of the circuit block diagram. Typical DC voltages for each circuit are provided on page 11. **NOTE:** If the trouble is traced to either a plug-in probe or to the phase shift module, then the defective module should be returned to the factory for service. When returning a probe, always return both parts — the module/housing and the crystal/handle.

THE BATTERY-POWER SUPPLY SYSTEM

The nominal voltage of the battery pack is +12V DC. The nominal capacity is 1 Ampere hour. Charging current with the VERSATONE in the "OFF" position is 100 ma (+15 ma, −10 ma) at 115V AC line voltage.

The "ON" charging current is adjustable and should be set to 100 ma (+10 ma, −20 ma) with 115V AC line voltage. When replacing the slip-on battery clip, make sure the contact is firm. A time test of battery condition may be obtained by fully charging the battery and then discharging it at a known rate for a known time (100 ma for 10 hours). When replacing the battery pack, it is a good idea to replace the mercury reference cell (B1) at the same time. This battery is supplied with plug-in pins and simply plugs into the circuit board. Be sure to observe correct polarity when installing replacement batteries.

The output of the −12V power supply should measure within +0.8V and −0.4V of −12V. The positive and negative 7 volt power supplies are located on the amplifier circuit board and should measure as follows: +7V (±0.02V) and −7V (−7.1 to −7.8V).

THE AMPLIFIER CIRCUIT

Troubleshooting the bi-directional and audio circuits on this circuit board can be accomplished with the aid of the plug-in adapter circuit shown in Fig. 2.

Apply a 1 kHz, 50 mv pp signal to the adapter as shown. Adjust the volume control (P2) to its midrange and measure the signals at J7. The voltages at this point will be approximately 1V pp. The difference between the advancing and receding signals at this point should be no greater than 10%.

To test the non-directional input circuit, the plug-in adapter circuit shown in Fig. 3 can be used. Apply a 1 kHz, 50 mv pp signal as shown. The signals at J7 will be 100 mv pp.

ELECTROCAUTERY CUT-OUT (Option 901)

If the electrocautery cut-out circuit fails to operate be sure the antenna is unclipped from its holding clip, rotated vertically, and fully extended. In case cut-out still does not occur in the presence of interference, move the VERSATONE or the antenna closer in proximity to the electrocautery device. **NOTE:** Not all

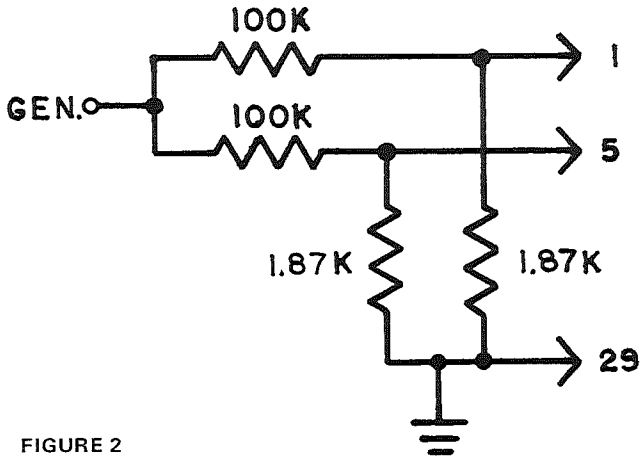


FIGURE 2

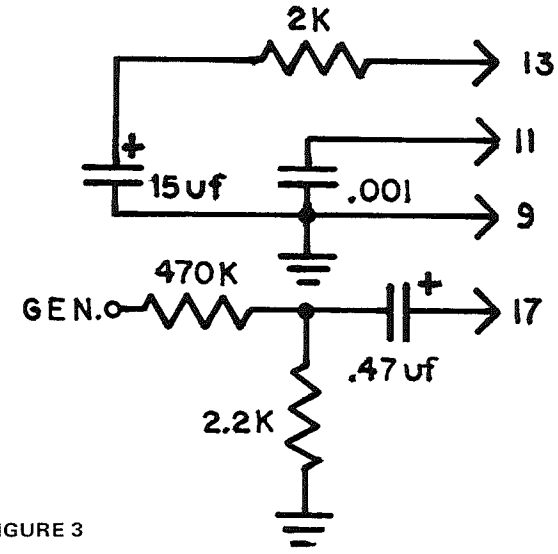


FIGURE 3

electrocauteries radiate sufficient energy to activate the cut-out circuit and bipolar electrodes radiate less as well. It may be necessary to clip on a 3 or 4-foot length of wire to the antenna to increase the circuit sensitivity. In turn, the sensitivity may be reduced by partially collapsing the antenna. In rare instances the sound cut-out may be activated by other sources of radio frequency energy, such as rotating machinery or powerful nearby AM broadcast radio transmitters.

To accurately determine the sensitivity of the cut-out circuit, apply a 750 kHz, 40 mv pp signal between the antenna and ground. The cut-out should operate at this input level so that no Doppler signal comes through the VERSATONE loudspeaker. To aid in troubleshooting the electrocautery cut-out circuit, refer to the chart of bias voltages on page 12.

CHART RECORDER (Option 903)

The proper operation of the chart recorder circuit can be checked with the aid of the internal 1 kHz calibrate circuit. With a P92 probe plugged into place, adjust the "Input Level" control for a small amount of baseline noise present on the recording. With the "output range" set to "HI", depress the calibrate button on the rear panel; the advancing output should deflect to 1 volt. As shown in Figure 4, the zero baseline appears after the calibration pulse in the advancing channel. The waveform in the receding channel (Figure 5) shows the zero baseline before the calibration pulse. The combined output calibration is shown in Figure 6.

Use the calibration pulse to isolate the defective stage, then refer to the voltage chart to complete the repairs.

ADDITIONAL TESTS

NOTE: The power cord and receptical ground connection should be tested periodically and should read less than 0.1 ohms to chassis ground. The plug-in probes should be periodically inspected for insulation integrity.

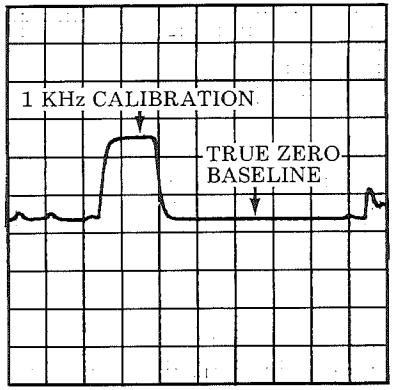


FIGURE 4

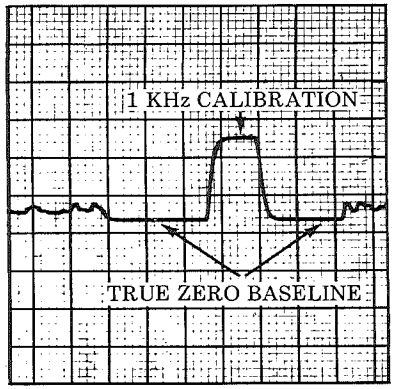


FIGURE 5

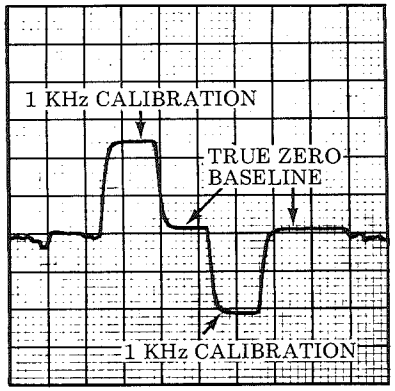


FIGURE 6

TYPICAL DC VOLTAGES NOTE: All voltages measured with a DVM

POWER SUPPLY CIRCUIT BOARD

BATTERY CHARGING CIRCUIT (NOTE: 115V AC line voltage)

	E	B	C	Front Panel Power Switch
Q10	19.02	18.33	14.10	"STANDBY"
Q10	16.20	15.45	14.18	"ON"
Q9	0.00	0.28	18.29	"STANDBY"
Q9	5.5	6.07	15.44	"ON"

TIMED-ON CIRCUIT

Q2	12.00	11.86	0.0	"STANDBY"
Q2	11.98	11.85	11.40*	"TIMED-ON"
Q4	12.00	12.00	0.61	"STANDBY"
Q4	12.00	11.29	11.93	"TIMED-ON"

* Decays for 1 minute

LOW BATTERY WARNING CIRCUIT
(NOTE: VS must be reduced to +11.5V DC to activate circuit)

PIN	1	2	3	4	5	6	7	8	
A2	7.98	4.29	4.35	0.0	7.50	7.37	10.60	11.41	(no audible tone)
A2	7.98	4.29	4.35	0.0	3.72	3.84	2.16	11.41	(audible tone)

	E	B	C	
Q7	0.0	0.65	0.01	(no audible tone)
Q7	0.0	0.39	2.83	(audible tone)

LOW BATTERY CUT-OUT CIRCUIT
(NOTE: Battery voltage must be reduced to 10.4V DC to activate)

PIN	1	2	3	4	5	6	7	8
A1	0.0	1.30	1.31	0.0	0.56	7.14	10.40	0.0

	E	B	C
Q1	0.0	0.50	0.02
Q3	0.0	0.03	10.40

−12V POWER SUPPLY

PIN	1	2	3	4	5	6	7	8
A3	0.73	6.15	6.04	0.0	1.02	6.15	11.95	4.97

	E	B	C
Q5	6.21	6.15	11.33
Q6	6.21	6.15	0.0

Pin 11 of PC board is −12V (+0.8V, −0.4V) under typical instrument load.

