Audio Menu

Operation Manual

Covers Welch Allyn TM262 Auto Tymp

Grason-Stadler, Inc.

GSI 38 Service Manual

GSI™
Grason-Stadler
A Welch Allyn Company

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WARRANTY

We, Grason-Stadler, Inc. warrant that this product is free from defects in material and workmanship and, when properly installed and used, will perform in accordance with applicable specifications. If within one year after original shipment it is found not to meet this standard, it will be repaired, or at our option, replaced at no charge except for transportation costs, when returned to an authorized Grason-Stadler service facility. If field service is requested, there will be no charge for labor or material; however, there will be a charge for travel expense at the service center's current rate.

NOTE

Changes in the product not approved in writing by Grason-Stadler shall void this warranty. Grason-Stadler shall not be liable for any indirect, special or consequential damages, even if notice has been given in advance of the possibility of such damages.

THIS WARRANTY IS IN LIEU OF ANY OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO, ANY ***IMPLIED WARRANTY OF MERCHANTABILITY OF FITNESS FOR A PARTICULAR PURPOSE.***

WARNING

The GSI ***38*** is designed to be used with a hospital grade outlet. Injury to personnel or damage to equipment can result when a three-prong to two-prong adapter is connected between the GSI 38 power plug and an AC outlet or extension cord. Additionally, those GSI 38 Auto Tymps that are equipped with power transformers, use a specific transformer (8000-0260, 800-0261, or 8000-0262) which should not be interchanged with any other transformer or supply.

The GSI 38 is a specifically calibrated device and the periodic service and adjustments which the instrument may require should be done only by an authorized Grason-Stadler service technician.

PRODUCT SPECIFICATION

GSI 38 PRODUCT SPECIFICATIONS (RI)

CATALOG LISTINGS

1738-9700	GSI 38 Auto Tymp, V1, USA	Tymp + Ipsi Reflex
1738-9705	GSI 38 Auto Tymp, V1, Export	
1738-9706	GSI 38 Auto Tymp, V1, Export, 100V	
1738-9708	GSI 38 Auto Tymp, V1, Export, 240V	
1738-9710	GSI 38 Auto Tymp, V2, USA	Tymp + Ipsi/Contra Reflex
1738-9715	GSI 38 Auto Tymp, V2, Export	
1738-9716	GSI 38 Auto Tymp, V2, Export, 100V	
1738-9716	GSI 38 Auto Tymp, V2, Export, 240V	
1738-9720	GSI 38 Auto Tymp, V3, USA	Tymp +Ipsi/Contra + Aud.
1738-9725	GSI 38 Auto Tymp, V3, Export	
1738-9726	GSI 38 Auto Tymp, V3, Export, 100V	
1738-9728	GSI 38 Auto Tymp, V3, Export, 240V	
1738-9730	GSI 38 Auto Tymp, V4, USA	Tymp + Ipsi + Aud.
1738-9735	GSI 38 Auto Tymp, V4, Export	
1738-9736	GSI 38 Auto Tymp, V4, Export, 100V	
1738-9738	GSI 38 Auto Tymp, V4, Export, 240V	

DESCRIPTION

The GSI 38 is an automatic acoustic admittance and reflex measurement system with a screening audiometer. The instrument consists of a probe and a desk-to-base interconnected via a cable. It is a combination of GSI 17 and GSI 37 plus acoustic reflex testing capabilities, both ipsilateral and contralateral. The audiometric portion is a single channel pure tone audiometer, with a pair of air-conduction earphones. Int he tympanometric mode, the measurement of acoustic admittance is corrected for the acoustic admittance of the external auditory meatius, and the ear canal volume is displayed. Also a test cavity assembly is provided.

INSTRUCTION MANUAL

The GSI 38 is supplied with an instruction manual which meets the requirements of the applicable standards.

STANDARDS

ANSI S3.39 - 1987	Aural Acoustic Impedance and Admittance Standard Type 3 (Middle Ear)
ANSI S3.6 - 1989	Audiometric Standard Type 4 (Audiometer)
IEC 1027-l 991	Aural Acoustic Impedance/Admittance Type 3
ISO 645	Type 4 (Audiometer)
IEC 601-l	Medical Electrical Equipment General Requirements For Safety

Designed to Meet International Standards Organization requirements fo Electro-Magnetic Compatibility and Safety

ACOUSTIC ADMITTANCE MEASUREMENT SYSTEM - AUTO TYMP

Probe Signals

Frequency: 226 Hz, +/- 3%

Sound Pressure Level: 85.5 dB SPL, +/- 2.0 dB, Measured in a 2.0 cm^3 coupler (ANSI Spec 90 dB SPL Max)

Harmonic Distortion: < 5%

Acoustic Admittance Range

0.0 to 1.5 cm^3 or 0.0 to 3.0 cm^3 - selected automatically for compensated tympanogram.

0.2 to 6.0 cm^3 - ECV/cavity limits for initiating pressurization (starting test)

The 0.2 to 6.0 cm^3 is the sum of the ear canal volume and the middle ear admittance.

(Full pressure sweep for 6 cc up to 7000 ft. altitude with no leak)

Acoustic Admittance Accuracy +/- 5% or +/- 0.1 cm^3 whichever is greater

Tympanogram Gradient: Pressure interval at 50% of compensated admittance peak.

Pneumatic Svstem

Pressure Range (corrected for altitude): + 200 to - 400 dapa (1 dapa = 1.02 mm water)

Pressure sweeps to at least -100 dapa if tymps complete otherwise sweeps to -400 daPa

Pressure Accuracv: +/- 15% or +/- 10 daPa whichever is greater.

Rate of Sweep: 600 daPa/sec - for tymp slopes of <0.2 ml per 24 daPa

200 daPa/sec - for tymp slopes =,> 0.2 ml per 24 daPa

Test Time

Approximately 1 sec (high relative tymp will take longer).