AMPLIFIER CIRCUIT BOARD (NOTE: Battery voltage +12V DC)

NON-DIRECTIONAL PROBE CIRCUIT (P81 plugged in)

	E	B	C
Q1	10.47	9.85	5.52

PIN	1	2	3	4	5	6	7	8
A1	1.34	5.45	5.43	0.0	1.17	5.46	11.64	4.27

AUDIO CIRCUITS

PIN	1 – 3	4	5 – 10	11	13 – 14
A4	0.0	12.00	0.0	–12.00	0.0

PIN	1	2–5	6	7	8	9	10	11	12	13	14
A5	6.24	0.0	0.71	0.06	1.42	0.0	5.45	0.0	11.8	0.0	12.0

	E	B	C
Q2	–0.72	–0.10	10.38

ELECTRONIC SWITCH

	E	B	C	Probe Switch
Q3	0.0	0.53	0.04	Open
Q3	0.0	0.16	11.02	Closed
Q4	12.0	11.42	12.0	Open
Q4	12.0	11.49	0.0	Closed
Q5	0.0	0.01	11.01	Open
Q5	0.0	0.50	0.03	Closed
Q6	12.0	11.73	0.0	Open
Q6	12.0	11.43	11.98	Closed

+7V POWER SUPPLY

PIN	1	2	3	4	5	6	7	8
A2	7.06	12.0	12.0	0.0	1.74	1.75	7.80	7.0

–7V POWER SUPPLY

PIN	1	2	3	4	5	6	7	8
A3	–10.3	0.0	–11.76	0.0	–10.6	–11.8	11.9	–8.5

OPTION 901 ELECTROCAUTERY CIRCUIT BOARD

	E	B	C	
Q1	3.96	4.57	8.67	
Q2	2.09	2.72	3.96	
Q3	11.96	11.75	–11.99	No signal at antenna
Q3	11.96	11.34	1.10	With signal

	E	B	C	
Q4	–12.11	–12.0	0.0	No signal
Q4	0.0	0.64	0.0	With signal
Q5	–12.12	–12.10	0.01	No signal
Q5	–12.21	–11.59	–12.19	With signal

903 CHART RECORDING OUTPUT CIRCUIT BOARD

ZERO CROSSING CIRCUITS
(Note: Apply a 1 kHz, 50 mv pp signal to Lug 5)

PIN	1	2	3	4	5	6	7	8	9	10	11	12	13	14
A1	0.37	0.0	0.0	−12.15	0.0	0.0	0.45	12.0	–	–	–	–	–	–
A2	−11.7	0.0	0.0	−12.15	−11.11	1.57	12.0	1.22	–	–	–	–	–	–
A3	−11.7	0.13	0.0	−12.15	−11.03	1.49	12.0	1.13	–	–	–	–	–	–
A4	0.0	0.0	0.0	12.0	0.45	0.43	1.0	0.0	0.50	0.50	−12.0	0.42	0.43	1.0

	E	B	C
Q1	0.0	0.02	6.54
Q2	6.21	6.54	7.0
Q3	0.0	0.07	6.5
Q4	0.0	0.52	0.43
Q5	0.0	0.15	6.54
Q6	6.21	6.54	7.0
Q7	0.0	0.59	6.5
Q8	0.0	0.53	0.42

DIRECTION SWITCH

	E	B	C	Probe Switch
Q9	0.0	0.01	0.51	Open
Q9	0.0	0.50	0.05	Closed
Q10	0.0	0.51	0.03	Open
Q10	0.0	0.05	11.34	Closed
Q11	12.0	11.41	12.00	Open
Q11	12.00	11.50	0.0	Closed
Q12	0.0	0.0	11.04	Open
Q12	0.0	0.48	0.02	Closed
Q13	12.0	11.74	0.75	Open
Q13	12.0	11.40	12.0	Closed

CALIBRATION OSCILLATOR

	E	B	C	Calibrate Switch
Q16	0.0	−2.79	6.79	OFF
Q16	0.0	0.62	0.0	ON

	A	K	G	
Q21	6.74	0.0	6.32	OFF
Q21	3.05	0.0	3.95	ON

PIN	1	2	3	4	5	6	7
A5	−11.45	1.05	0.04	11.98	0.09	2.40	−11.45

	8	9	10	11	12	13	14
A5	−11.45	2.71	0.06	−12.18	0.08	1.04	−11.41

CALIBRATION

POWER SUPPLY

Calibration of the VERSATONE power supply is performed to control the charging of the internal battery pack. This procedure should not be necessary unless replacement parts in this circuit have been installed. The low voltage warning circuit is calibrated first. Pull off the positive (red) lead (see photo page15) from the battery pack and connect it to a variable voltage 2A capacity power supply. Set the variable power supply to +11.5V DC and adjust P3 on the power supply circuit board so that the low battery LED on the front panel "just turns on".

(**NOTE:** The low voltage beeper should be heard about once every 15 seconds, after the LED turns on.) Readjust the variable power supply to +12V DC; the LED should turn off and the beeper stop. Now vary the power supply through +11.5V DC to verify that the low voltage warning circuit turns on at this voltage; readjust P3 as necessary.

The "over discharge" cut-out protection circuit is calibrated next. Test the mercury reference battery (1.3V min.). Set the variable power supply to 10.4V DC. Adjust P1 on the power supply circuit board so that the low battery LED and beeper "just turns off". Increase the variable power supply to 12.0V DC and readjust it back through 10.4V DC to be sure the LED turns off at that voltage. Readjust P1 as necessary. Replace the positive lead to the battery pack terminal. Make sure the slip-on connector grips the terminal securely.

When the D9 VERSATONE is turned "on" and the line cord is plugged in, the current to the battery pack should be 100 ma (+10 ma, −20 ma) @ 115V AC line voltage. This charging current is set by adjusting P4.

CHART RECORDER

In order to calibrate the chart recorder circuit it will be necessary to remove the printed circuit board from the chassis. If you wish to remove the chart recorder control panel from the rear of the D9 you must first remove the D9 rear panel. The chart recorder assembly must remain plugged into the main amplifier PC board for the +12, −12, and +7V power supply voltages. (**NOTE:** Tolerances are shown many times tighter than required in normal clinical service simply to reflect good set-up practice.)

The first circuit to be calibrated is the 1 kHz oscillator. Connect a frequency counter at R81. Ground pin 13 of A5 to turn on the oscillator circuit. It may be necessary to apply −12V through 10K ohms to activate the circuit. (**NOTE:** If the counter does not respond correctly, then connect it to the collector of Q5.) Adjust P7 for 1 kHz ±2 Hz. Disconnect the counter and turn off the oscillator circuit.

NOTE: The following output voltages will be measured at the 7 pin rear panel connector J1. Remove any Doppler probes from the D9 front connector, turn the Volume Control CCW, the rear panel "Input Level" to #10 and the "Output Range" to "HI". Connect a DVM to pin 3 of J1 and adjust P3 for 0.0V DC ±1 mv reading on the DVM. Connect the DVM to pin 5 and adjust P6 for a 0.0V DC ±1 mv reading. Now connect the DVM to pin 6; the reading here should be 0.0V DC ±5 mv DC.

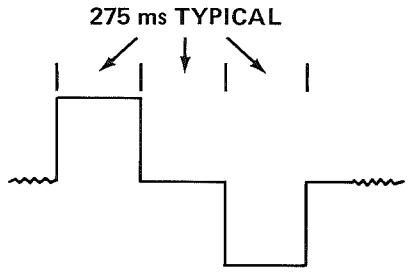
Apply a 50 mv, 5 kHz ±5 Hz signal to terminal 4. Connect the DVM to pin 3 of J1 and adjust P2 for 5V DC ±10 mv. Switch the output switch to "MED"; the reading should be 125 mv ±5 mv, switch to "LOW"; the reading should be 12.5 mv ±0.5 mv. Return to "HI", turn "Off" generator output and verify that the reading at pin 3 is still 0.0V DC ±1 mv (readjust P3 if necessary). Turn on the generator and move the DVM to pin 6; it should be −5V DC ±100 mv.

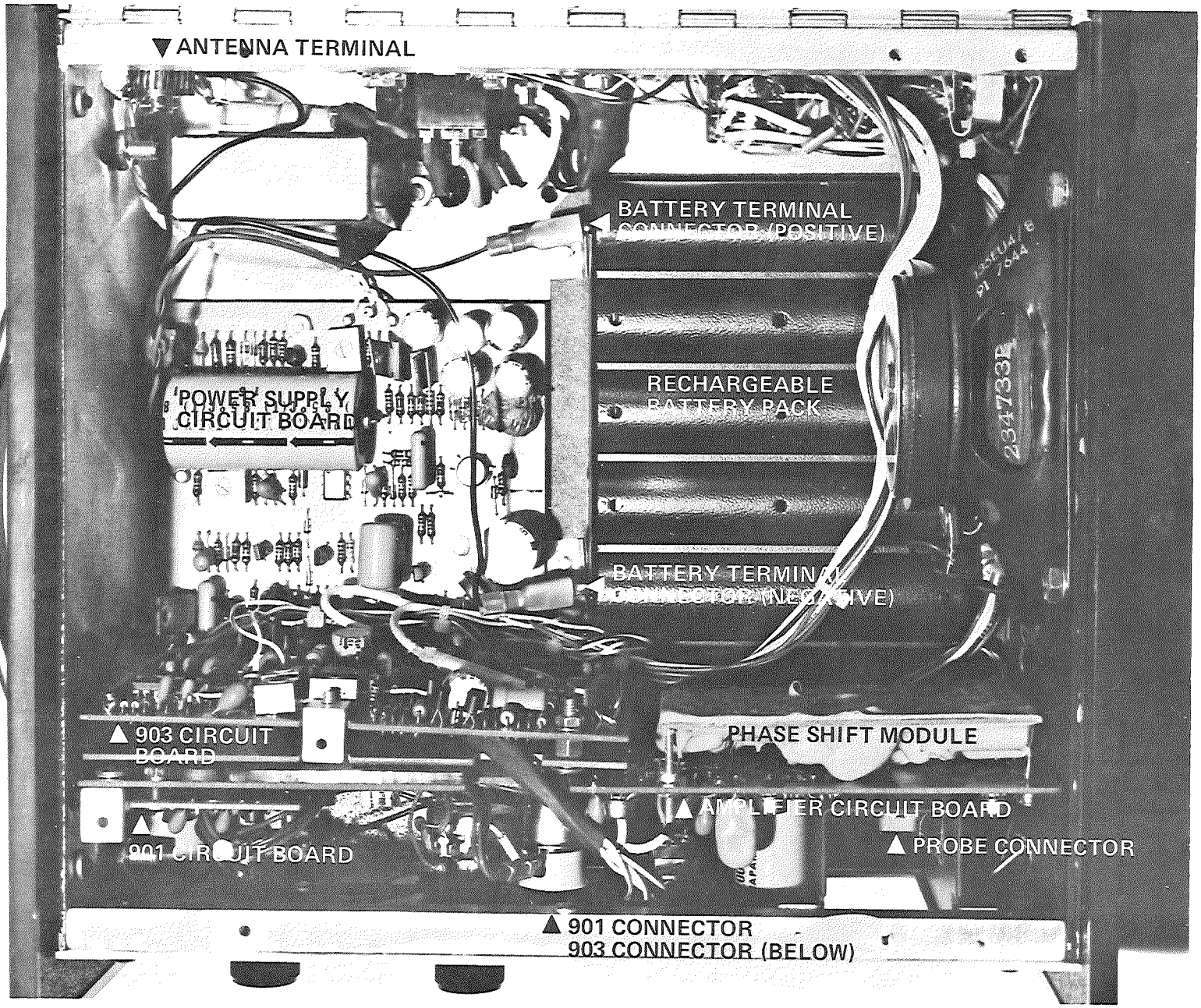
Change the generator to 1 kHz ±2 Hz @ 50 mv. Move the DVM to pin 3; it should read 1V DC ±20 mv. Change the generator to 10 kHz ±10 Hz @ 50 mv; the output should change to 10V ±100 mv. The linearity of the zero-crossing circuit has now been confirmed for one channel.

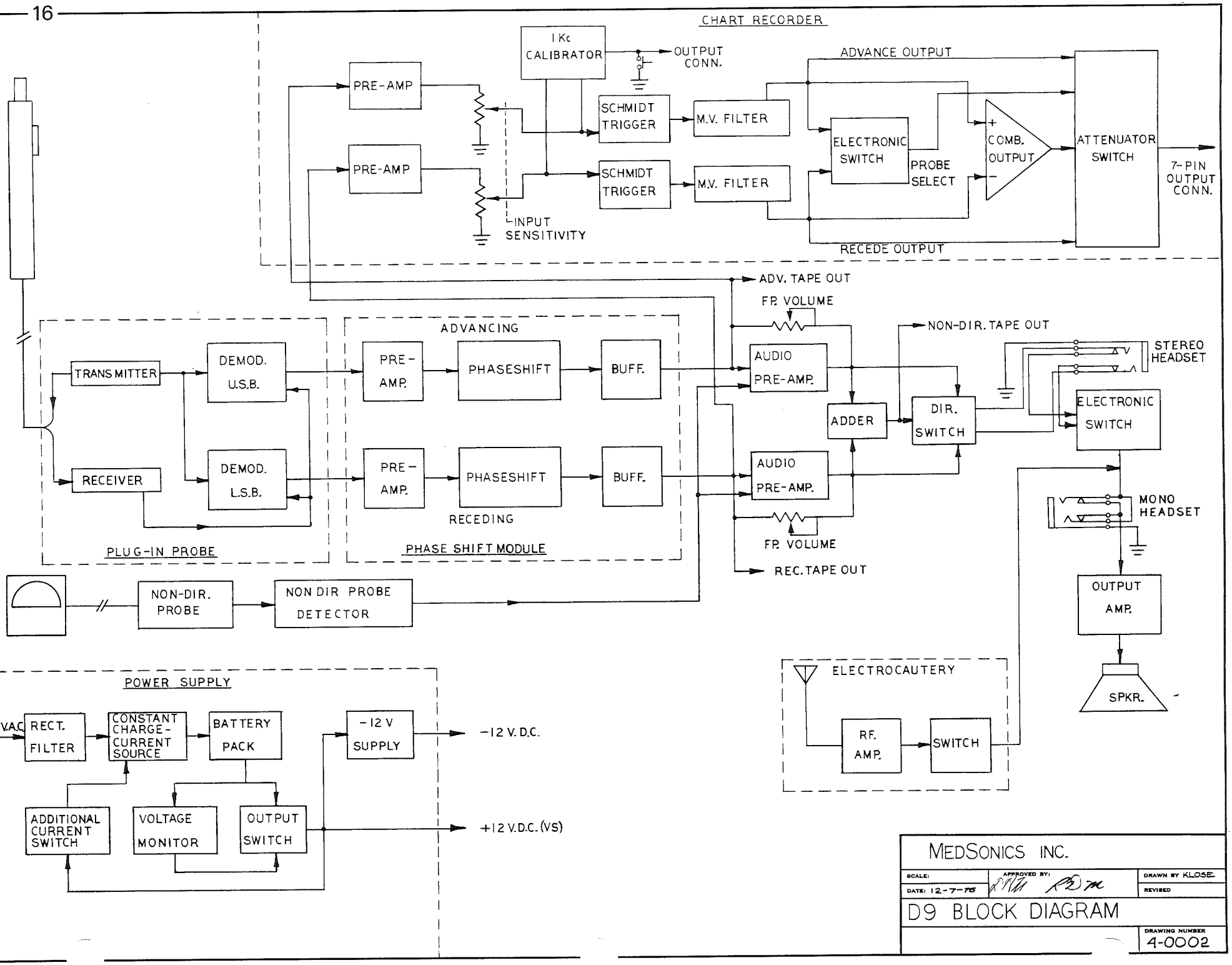
Connect the generator to terminal 6 and change it to 5 kHz ±5 Hz 50 mv. Move the DVM to pin 5 and adjust P5 for 5V DC ±10 mv. Switch the output range to "MED". The reading should be 125 mv ±5 mv. Switch to "LOW"; the reading should be 12.5 mv ±0.5 mv. Return the output range switch to "HI", turn off the generator and verify that the output is still 0.0V DC ±1 mv (readjust P6 if necessary). The linearity of the second channel now has been set.

Turn on the generator; move the DVM to pin 6. The reading should be 5V DC ±100 mv. Move the DVM to pin 7; the reading should be 5V DC ±20 mv. Switch the output to "MED"; the reading should be 125 mv ±5 mv, change to "LOW"; the reading should be 12.5 mv ±0.5 mv. Return to "HI" and apply +12V DC to pin 1 of J1; the reading at pin 7 should drop to zero. Disconnect the voltage from pin 1 and move the generator back to pin 5. Set the generator to 1 kHz ±2 Hz 50 mv. The output should be 1V DC ±20 mv. Move the DVM to pin 6 and change the generator to 10 kHz ±10 Hz @ 50 mv. The reading should be 10V + 100 mv-0.0. This completes the calibration of the chart recorder circuit.

To check the calibration waveform, apply an oscilloscope to pin 6, plug in a P92 probe, adjust the input level for a slight amount of noise on the baseline. Press the 1 kHz Cal button and observe the following waveform at pin 6.




ANTENNA TERMINAL
BATTERY TERMINAL CONNECTOR (POSITIVE)
POWER SUPPLY CIRCUIT BOARD
RECHARGEABLE BATTERY PACK
234738
BATTERY TERMINAL CONNECTOR (NEGATIVE)
903 CIRCUIT BOARD
PHASE SHIFT MODULE
AMPLIFIER CIRCUIT BOARD
901 CIRCUIT BOARD
PROBE CONNECTOR
901 CONNECTOR
903 CONNECTOR (BELOW)

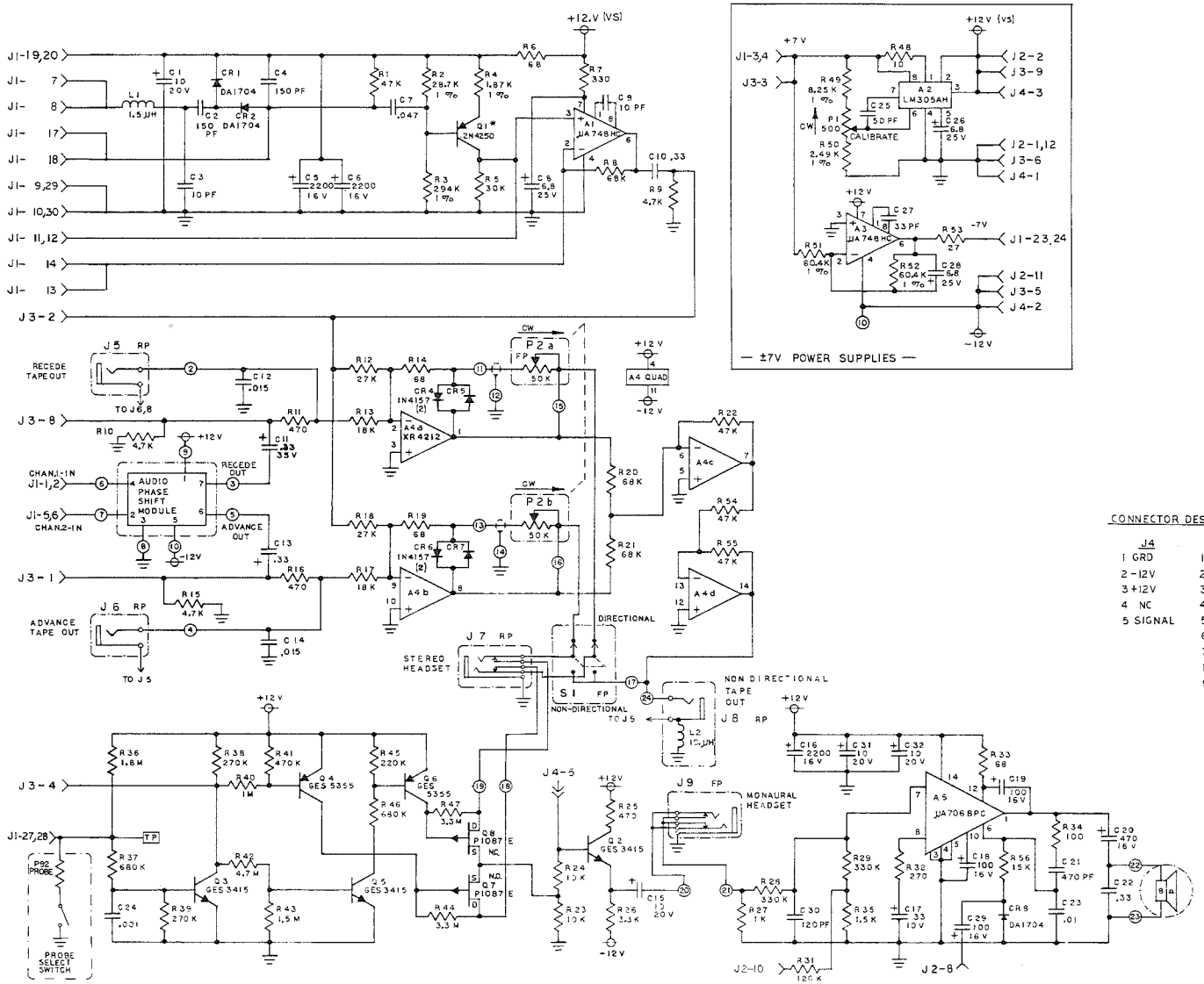


MEDSONICS INC.