Direction of Sweep: Positive to Negative

ACOUSTIC - REFLEX ACTIVATING STIMULUS SYSTEM

Stimulus Frequencies: 500, 1000, 2000, and 4000 Hz

Stimulus Freauencv Accuracv: +/- 3%

Stimulus Total Harmonic Distortion: <5% measured acoustically except at 4 khz where speaker driving signal is measured

Stimulus Output Levels:

IPSI:	500, 4000 Hz	80, 90, 100 dB HL
	1000, 2000 Hz	85, 95, 105 HL

(Time multiplexed with probe tone, 106 ms On/53 ms Off Cycle)

CONTRA: 500, 1000, 2000 and 4000 HZ 90, 100, 110 db HL

(Steady tone, non multiplexed)
Equivalent Hearing Threshold Levels, in DB SPL

Transducer Type	Stimulus Tone			
Frequency (HZ)	500	1000	2000	4000
Contra (Insert Phone) (in HA-l Coupler)	6.0	1.0	6.0	3.0
IPSI (in HA-l Coupler)	7.0	4.5	2.0	3.5
Contra (Insert Phone) (in IEC 711 Coupler)	9.5	5.5	11.5	15.0

Rise/Fall Time: 5 to 10 msec

Pressure: Automatically set to the pressure of peak compliance - 20 daPa.

Reflex Determination: Minimum compliance change -- 0.05 cm^3

Test Time: Approximately 2 -12 seconds, depending on number of test frequency selections and if tymp only test. (four maximum)

Probe LED indicators:

Green - blinking: Ready to test
Green - steady: Test in progress
Orange - steady: leak or other error
Yellow - steady: Occlusion

AUDIOMETER

Test **Stimulus**

Pure Tone Specifications: A pure tone is the only stimulus source for this audiometer.

Discrete Frequencies: 125, 250, 500. 750, 1000, 1500, 2000, 3000, 4000, 6000 and 8000 Hz.

Equivalent Hearing Threshold Levels, in dB SPL for TDH 39 Earphones:

Frequency (Hz)	125	250	500	750	1000	1500
Reference Threshold (dB)	45.0	25.5	11.5	7.5	7.0	6.5
Frequency (Hz)	2000	3000	4000	6000	8000	
Reference Threshold (dB)	9.0	10.0	9.5	15.5	13.0	

Frequency Accuracy: +/- 3%

Total Harmonic Distortion (From 125Hz to 3000 Hz, measured Acoustically at the Maximum HL, measured electrically at 4000 & 6000 Hz) < 3%.

Output Hearing Level Control

Calibrated in dB HL.

Measured in increments of 5 dB

Ranges:		
	125 Hz	-10 to 50 dB HL
	500 to 6000 Hz	-10 to 90 dB HL
	250 and 8000 Hz	-10 to 70 dB HL

Additionally a "+10 dB" Extended Range switch, which extends the Maximum HL at all frequencies by IO dB.

Accuracy of all settings of Hearing Level control:

125 to 4000 Hz	+/- 3 dB
6000 to 8000 Hz	+/- 5 dB

Signal to Noise ratio (in 1/3 Octave): >70 dB or less than -10 dB HL
(for levels less than 60 dB HL)

Tone Switch: This electronic switch turns the stimulus signal on/off with minimal audible distortion.

Modes:		
	Normal state:	Stimulus Off
	Activated state:	Stimulus On

Rise/Fall Time: 20-50 msec
Measured at the -1 dB and -20 dB points on the signal envelope.

On/Off Ratio: With the tone switch off, the output will be at least -10 dB below standard reference equivalent threshold with HL setting of 60 dB.

Above 60 dB HL setting: >70 dB

Cross Channel Leakage: At HL settings of 70 dB or greater, the unwanted signal in the non test earphone shall be at least 70 dB below the tone in the test earphone.

Stimulus Signals

Continuous signals

Continuous FM

Pulsed

Signal Format

Continuous -- Signal steady as long as present bar is depressed

Pulsed

Pulse rate: 2.5 pulses/sec

Duty Cycle: 50%

Rise/Fall Time: 20 - 50 msec

On/Off Ration (between pulses): > 20 dB

Frequency Modulation

FM Rate: 5Hz

FM deviation: +/- 5%

Transducers

Headset: TDH-39 Earphones with 60 ohm impedance

Insert Phone: Audiovox Model SM-N Earphone, Eartip, Eartip adapter and cord.

Output impedances and voltages on back panel

Left Phone 130 ohm 2.5 volts rms max open circuit
Right Phone 130 ohm 2.5 volts rms max open circuit in Audiometer mode
Insert Phone <1 ohm 2.5 volts rms max open circuit
Subject response input 47 kohm pull up to 5 volts

DESK-TOP FRONT PANEL CONTROLS AND BACK PANEL CONNECTORS

FRONT PANEL CONTROLS		
CONTROLS	TYMP & REFLEX	AUDIOMETER
Mode	Tymp Tymp & Reflex Program	Audiometer
Stimulus	Ipsi, Contra or lpsi & Contra	Pulse, Steady or FM
Frequencies	500, 1K, 2K or 4KHz	Frequency Up, Down 250, 500,....or 8KHz
Intensity	Autoset	Rotary Knob (numeric) dBHL
Tone on Stimulus	Automatically controlled	Present Press to turn on
Extended Range	N/A	+ 10 dB
Left/Right	L or R (uses R phone for contra)	L or R
Recall or Page Memory Scroll	Page (scrolls through screens)	
Clear	M- Erase Screen M- Erase All	M- Erase Screen M- Erase All
Program Mode	Save (saves program state)	Save
Print	Print Screen Print All	Print Screen Print All

Paper Advance (Press to advance paper, or abort print during printing)

Power Switch --- Power On Switch on Back Panel Green indicator light on Front panel.

Subject Response --- Subject Response Indicator on LCD screen

Display

The display consists of an LCD panel which will display alpha-numeric, icons and graphics (240 X 64 pixels). Items displayed are:

- Frequencies (alpha-numeric) and Intensity (alpha-numeric) in dBHL
- Tympanogram (graphics)
- Ear Canal Volume (alpha-numeric)
- Tymp Peak-Admittance (numeric)
- Gradient (alpha-numeric)
- Tymp Peak-Pressure (numeric)
- Left/Right Ear (symbol)
- Memory Ml to M8
- IPSI/CONTRA (alpha-numeric)
- Reflex Tracing (graphics)
- Reflex with dBHL/No Reflex (alpha-numeric)
- Altitude calibration or sea level calibration (icon - only in altitude calibration mode.
- Generic Error (Error Code)
- Audiogram (dBHL, Frequencies, cursor on frequency under test) or tabular format.

Back Panel Connectors

- Left/Right Earphone
- Insert Earphone
- Power Cord
- Patient Response Switch

PRINTER

Printer: Used to provide a hardcopy of the test data.

Printed Data Format: Graphical area 3.75" horizontal X 6.75" vertical (Audiogram or Tymp & Reflex for 2 ears), 51 columns/in horizontal and 40 rows /in vertical

Choice of Audiogram or Audiotable: 3 choices of reflex printouts

Printer approximately 1.5 minutes to print three screens Tymp and reflex data for each ear and audiogram for both ears.

POWER

Wallmount power supplies of various types with 5 pin DIN connections are available. Either three prong plugs (grounded) or two prong plugs (ungrounded) are provided depending upon the safety requirements of the country.

OR

The internal power supply, powered by AC line, 50 or 60 Hz via IEC 320 power inlet with fuse and on/off switch on the rear panel, is also available, for the countries where the wallmount power supplies are not available.

Two voltage ranges are provided 200 to 250 V or 90 115 V.

Line Voltage variation	+/- 10 %
Line frequency range	50 - 60 Hz
Line Voltage Current	0.2 amps at 120 V or 0.1 amps at 240 V AC.
Power Consumption	15 watts maximum while printing
Line Frequency variation	+/- 5%

Low voltage input for Wallmount power supplies 10 - 11 V DC 970 mA.
Hi Pot 3000 volts

SUPPLIED ACCESSORIES

VERSION 1	1738-0520	Wall Chart Rolled
	1700-l 030	Ass'y Test Cavity (0.5, 2.0 and 5.0 cc)
	1700-9622	Eartips Package (screening)
	1738-0100	Instruction Manual
	1738-9600	Printer Paper (3 rolls supplied with new unit)
	1738-9610	Kit, Grease, 0 Ring
	(1738-0401	Label Version 1 installed at factory)
VERSION 2	'1738-0520	Wall Chart Rolled
	1700-1030	Ass'y Test Cavity (0.5, 2.0 & 5.0 cc)
	1700-9622	Eartips Package (screening)
	1700-9660	Eartips Package (Contra Phone / Diagnostic)
	1738-0100	Instruction Manual
	1738-9610	Kit, Grease, 0 Ring
	8000-0079	Contra Insert Phone Ass'y
	(1738-0402	Label Version 2 installed at factory)
VERSION 3	1738-0520	Wall Chart Rolled
	1700-1030	Ass'y Test Cavity (0.5, 2.0, & 5.0 cc)
	1700-9622	Eartips Package (Screening)
	1700-9660	Eartips Package (Contra Phone Diagnostic)
	1738-0100	Instruction Manual
	1738-9600	Printer Paper (3 rolls supplied with new unit)
	1738-9610	Kit, Grease, 0 Ring
	8000-0175	Test Headset Assembly (TDH-39)
	8000-0079	Contra Insert Phone Ass'y
	(1738-0403	Label Version 3 installed at factory)

SUPPLIED ACCESSORIES CONT.

VERSION 4	1738-0520	Wall Chart Rolled
	1700-1030	Assembly Test Cavity (0.5, 2.0 & 5.0 cc)
	1700-9622	Eartops Package (Screening)
	1738-0100	Instruction Manual
	1738-9600	Printer Paper (3 rolls supplied with new unit)
	1738-9610	Kit, Grease, 0 Ring
	8000-0175	Test Headset Ass'y (TDH-39)
	(1738-0404	Label Version 4 installed at factory)

OPTIONAL ACCESSORIES

1738-9680	Carrying Case
1738-9620	Dust Cover
4204-0505	Patch Cord (1Ea.)
7874-0156	Subject Response Handswitch
8000-0155	Audiocups
1738-0110	Service Manual
1738-9600	Printer Paper Thermal 4" (10.16 cm wide) 5 rolls
8000-0175	Test Headset Ass'y TDH 39
Consisting of:	8000-O 142 Head band Ass'y
	8000-0046 Earphone, 60 ohm, plastic, TDH 39P (1Ea.)
	4204-0147 Earphone Cord Ass'y
	8000-0143 Earphone Cushion (1Ea.) MX41AR
8000-0079	Contra Insert Phone Ass'y
Consisting of:	4204-0209 Cable, Coaxial 6"
	8000-0037 Earphone, Audiovox, 470 ohm
	8000-0255SVC Eartip Modified
1700-9622	Eartips Package Screening
	Contains: 2 Ea. of 8mm 11mm, 13mm, 15mm, 17mm, 19mm, size Eartips
1700-9600	Eartips Package Contra Phone / Diagnostic
	Contains: 4 Ea. of 7mm Yellow, 8mm Pink, 9mm Blue, 10mm Green, 1 mm, Pink, 12mm Yellow, 13mm Blue, 14mm Green

FUNCTIONAL DESCRIPTION

INTRODUCTION

INSTRUMENT DESCRIPTION

The GSI 38 Auto Tymp is a versatile combination instrument which provides testing capability for tympanometry alone, tympanometry combined with screening acoustic reflex measurements, and screening audiometry. Four different versions are available to meet your individual testing needs. The basic version provides two modes of operation, tympanometry alone and tympanometry plus screening ipsilateral acoustic reflex testing. A second version permits tympanometry alone and tympanometry combined with ipsilateral and contralateral screening acoustic reflex measurements. The third version provides testing capability for all three test modes, i.e., tympanometry alone, tympanometry combined with ipsilateral and contralateral screening acoustic reflex measurements, and screening audiometry. Finally, the fourth version allows tympanometry alone, tympanometry combined with ipsilateral acoustic reflex screening testing and screening audiometry. It is possible to field retrofit versions one, two and four with the full functionality provided with version number three after the time of original purchase.

PROBE INDICATORS

The probe indicators are show in Figure 2-1 and a description follows.