SCALE:	APPROVED BY:	DRAWN BY KLOSE
DATE: 12-7-76		REVISED

D9 BLOCK DIAGRAM

DRAWING NUMBER 4-0002



REVISIONS					
S/N	ECN	LTR	DESCRIPTION	DATE	APPROVED
N22	28	A	CHANGED R23,24,39 & C15	1-12-76	
N27	34	A	CHANGED TERM 1 TO 17 (ARTWORK CHANGE)	1-12-76	
N47	35	B	CHANGED SUPPLY CKT: R51,52; C28,	1-23-76	
		B	DELETED C33,CR3 & REDREW.	"	
N27	43	B	P1,R49,50, ARE:500, 8.25K 1%, 2.49K 1%;		
			WERE: 1K, 8.2K 5%, 2.4K 5%.	10-16-75	
N66	55	C	ADDED L2 TO J103,4,5.	7-23-76	
	132	D	DESIGNATION CHANGE (SEE BODY OF ECO) -	3-18-77	
	130	E	SEE BODY OF ECO	7-7-77	

NOTES: (UNLESS SPECIFIED OTHERWISE)

1. ALL RESISTOR VALUES ARE IN OHMS, ± 5 %, 1/4 W.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS.
3. ITEMS ENCLOSED IN———— LINES NOT ON PC BRD.
4. AN ASTERISK DESIGNATES A FACTORY SELECTED PART.
5. (FP) FRONT PANEL; (RP) REAR PANEL.
6. POINTS DESIGNATED Ⓘ ARE STAKED TERMINALS.
7. AUDIO PHASE SHIFTER IS GROUNDED TO AMPLIFIER BOARD THROUGH THE MOUNTING SCREWS
8. LUGS 25-28,30-32 SHOWN ON POWER SUPPLY SCHEMATIC.

CONNECTOR DESIGNATIONS

J4	J5
1 GRD	1 ADVANCING AUDIO
2 -12V	2 NON-DIR. AUDIO, P80 PROBE
3 +12V	3 +7V
4 NC	4 PROBE CONTROL
5 SIGNAL	5 -12V
	6 GRD
	7 NOT USED
	8 RECEDING AUDIO
	9 +12V

REFERENCE DESIGNATIONS

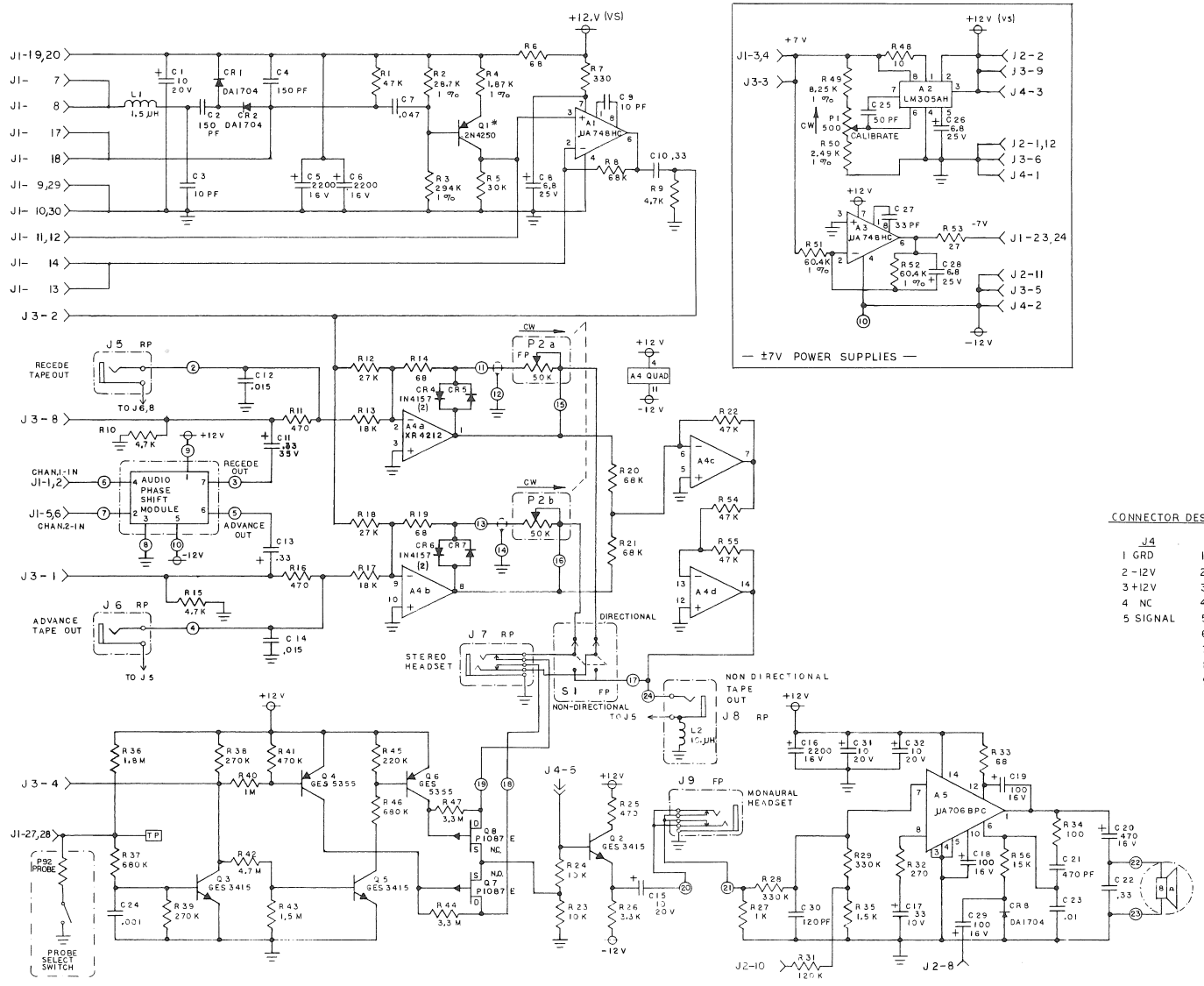
LAST USED	NOT USED
R56	R30
C32	
CR8	CR3
Q8	
A5	
L2	
P2	
J9	
㉜	Ⓘ㉙

CONNECTOR DESIGNATIONS

J1 TO PLUG IN PROBES.
J2 TO POWER SUPPLY BOARD.
J3 TO CHART RECORDER BOARD (OPTION 903).
J4 TO ELECTROCAUTERY BOARD (OPTION 901).

MEDSONICS INC.

SCALE:	APPROVED BY: JW Ik	DRAWN BY KAKUK	
DATE: 1-23-76		REVISED H.M.LOSE	
2-0015	D-9	AMPLIFIER SCHEMATIC	
NEXT ASSY.	USED ON		
APPLICATION		DRAWING NUMBER 5-0017	E



REVISIONS					
S/N	ECN	LTR	DESCRIPTION	DATE	APPROVED
N22	28	A	CHANGED R 23,24,39 & C 15	1-12-76	
N27	34	A	CHANGED TERM 1 TO 17 (ARTWORK CHANGE)	1-12-76	
N47	35	B	CHANGED SUPPLY CKT: R 51,52; C 28,	1-23-76	
		B	DELETED C 33, CR 3 & REDREW.	"	
N27	43	B	P1, R 49,50, ARE: 500, 8.25K 1%, 2.49K 1%;		
			WERE: 1K, 8.2K 5%, 2.4K 5%,	10-16-75	
N66	55	C	ADDED L2 TO J103,4,5.	7-23-76	
	132	D	DESIGNATION CHANGE (SEE BODY OF ECO) -	3-18-77	
	130	E	SEE BODY OF ECO	7-7-77	

NOTES: (UNLESS SPECIFIED OTHERWISE)

1. ALL RESISTOR VALUES ARE IN OHMS, ± 5 %, 1/4 W.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS.
3. ITEMS ENCLOSED IN -·-·-·- LINES NOT ON PC BRD.
4. AN ASTERISK DESIGNATES A FACTORY SELECTED PART.
5. (FP) FRONT PANEL; (RP) REAR PANEL.
6. POINTS DESIGNATED (1) ARE STAKED TERMINALS.
7. AUDIO PHASE SHIFTER IS GROUNDED TO AMPLIFIER BOARD THROUGH THE MOUNTING SCREWS
8. LUGS 25-28,30-32 SHOWN ON POWER SUPPLY SCHEMATIC.

CONNECTOR DESIGNATIONS

J4	J5
1 GRD	1 ADVANCING AUDIO
2 -12V	2 NON-DIR. AUDIO, P80 PROBE
3 +12V	3 +7V
4 NC	4 PROBE CONTROL
5 SIGNAL	5 -12V
	6 GRD
	7 NOT USED
	8 RECEDING AUDIO
	9 +12V

REFERENCE DESIGNATIONS

LAST USED	NOT USED
R 56	R 30
C 32	
CR 8	CR 3
Q 8	
A 5	
L 2	
P 2	
J 9	
(32)	(1) (29)

CONNECTOR DESIGNATIONS

J1 TO PLUG IN PROBES.
J2 TO POWER SUPPLY BOARD.
J3 TO CHART RECORDER BOARD (OPTION 903).
J4 TO ELECTROCAUTERY BOARD (OPTION 901).

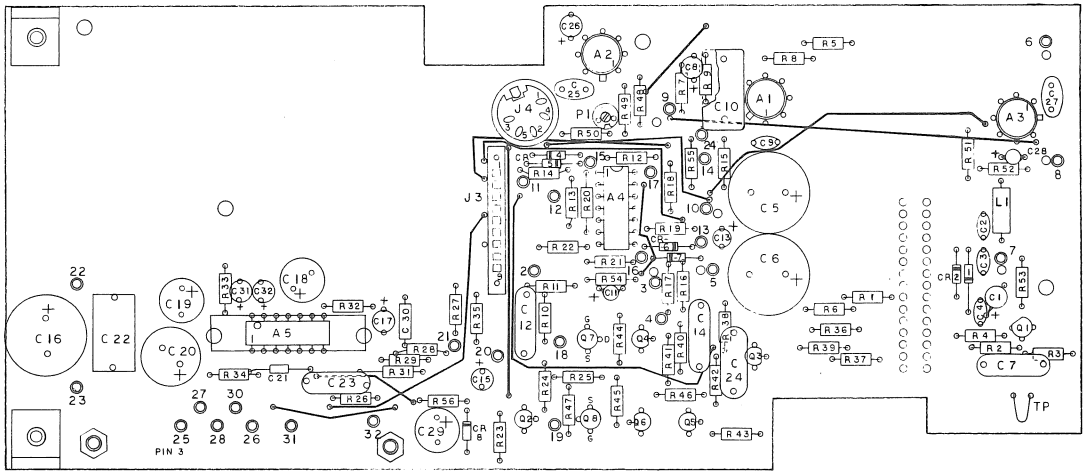
MEDSONICS INC.