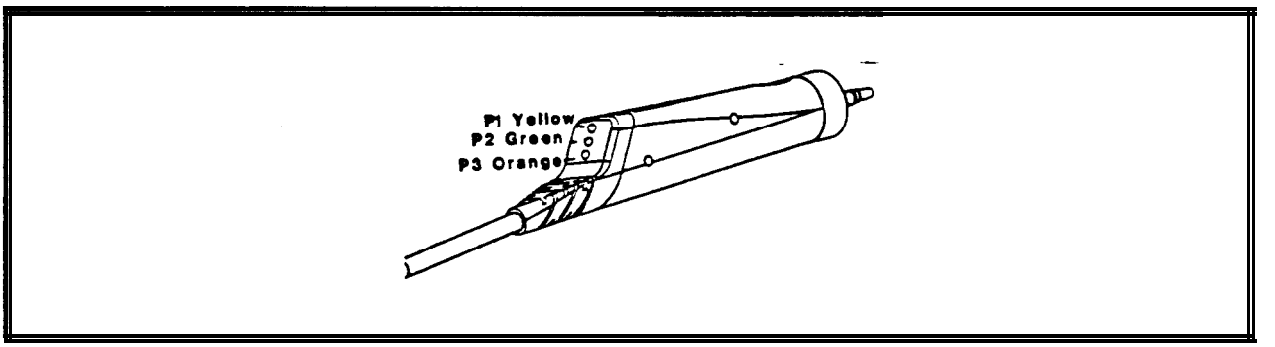


Figure 2-1: Probe Indicators

P1 **Yellow:** the probe is occluded; remove the probe and inspect for cause of occlusion

P2 **Green lamp:** blinking - GSI 38 Auto Tymps is ready to begin a Tymp; steady green - test successfully started and in progress.

P3 **Orange:** a pressure leak has been detected.

FRONT PANEL CONTROLS AND INDICATORS

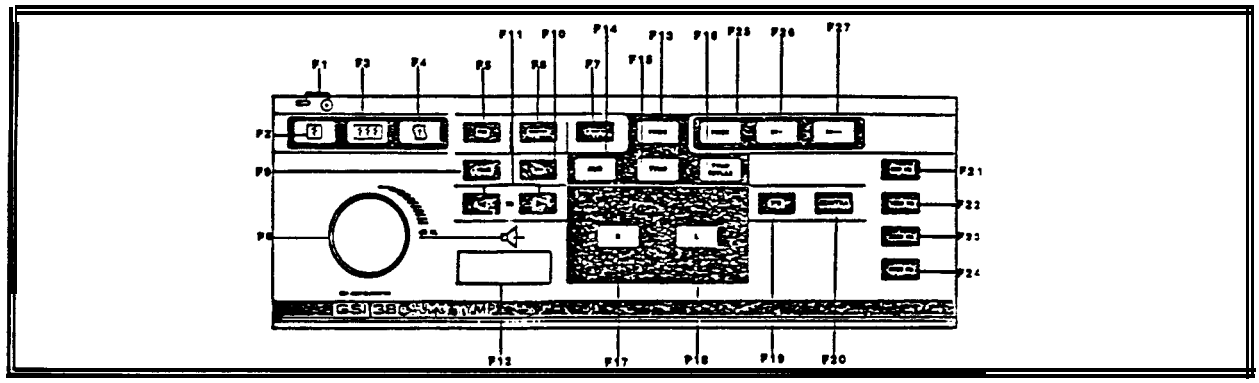


Figure 2-2: Front Panel

F1 **Power on indicator and label:** indicator is illuminated when the GSI 38 is receiving power.

F2 **Print Screen:** pushbutton used to print the currently displayed page of memory.

F3 **Print** All Memory: used to print all pages of data from memory.

F4 **Paper Advance:** causes paper to feed through printer; may be used to load paper or to provide space between printouts.

F5 FM: used during the Audiometry mode to select a frequency modulated test tone when the present bar is depressed; causes the letters FM to appear on the display when selected.

F6 **Steady:** used during Audiometry mode to select a continuous test tone when present bar is depressed; causes the steady symbol to appear on the display.

F7 **Pulsed:** used during Audiometry mode to select a pulsed tone when the present bar is depressed; causes the pulsed symbol to appear on the display.

F8 **Attenuator Knob (dB HL):** used to increase or decrease the intensity of the test tone presented in Audiometry mode; counterclockwise rotation causes the intensity to be lowered; clockwise rotation causes the intensity to be increased.

F9 **+10 dB:** used to temporarily extend the intensity range by 10 dB; causes a large + sign to appear on the display indicating that the extended range has been selected.

F10 M+: save key; during Audiometry mode, causes the threshold information per frequency to be saved on the display; during Program mode, causes option to be selected; during Tymp/Reflex mode, causes frequency to be stored as a default parameter.

F11 **< and > Hz:** Selecting < causes the cursor to move the next lower frequency; selecting > causes the cursor to move to the next higher frequency.

F12 **Present Bar:** Push downward to present test signal to appropriate earphone; release to turn test tone off.

F13 **Prog(ram):** press to select Program mode screen which lists setting available to reflex presentation format, printout header format, audiogram vs. tabular format, display normal box, and identify frequency range for Audiometry mode.

F14 **Aud(iometry):** press to select Audiometry mode. (Available in Versions 3 & 4 only).

F15 **TYMP**: press to select Tympanometry only mode.

F16 **Tymp Reflex:** press select Tympanometty and Reflex mode.

F17 **R:** used to identify right ear under test so that data stored in memory and/or printed is properly identified; for Versions 3 and 4, used to select right earphone for audiometry.

F18 L: used to identify left ear under test so that data stored in memory and/or printed is properly identified: for Versions 3 and 4, used to select left earphone for audiometry.

F19 IPSI: used to select an ipsilateral reflex test.

F20 CONTRA: used to select a contralateral reflex test (available with Versions 2 and 3 only).

F21 500: selects 500 as a stimulus during reflex testing.

F22 1000: selects 1000 Hz as a stimulus during reflex testing.

F23 2000: selects 2000 Hz as a stimulus during **reflex** testing.

F24 4000: selects 4000 Hz **as** a stimulus during reflex testing.

F25 **PAGE:** used to scroll through test results stored in memory.

F26 M-: used to erase currently displayed page of data from memory.

F27 M-: used to erase all pages of data from memory.

PRINTER AND DISPLAY

The printer cover can be removed to reload paper. See Figure 2-3 for location of the printer and printer cover. Section 2-7 provides paper loading instructions.

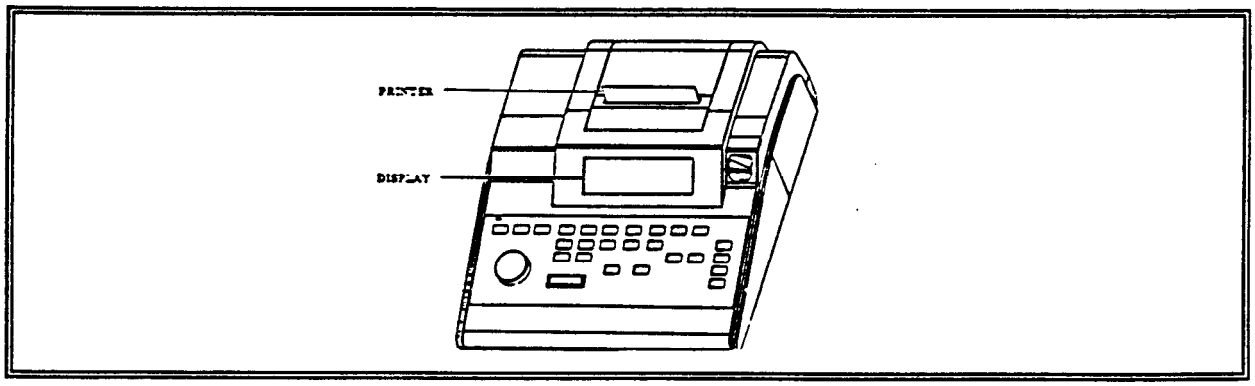


Figure 2-3: Printer and Display

The display indicates test mode, parameters for test and test results. See Figure 2-3 for location of display. Figures 2-4 through 2-8 show the individual display format for each test mode.

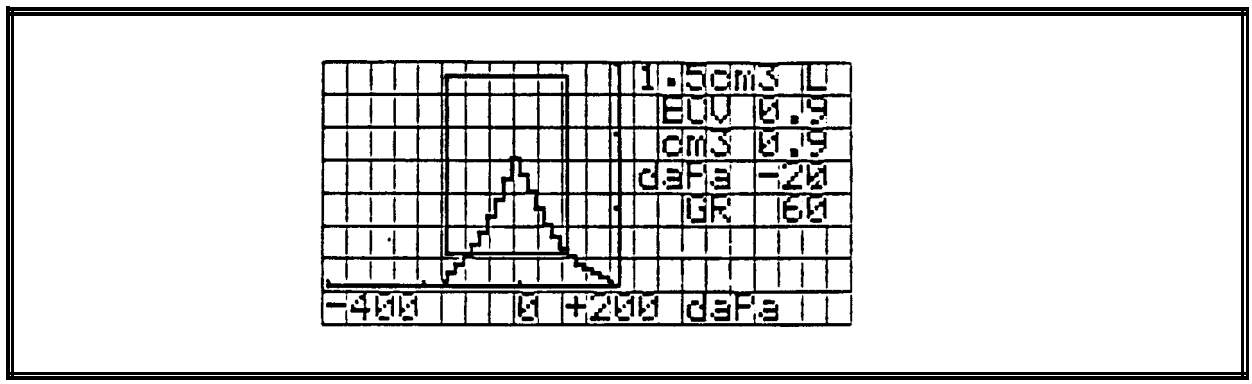


Figure 2-4: Display Format for TYMP Only Test

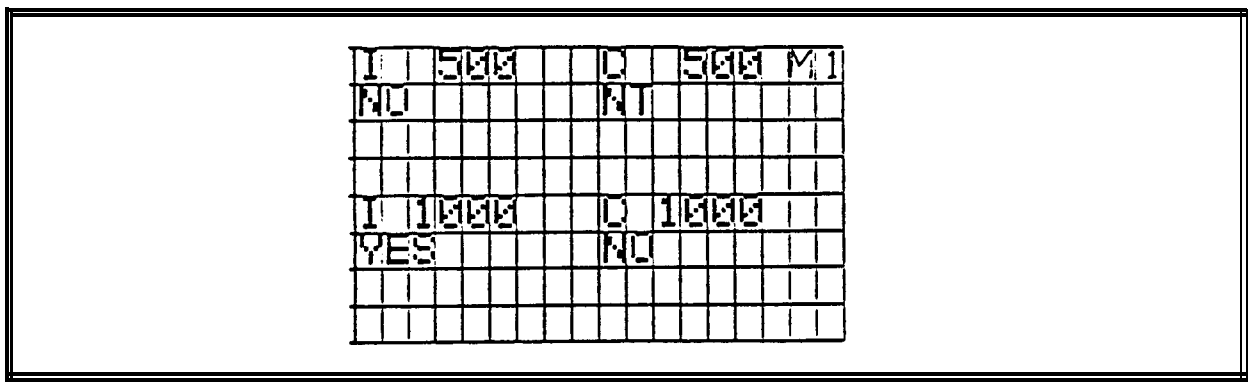


Figure 2-5: Display Format for TYMP/REFLEX Test
(Reflex test results given as “Yes” or “No”).

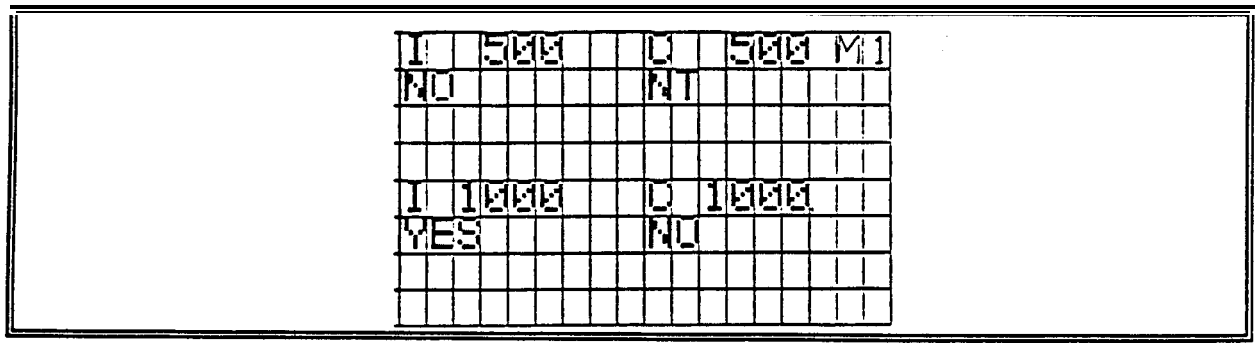


Figure 2-6: Display for TYMP/REFLEX Test
(Reflex test results given in "dB HL").