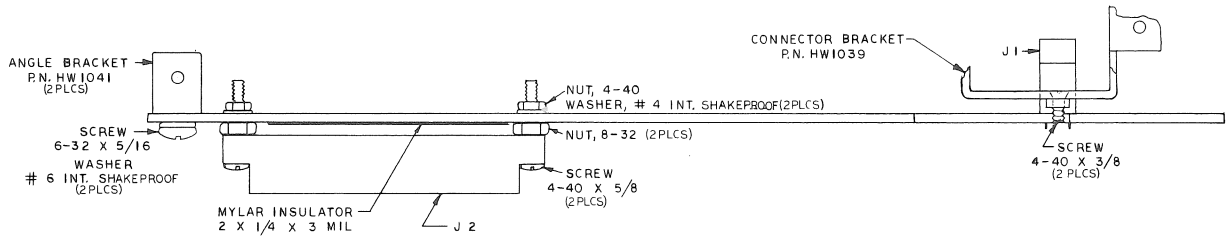
SCALE:	APPROVED BY: Jwolk	DRAWN BY KAKUK	
DATE: 1-23-76		REVISED H-KLOSE	
2-0015	D-9	AMPLIFIER SCHEMATIC	
NEXT ASSY.	USED ON		
APPLICATION		DRAWING NUMBER 5-0017	E

REVISIONS				
ECO	REV		DATE	APPROVED
130	A	REVISE Q2,3,4,5 & 6	3-8-77	

STAKED TERMINAL DESIGNATIONS:
(WIRE COLOR CODE)

1.
2. WHT
3.
4. WHT/YEL
5.
6.
7.
8.
9.
10.
11. COAX
12. COAX GRD.
13. COAX
14. COAX GRD. (BLK. EXT.)
15. GRY
16. BLU
17. GRN
18. GRN (NOT SAME AS 17)
19. YEL
20. WHT/GRN
21. WHT/ORN
22. BRN
23. BLK
24. BLK/WHT
25. ORN
26. YEL
27. WHT/RED
28. RED
29.
30. WHT/YEL
31. BRN
32. BLK (2WIRES)





NOTES:
1. J1 OMITTED IN TOP VIEW FOR CLARITY.
2. ALL JUMPERS TO BE 24 GA. BUSS WIRE WITH 22GA. TEFLON SLEEVING.
3. INSTALL J3 WITH KEY PIN FACING C12.
4. TP 24 TO BE ABOUT ONE INCH HIGH.

REF:
1. SCHEMATIC 5-0017
2. PC LAYOUT 9-0005
3. ARTWORK 7-0017
4. BOM 12-0015

11-0024	D9
NEXT ASSY.	USED ON
APPLICATION	

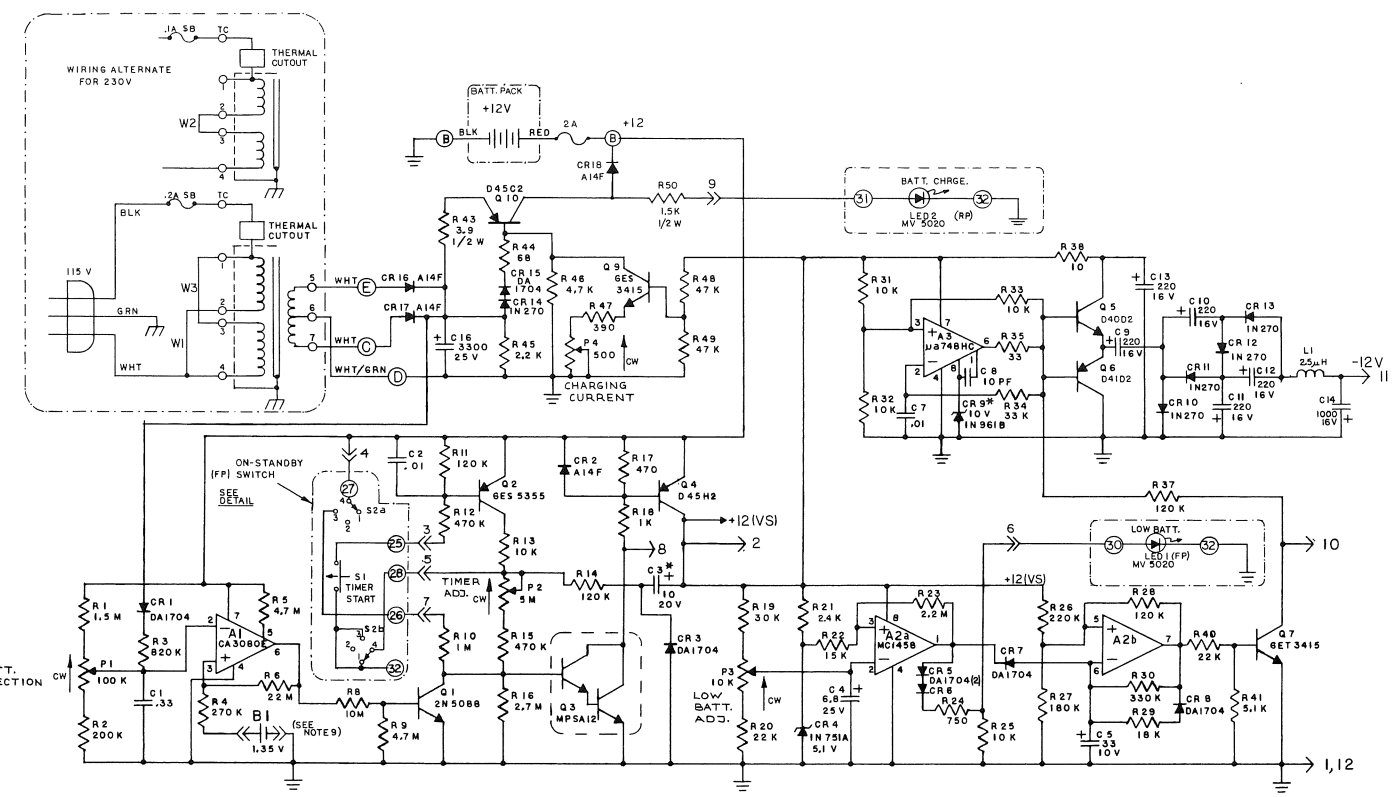
MEDSONICS INC

SCALE: 2:1	APPROVED BY:	DRAWN BY KAKUK
DATE: 2-27-76		REVISED KLOSE

AMPLIFIER P.C. ASSY.

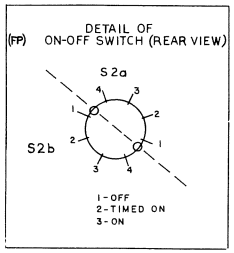
DRAWING NUMBER 2-0015 A

REVISIONS					
S/N	ECN	LTR	DESCRIPTION	DATE	APPROVED
		A	REDRAWN	3-18-76	
N66	50	B	PWR RECP & XFMR CHANGE.	6-9-76	
	52	C	R21 NOW 2.4 KΩ WAS 4.7 KΩ	11-11-76	
N91	73	D	REVISED D5,Q6(GET 3415,GET 5355) NOW D40D2, D41D2; REV. C9,10,11,12, 13(100μ, 16V) NOW 220 16V; REMOVE R36 ADD L1 2.5μH TOROID	11-11-76	
	189	E	UPDATE AS PER ECO, ADD 2A FUSE.	7-6-77	
	130	F	SEE BODY OF ECO	7-7-77	



NOTES: (UNLESS SPECIFIED OTHERWISE)

1. ALL RESISTOR VALUES ARE IN OHMS, ± 5%, 1/4 W.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS.
3. AN ASTERISK DESIGNATES A FACTORY SELECTED PART.
4. ITEMS ENCLOSED IN — · — · — LINES NOT ON PC BRD.
5. (FP) FRONT PANEL; (RP) REAR PANEL.
6. STAKED LUGS 25-28,32 LOCATED ON AMP. PC.
7. POINTS DESIGNATED ◯ ARE STAKED TERMINALS.
8. "VS" INDICATES VOLTAGE SWITCHED.
9. ⟩⟩— INDICATES PC CONNECTOR. (EXEPT B1 WHICH ARE CAMBION PINS.)