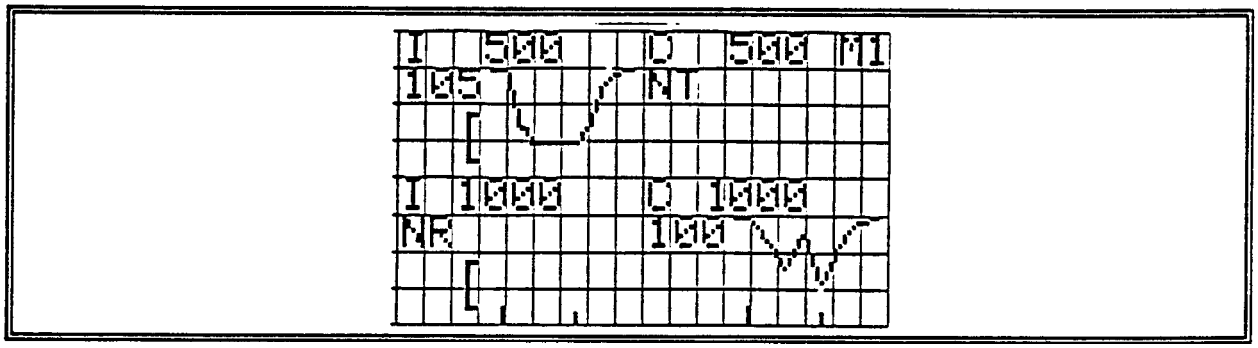


Figure 2-7: Display Format TYMP/REFLEX Test
(Reflex test results given in "dB and also shown with a “tracing”)

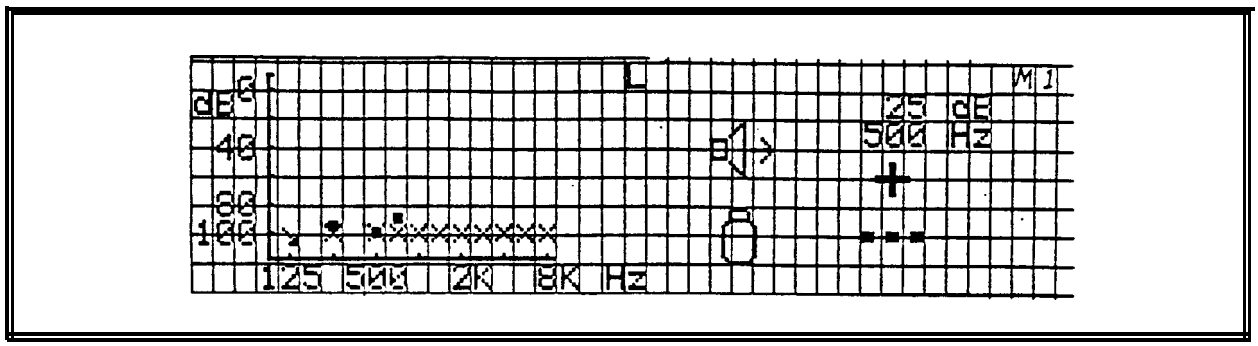


Figure 2-8: Display Format for AUDIOMETRY

REAR AND BOTTOM PANEL LABELS/CONNECTORS

The rear panel labels and connectors are shown in Figure 2-9 and a description of each one follows.

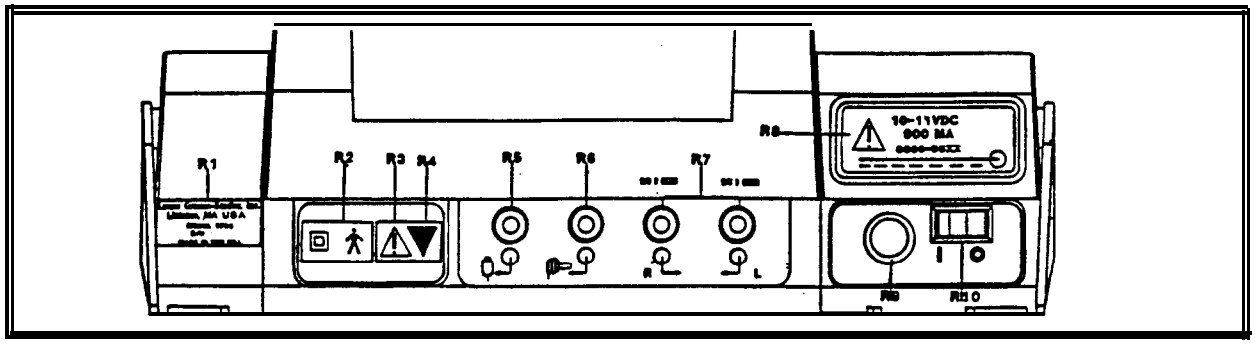


Figure 2-9: Rear Panel

R1 Company name, address, model, serial number and country of origin.

R2 Symbol denotes a Type B, Class II Product per IEC 878 as referenced in IEC 601 Standard.

R3 Symbol denotes Attention, consult accompanying documents.

R4 Symbol indicates a service adjustment part that is intended for service personnel use only.

R5 Connector for handswitch. Input impedance -47 k ohm pulls up to 5 volts.

R6 Connector for contralateral insert phone. < 1 ohm, 2.5 volts rms maximum open circuit.

R7 Connectors for right and left earphone. 130 ohm, 2.50 volts rms maximum open circuit.

R8 Label describing low input voltage and current from wall mounted power supply.

R9 Power Input Jack. 5-pin DIN connector for external wall mounted power supply.

RIO Power Switch with ON/OFF indicators.

NOTE

There is a symbol on the bottom panel that indicates entry by qualified service personnel only. This symbol is marked "B 1" in Figure 2-10 Bottom Panel.