REFERENCE DESIGNATIONS

LAST USED	NOT USED
R50	R7, 39, 42
C16	C6
CR18	
Q10	Q8
A3	
P4	
B2	
Ⓔ	
J2	
LED 2	
⟩⟩12	

MEDSONICS INC

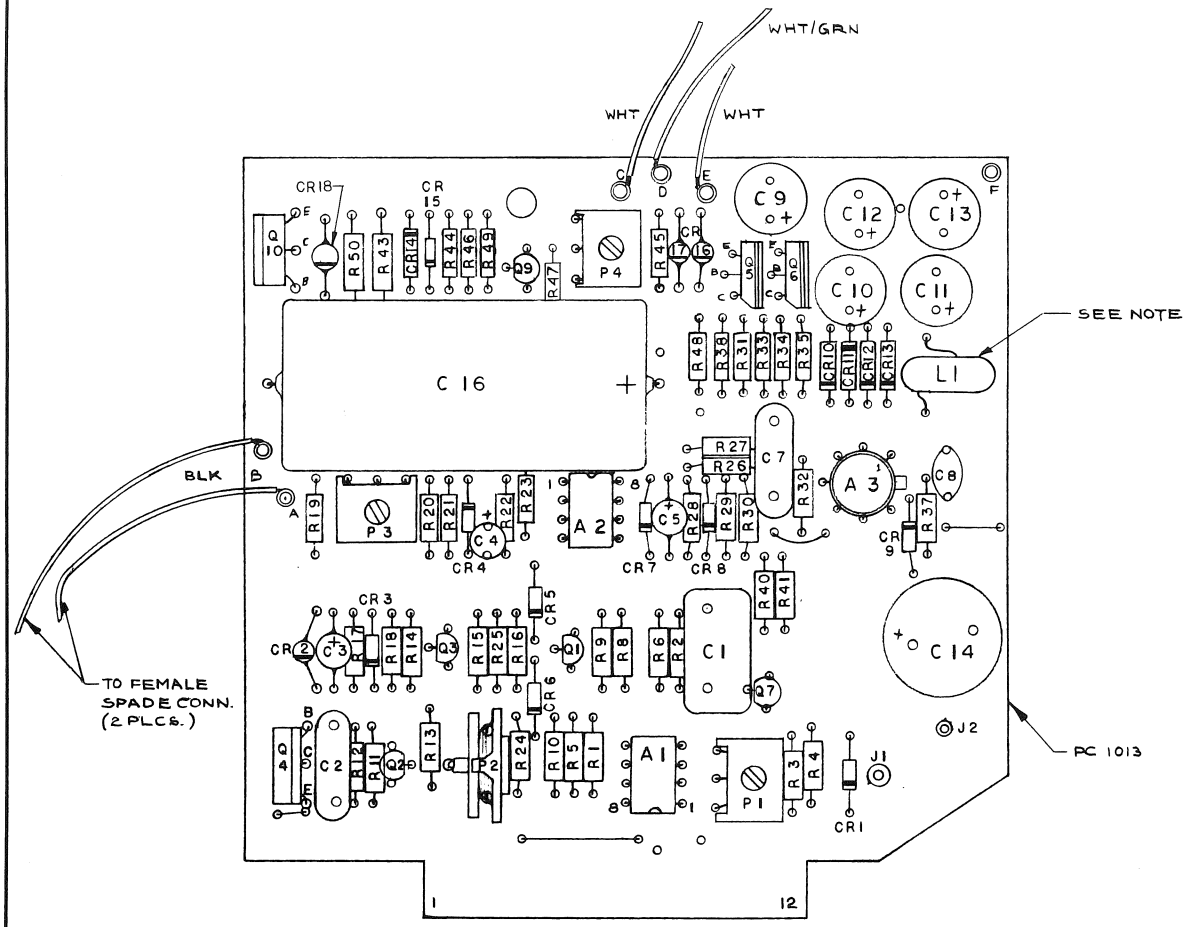
SCALE:	APPROVED BY: Jwelk
DATE: 3-18-76	DRAWN BY KAKUK
	REVISED H.K.

POWER SUPPLY SCHEMATIC

2-0014 D9
NEXT ASSY. USED ON
APPLICATION

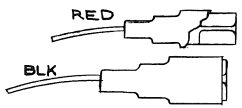
DRAWING NUMBER 5-0016 REV F

REV	ECO	DESCRIPTION	DATE	APPROVED
A	73	REVISE Q5,Q6; REMOVE R36, INSTALL L1	11-12-76	
B	130	REVISE Q2, Q7, Q9	3-8-77	
C	134	RELOCATE R47, TERMINAL A	3-24-77	



NOTE:
1. USE RTV AS REQ. TO SECURE L1 IN POSITION

REF:
1. SCHEMATIC 5-0016
2. BOM 12-0014
3. ARTWORK 7-0016
4. PC. LAYOUT 9-0004



FEMALE SPADE CONN. IN 1/4"x1" SHRINK TUBING. (2 REQ.)

11-0024	D9
NEXT ASSY.	USED ON
APPLICATION	

MEDSONICS INC

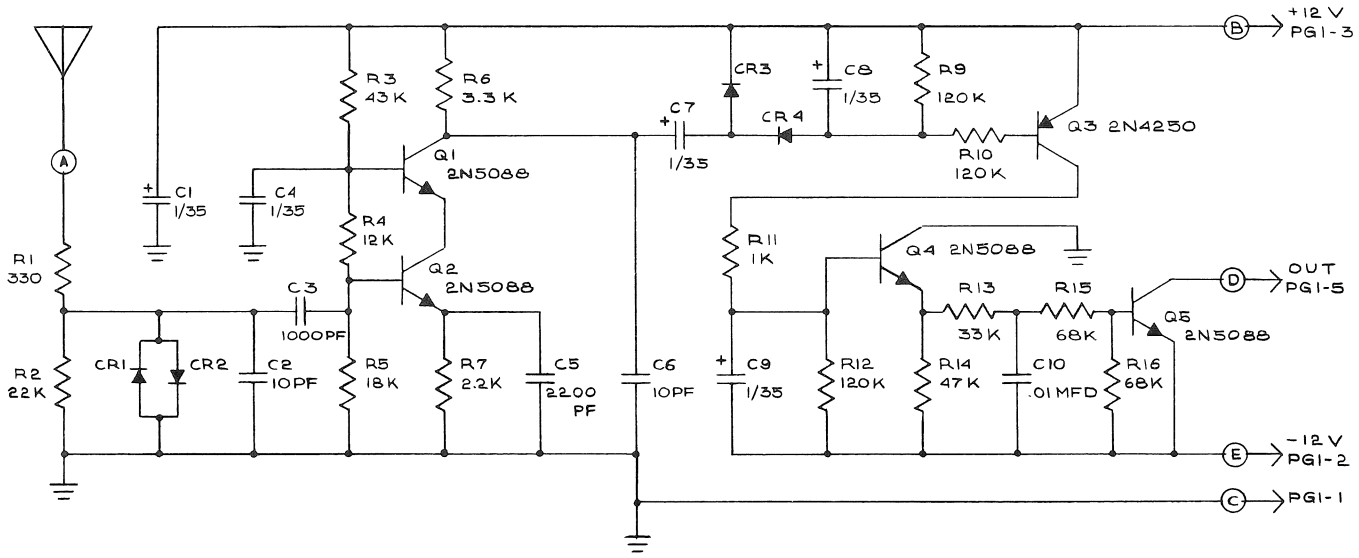
SCALE: 2:1	APPROVED BY:	DRAWN BY KAKUK
DATE: 1-30-76		REVISED KLOSE

POWER SUPPLY, PC ASSY.

DRAWING NUMBER 2-0014

REV. C

REVISIONS				
ECO	REV	DESCRIPTION	DATE	APPROVED
96	A	REDRAWN	12-2-76	



NOTES: (UNLESS OTHERWISE NOTED)
1. ALL RESISTORS ARE CARB. COMP. 1/4 W. 5%
2. C1,4,7,8,9 ARE TANTALUMS
3. ◯ DESIGNATS STAKED LUGS ON PC BOARD
4. CR1,2 ARE IN1704 (REF.)
5. CR3,4 ARE IN270 (REF.)

REF. DESIGNATIONS:

LAST USED	NOT USED
R16	R8
C10	PG1-4

2-0018	D9/901
NEXT ASSY.	USED ON
APPLICATION	

MEDSONICS INC.

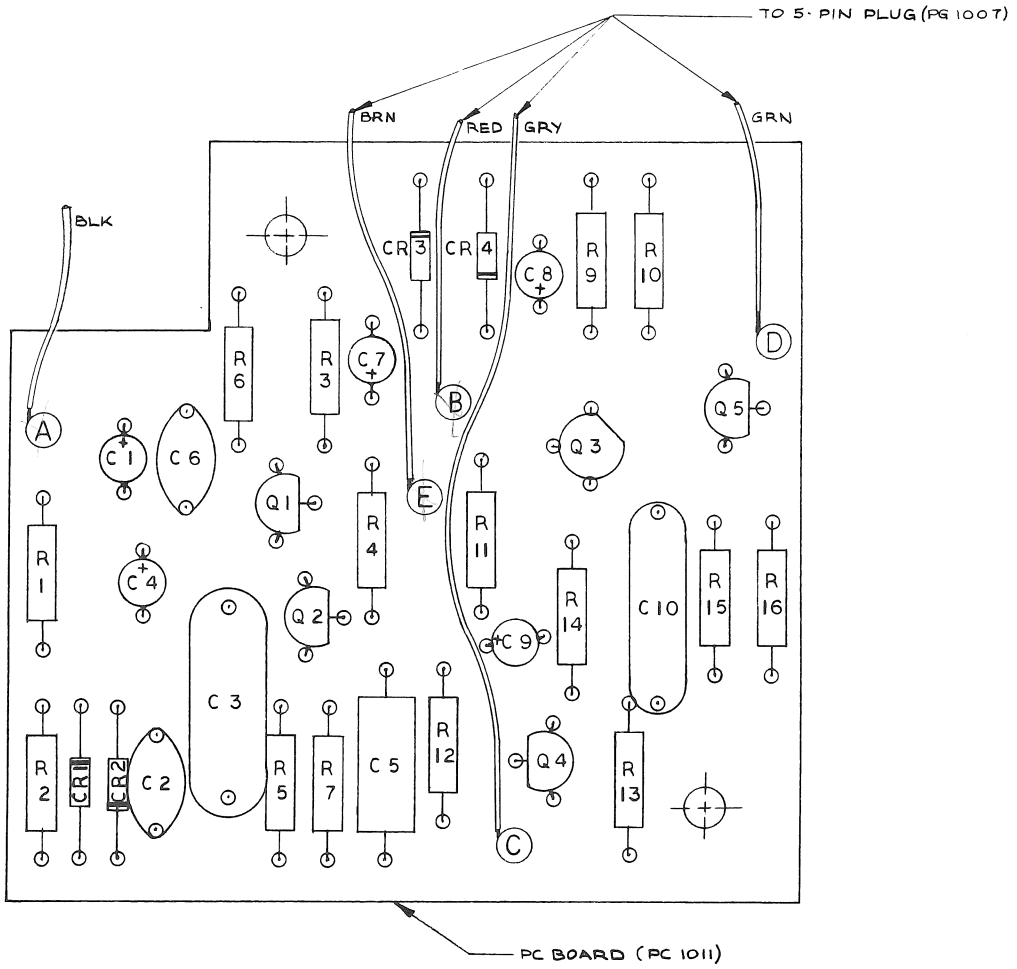
SCALE:	APPROVED BY: RJM RSW	DRAWN BY H. KLOSE
DATE: 12-2-1976		REVISED

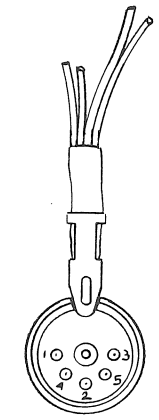
ELECTROCAUTERY OPT. SCHEM.