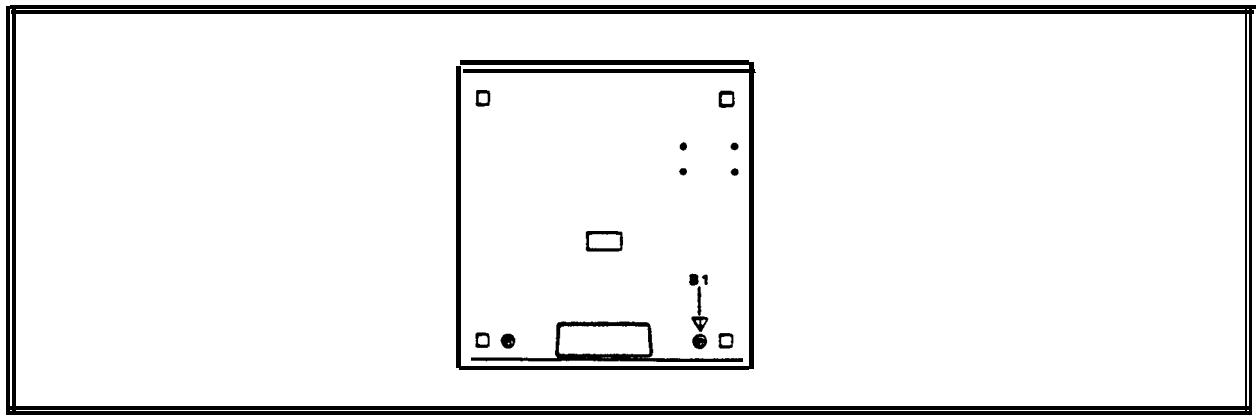


Figure 2-10: Bottom Panel

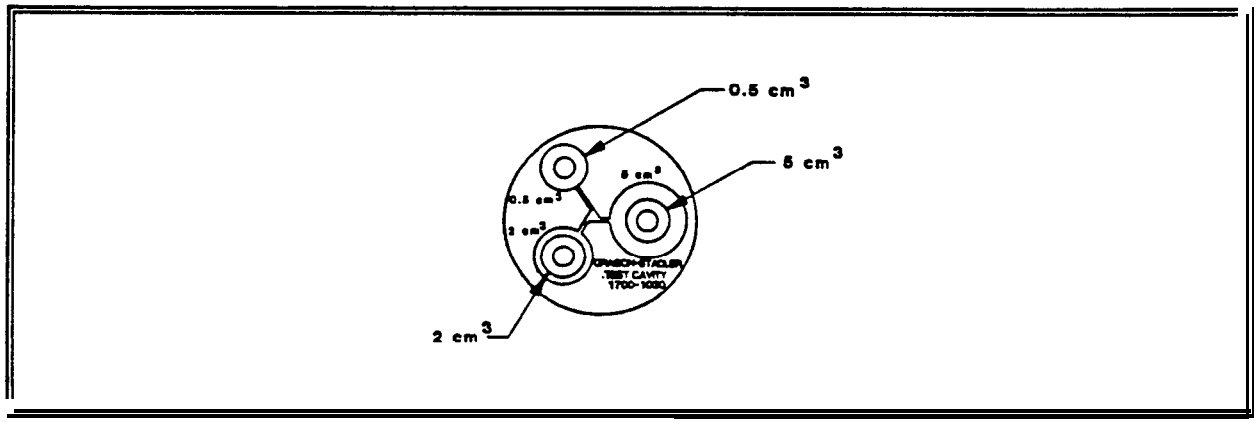


Figure 2-11: Test Cavity

PRETEST TYMP CHECKS

For your convenience, a test cavity is provided with your GSI 38 Auto Tymp. This test cavity enables you to quickly verify, on a daily basis, the prober calibration of your unit. GSI strongly recommends that you make this quick check a part of your daily routine.

TYMP CALIBRATION VERIFICATIONS

To initiate the quick check, select the Tymp only mode and insert the probe into the ***0.5*** cm^3 opening on the test cavity. See Figure 2-l 1.

NOTE

Since the GSI 38 ***is designed to start automatically, it is important that the probe is inserted as quickly and as smoothly as possible. During the calibration check, the probe must be held carefully and without movement. Do not place the probe on the same counter as the instrument or any moving object during this check as mechanical noise will be picked up by the probe and interfere with the calibration check.***

The calibration check will start automatically if the probe has been inserted into the cavity properly. This is confirmed by the green lamp changing from blinking to a steady condition. If the orange lamp is illuminated, the probe is not properly positioned within the cavity so that a large pressure leak exists. If the yellow lamp is illuminated, the probe tip has been occluded. In either case, remove the probe and wait for the blinking green lamp. Insert the probe once again. Clean the probe tip if necessary (XXXXXX).

When the test sequence is completed, the green lamp on the probe is no longer illuminated. Remove the probe from the test cavity and note that the green lamp is blinking once again. The display will indicate a flat line on the tympanogram along with the value of the test cavity next to the letters ECV (ear canal volume) i.e., 0.5. The letters NP will appear next to the labels cm^3 and daPa and three dashed lines will appear next to the letters GR (gradient). Since the test cavity is a hard-walled cavity, the tympanogram should be a flat line indicating that there is no mobility in the system. The GSI 38 places the letters NP next to the cm^3 and daPa headers to indicate that there is no peak compliance and, therefore, no peak pressure can be determined during the quick check. Also, since there is no compliance peak detected, it is not possible to calculate a gradient. Therefore, the GSI 38 displays the dashed lines when a gradient calculation isn't possible. Using the same sequence, place the probe in the test cavity opening labelled 2.0 cm^3 Note that the display looks the same as with the 0.5 cm^3 measurement except for the value placed next to the letters ECV 2.0. If you wish, the same sequence can be followed with the 5.0 cm^3 opening on the test cavity. To keep a record of this test cavity calibration check, simply press the print all pushbutton on the front panel of the GSI 38.

Since sound pressure will vary with altitude and barometric pressure, some variation from the 0.5, 2.0 and 5.0 cm^3 readings may be observed. Your GSI 38 is carefully calibrated at our factory which is at approximately 250 feet above sea level. If you are located at an elevation of 1000 feet or higher, your instrument may need to be recalibrated to account for your elevation (See Section XXXX). If is not necessary to recalibrate for barometric pressure changes on a daily basis. Just keep in mind that a change in barometric pressure (i.e., from low to high or high to low) will slightly affect the test cavity readings.