DRAWING NUMBER 5-0018

REV. A

REVISIONS				
ECO	REV	DESCRIPTION	DATE	APPROVED





5-PIN PLUG
(PG 1007)
(SHOWN 2× SIZE)

PIN DESIGNATION
1. GRAY
2. BROWN −12V
3. RED +12V
4. NOT USED
5. GREEN → Advance +

REF:
1. SCHEMATIC 5-0018
2. BOM 12-0018
3. ARTWORK 7-0023

12-0062	09/901
NEXT ASSY.	USED ON
APPLICATION	

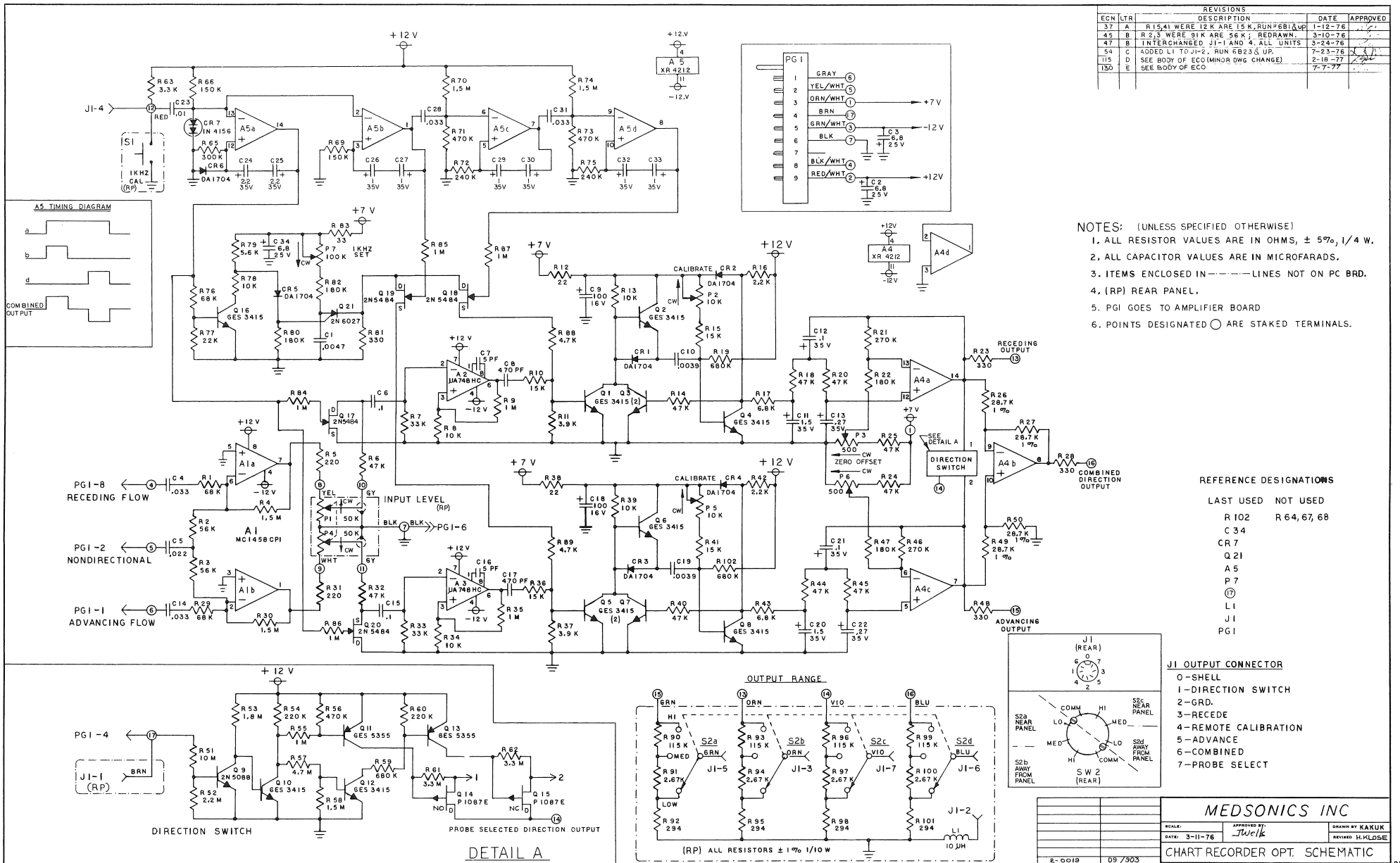
MEDSONICS INC

SCALE: 4:1 | APPROVED BY: | DRAWN BY KLOSE

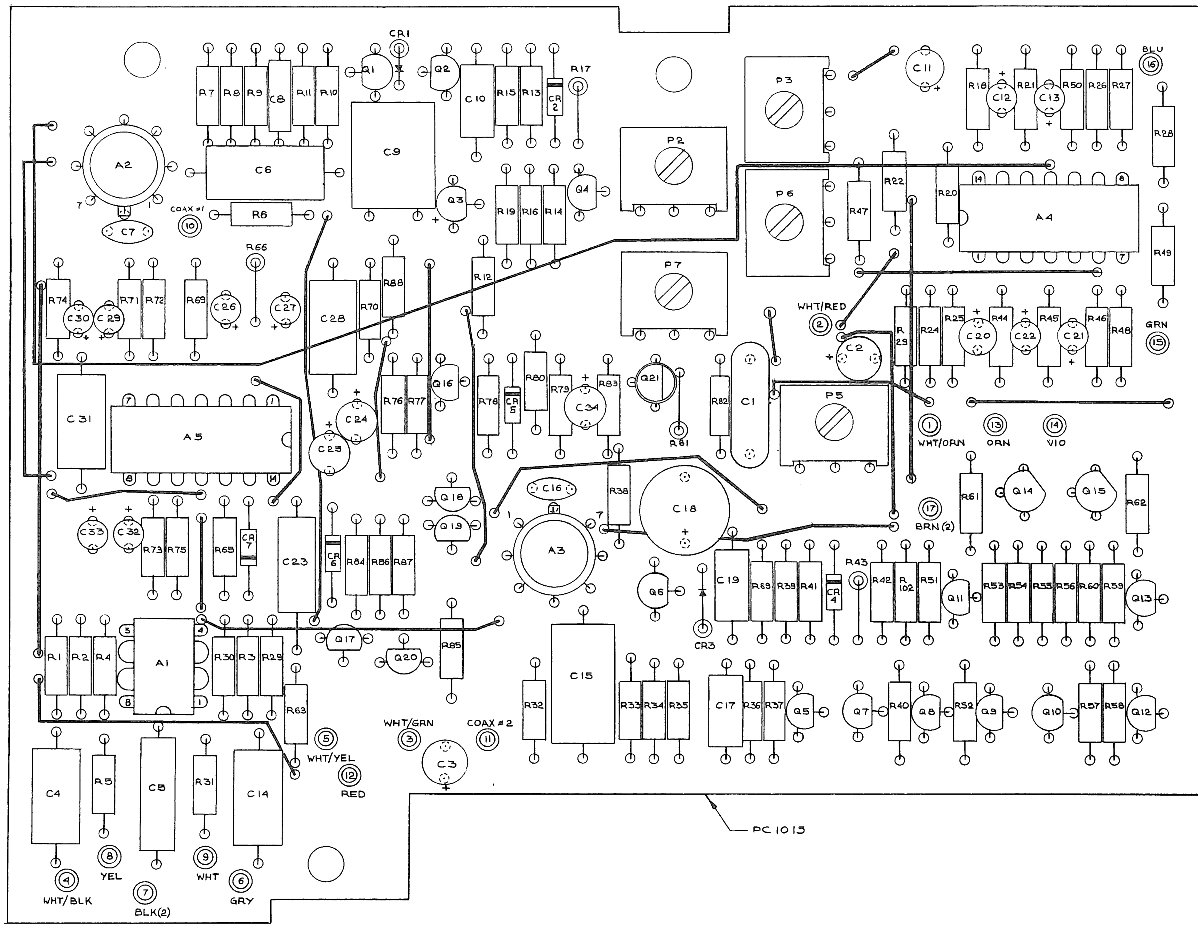
DATE: 1-28-76 | REVISED

ELECTROCAUTERY PC. ASSY.

DRAWING NUMBER 2-0018


REVISIONS
ECN LTR DESCRIPTION DATE APPROVED
37 A R15,41 WERE 12 K ARE 15 K, RUN #6818 UP 1-12-76
45 B R 2,3 WERE 91K ARE 56K; REDRAWN. 3-10-76
47 B INTERCHANGED J1-1 AND 4, ALL UNITS 3-24-76
54 C ADDED L1 TO J1-2, RUN 6823 & UP. 7-23-76
115 D SEE BODY OF ECO (MINOR DWG CHANGE) 2-18-77
130 E SEE BODY OF ECO 7-7-77
NOTES: (UNLESS SPECIFIED OTHERWISE)
1. ALL RESISTOR VALUES ARE IN OHMS, ± 5%, 1/4 W.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS.
3. ITEMS ENCLOSED IN - - - - LINES NOT ON PC BRD.
4. (RP) REAR PANEL.
5. PG1 GOES TO AMPLIFIER BOARD
6. POINTS DESIGNATED ◯ ARE STAKED TERMINALS.
A5 TIMING DIAGRAM
COMBINED OUTPUT
PG1-8 RECEDING FLOW
PG1-2 NONDIRECTIONAL
PG1-1 ADVANCING FLOW
INPUT LEVEL (RP)
ZERO OFFSET
DIRECTION SWITCH
RECEDING OUTPUT
ADVANCING OUTPUT
COMBINED DIRECTION OUTPUT
REFERENCE DESIGNATIONS
LAST USED NOT USED
R 102 R 64, 67, 68
C 34
CR 7
Q 21
A 5
P 7
17
L1
J1
PG1
J1 OUTPUT CONNECTOR
0-SHELL
1-DIRECTION SWITCH
2-GRD.
3-RECEDE
4-REMOTE CALIBRATION
5-ADVANCE
6-COMBINED
7-PROBE SELECT
PG1-4
DIRECTION SWITCH
PROBE SELECTED DIRECTION OUTPUT
DETAIL A
OUTPUT RANGE
(RP) ALL RESISTORS ± 1% 1/10W
MEDSONICS INC
CHART RECORDER OPT. SCHEMATIC
DRAWING NUMBER 5-0022
REV E
DRAWN BY KAKUK
REVISED H.KLOSE
DATE 3-11-76
8-0019 D9/303
NEXT ASSY. USED ON
APPLICATION -

ECO	REV	DESCRIPTION	DATE	APPROVED
130	A	REVISE Q1,2,3,4,5,6,7,8,10,11,12,13,16	3-8-77	[illegible]



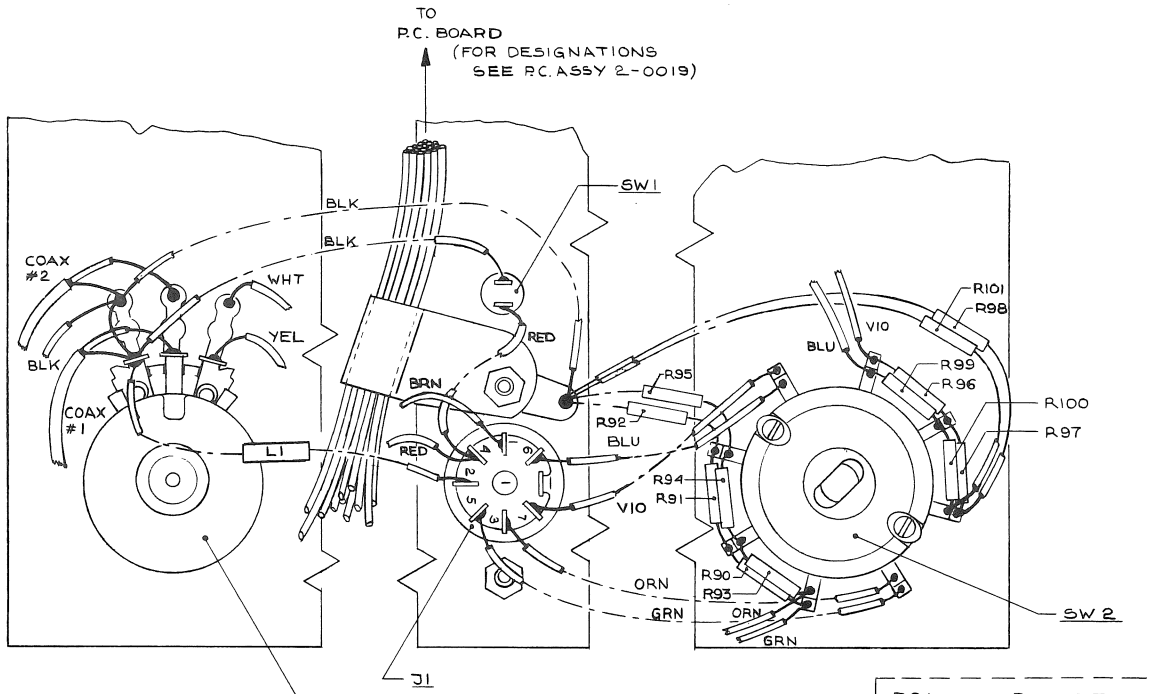
NOTE:
1. —/— DESIGNATES JUMPER WIRES.
2. ◎ DESIGNATES STAKED LUGS.

REF:
1. SCHEMATIC 5-0022
2. BOM 12-0019
3. ARTWORK 7-0020
4. PC LAYOUT 9-0009
5. FAB DWG 3-0114

12-0066	D3/903	
NEXT ASSY.	USED ON	
APPLICATION		

MEDSONICS INC.
SCALE: 4X APPROVED BY: DRAWN BY KLOSE
DATE: 12-7-76 REVISED
CHART RECORDER OPT. PC. ASSY.
DRAWING NUMBER 2-0019 A

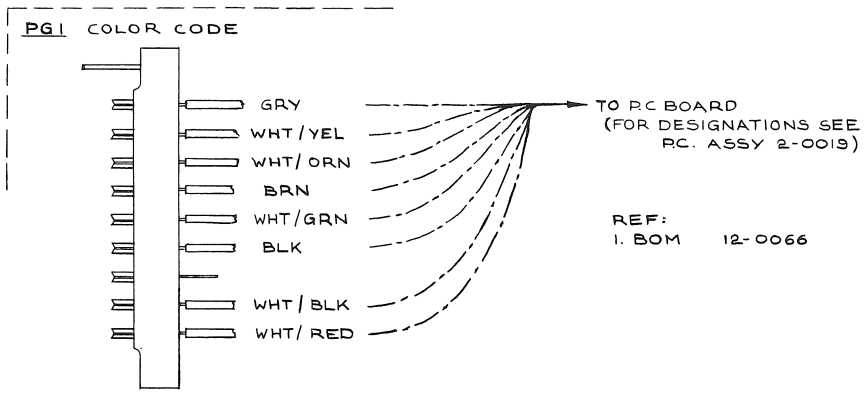
REVISIONS				
ECO	REV	DESCRIPTION	DATE	APPROVED
54	A	ADD L1 TO J1; RUN 6B23 AND UP	7-23-76	



NOTES:
1. COAX #1 DESIGNATED BY CLEAR BAND
   COAX #2 DESIGNATED BY BLACK BAND
2. WIRE - JUMPER BETWEEN P1 & P4
   AT COAX SHIELD TERMINALS.
3. USE #22 TEFLON SLEEVING ON L1;
   R98 & R101.
4. ALL WIRES NOT SPECIFIED AS TO
   DESIGNATION TO GO INTO HARNESS.

REF. WIRE DESIGNATIONS:

P1 (TOP):	P4 (BOTTOM):
COAX #1	COAX #2
L1	WHT
YEL	BLK (2)
BLK	



REF:
1. BOM 12-0066

12-0063	D9/903
NEXT ASSY.	USED ON
APPLICATION	

MEDSONICS INC.

SCALE:	APPROVED BY:	DRAWN BY KLOSE
DATE: 12-8-76		REVISED

HARNESS ASSY.

DRAWING NUMBER 2-0066 A

D9 PARTS LIST

CHASSIS

DESIGNATION	DESCRIPTION	MEDSONICS PART NUMBER
	Antenna	HW1050
	Antenna Clip	HW1051
	Battery Pack	AS1037
	Connector, Power	PG1006
	Cover, Top	HW1085
	Cord, Power	AS1081
F1	Fuse 0.2A	F1002
F2	Fuse 2A	F1005
	Fuse Holder	HW1035
	Fuse Holder (In Line)	HW1124
	Handle	HW1033
	Hinge	HW1055
	Hose Clamp	HW1052
LED-1,2	Indicator, Charging, Low Battery	LED5020
J1	Jack, Chart Output	J1008
J7,9	Jack, Headset	J1018
J4,5,8	Jack, Tape Recorder	J1003
	Knob, Output	HW1042
	Knob, On-Off, Volume	HW1038
	Panel, Front	HW1081
	Panel, Rear	HW1082
	Panel, Side (Handle)	HW1064
	Panel, Side (Speaker)	HW1063
	Potentiometer (Volume)	P50K-1
	Red Button (For S1)	HW1001
	Rubber Foot (Bottom)	HW1056
	Rubber Foot (Side)	HW1010
	Rubber Gasket (PG1006)	HW1131
S1	Switch (Start)	SW1001
S2	Switch (On-Off)	SW1002
S3	Switch (Toggle)	SW1003
	Speaker	HW1037
	Tray	PL1019
	Transformer	T1001

POWER SUPPLY

DESIGNATION	DESCRIPTION	MEDSONICS PART NUMBER
A1	Integrated Circuit CA3080E	A3080
A2	Integrated Circuit MC1458	A1458
A3	Integrated Circuit uA748HC	A748
B1	Battery (Reference)	B1001
C3	Capacitor (Selected)	C10UF20-2
CR1,3,5-8,15	Diode DA1704	CR1704
CR2,16-18	Diode A14F	CR14
CR4	Diode 1N751A	CR751
CR9	Diode (Selected)	CR961-2
CR10-14	Diode 1N270	CR270
P1	Potentiometer 100K	P100K-2
P2	Potentiometer 5M	P5M-1
P3	Potentiometer 10K	P10K-1
P4	Potentiometer 500	P500-2
Q1	Transistor 2N5088	TR5088
Q2	Transistor GES5355	TR5355
Q3	Transistor MPSA12	TRMPSA12
Q4	Transistor D45H2	TRD45H2
Q5	Transistor D40D2	TRD40D-2
Q6	Transistor D41D2	TRD41D2
Q7,9	Transistor GES3415	TR3415
Q10	Transistor D45C2	TRD45C2

AMPLIFIER

DESIGNATION	DESCRIPTION	MEDSONICS PART NUMBER
A1,3	Integrated Circuit uA748HC	A748
A2	Integrated Circuit LM305AH	A305
A4	Integrated Circuit XR4212	A4212
A5	Integrated Circuit uA706BPC	A706
CR1,2,8	Diode DA1704	CR1704
CR4-7	Diode 1N4157	CR4157
J1	Jack, Probe	J1006
J2	Jack, Power Supply	J1011
J3	Jack, 903 Option	J1012
J4	Jack, 901 Option	J1007
J5,6,8	Jack, Tape out	J1003
J7,9	Jack, Headphone	J1018
S1	Switch (Directional)	SW1003
	Speaker	HW1037
Q1	Transistor 2N4250	TR4250
Q2,3,5	Transistor GES3415	TR3415
Q4,6	Transistor GES5355	TR5355
Q7,8	Transistor P1087E	TR1087E

OPTION 901

DESIGNATION	DESCRIPTION	MEDSONICS PART NUMBER
CR1,2	Diode 1N1704	CR1704
CR3,4	Diode 1N270	CR270
PG-1	Plug, 5-pin	PG1007
Q1,2,4,5	Transistor 2N5088	TR5088
Q3	Transistor 2N4250	TR4250

OPTION 903

A1	Integrated Circuit MC1458CP1	A1458
A2,3	Integrated Circuit uA748HC	A748
A4,5	Integrated Circuit XR4212	A4212
CR1,6	Diode DA1704	CR1704
CR7	Diode 1N4156	CR4156
J1	Jack, 7-pin	J1008
PG1	Connector, 9-pin	J1014
P1,4	Potentiometer 50K ohm (dual)	P-50K-1
P2,5	Potentiometer 10K ohm	P-10K-1
P3,6	Potentiometer 500 ohm	P-500-1
P7	Potentiometer 100K ohm	P-100K-2
Q1-8	Transistor GES3415	TR3415
Q9	Transistor 2N5088	TR5088
Q10,12,16	Transistor GES3415	TR3415
Q11,13	Transistor GES5355	TR5355
Q14,15	Transistor P1087E	TR1087
Q17-20	Transistor 2N5484	TR5484
Q21	Transistor 2N6027	TR6027
S1	Switch, Push Button	SW1001
S2	Switch, (Hi-Med-Low)	SW1004