ALTITUDE ADJUSTMENT

The Altitude calibration adjustment allows the instrument operator to "correct" the ear canal volume (ECV) measurement and test cavity volume measurement for variations due to altitude. Because the GSI 38 is a pressure-sensitive device which makes measurements relative to ambient air pressure, changes in air pressure due to weather or altitude will affect the ECV read-out of the instrument. The slight pressure change resulting from changing weather conditions will usually yield volume read-outs within +/- 0.1 of the expected cavity value, but pressure changes due to altitude can shift these cavity values by as much as 30%. These **changes in pressure do not affect the accuracy of the compliance measurement system in any way.** However, many instrument operators prefer that their equipment give ECV values as they would appear at sea level. The altitude calibration mode allow the operator to adjust his/her Auto Tymp without the services of a qualified GSI representative.

TABLE 2-1 Altitude **Correction**

ALTITUDE CORRECTION	
Altitude (ft)	Altitude Table (cm^3)
0 - 1,500	2.0
2,000 - 3,500	2.1 +/- 0.1
4,000 - 6.000	2.2 +/- 0.1
6.500 - 7.600	2.3 +/- 0.1
6.600 - 6.000	2.4 +/- 0.1
6.500 - 10,000	2.5 +/- 0.1

The altitude calibration mode can only be entered when the GSI 38 is powered up from its "off' state while the program mode pushbutton, PROG is depressed. Hold the PROG pushbutton for approximately five seconds.

STEP 1

When entering the altitude mode the display will read as follow:

Altitude Mode
ECV 2.0
cm^3 9.99
Standard

(E71) is displayed in the bottom right corner of the display until the probe is in the 2.0 cm^3 cavity.

STEP 2

Place the probe into the 2.0cm^3 cavity provided with the instrument and check cm^3 value against the altitude correction table for accuracy.

STEP 3

If the measured volume is not within the published table value +/- .1cc, then the operator should exit the altitude mode by pressing the PROGRAM MODE pushbutton and contact field service. Providing the measured volume agrees with the published table +/- .1cc, the operator may proceed with the altitude adjustment.

STEP 4

With the probe still in the 2.0 cm^3 cavity, select the page pushbutton to enter the custom calibration mode. Custom will appear on the fourth line of the display.

STEP 5

The value now displayed in the cm^3 display area is the volume measured and adjusted to the current altitude. If the value displayed is 2.0 cc then the volume is adjusted to the current site. If the value is not 2.0 cc +/- .1, then press the SAVE pushbutton M+ to customize the volume measurement to the current altitude. The measured volume should now read 2.0 cc.

STEP 6

To exit the altitude mode press the PROG pushbutton to return to normal mode.

PROGRAM MODE

To enter the program mode, select the PROGram pushbutton located on the front panel. The following screen appears the first time you enter the Program mode after you receive your GSI 38 from the factory. (in other words, there are the default settings used at the factory during production).

Program **Mode - User Selections**

- Reflex HL + Curve
  Reflex HL only
  Reflex Yes/No
* **Pm Header GSI**
  Pm Header Off
  Pm Header Custom

- **Print - Audiogram**
  Print - Aud Table
- **Normal Box ASHA**
  Normal Box Off
* **Aud Range Normal**
  Aud Range Narrow

Note that these selections. fall into five different groups of controls:

Reflex format for printer
Print header format
Audiometric test result format
Status of normal box
Audiogram frequency range

The default setting for each group of controls has an asterisk (*) before it so that it is easy to scan the settings selected for each group.

REFLEX FORMAT

Reflex test results can be displayed and printed in three different ways: reflex dB HL plus curve; reflex dB HL only; or reflex yes/no. The default setting for this grouping is reflex dB HL plus curve. This means that all reflex test results will appear on the display and the printout with the following information.

NOTE

If you* had previous/y entered a custom header, position *the square cursor next to the asterisk (*) in front of Pm Header custom and press M+ to cause the line cursor to appear* at *the left-hand margin along the bottom of the display. The word SAVED will appear at the lower tight margin indicating that the custom header is still selected.

To move the cursor from the left-hand margin without inserting a letter or number, select the character which represents a space (i.e., rotate the knob one position to right of the letter A). Use the > Hz pushbutton to move over to the next character position. Repeat this sequence until the cursor is moved over to the desired start position for the first character to appear in your header. Rotate the dB HL knob to select the appropriate characters to spell out the desired header. After selecting each character, use the > Hz pushbutton to move over to the next character position. Once all of the header characters have been added, press the M+ pushbutton to save your header in memory. The word SAVED will appear on the right-hand margin indicating that you header is now saved. The square cursor will reappear next to Pm Header Custom. It is now possible to exit the program mode or to sequence on the next user selection. To exit the program mode, press the pushbutton labeled PROG. Enter a single test result and select print screen to see how the custom header looks.

AUDIOMETRIC FORMAT DURING PRINTING

The audiometric test results can be printed out in an audiogram format (PRINT - AUDIOGRAM) or in a tabular format (PRINT - AUD TABLE). The default setting for this function is the audiogram format.

NOTE

When a specific frequency is deselected for testing, the result will be a break in the audiogram line at that frequency. This eliminates the assumption that a threshold exists at that untested frequency.

Move the < or > Hz pushbutton to position the cursor in front of the description PRINT-AUD TABLE. Next, select the M+ pushbutton to save this format as the new default parameter. Note that the word SAVED appears in the lower right-hand comer of the display to indicate that this new setting has been saved. With PRINT-AUD TABLE selected, all audiometric test results will appear in a table with the frequency range typed horizontally along the top of the table followed by two lines of test data. The test results for the right ear will appear next to the letter R and below each frequency tested. Similarly, the test results from the left ear will follow below the right ear results.

NOTE

This setting (PRINT-AUD) selects the format for the printout only. An audiogram always appears on the screen while in this mode.

NORMAL BOX FORMAT

It is possible to have the normal box, as described by ASHA, appear on the tympanogram screen and printout. The boundaries for this normal box are -150 daPa to +100 daPa and 0.2 cm^3 to 1.4 cm^3.

NOTE

A compliance value of 7.5 cm^3 or greater will automatically turn off the ASHA normal box.

The normal box is the default setting. To deselect this normal box, move the square cursor with either the < or > Hz so that it is placed in front of the words Normal Box Off. While the cursor is in this position, select the M+ pushbutton to save this feature as the new default setting. Note that the word SAVED appears in the lower right-hand margin. This message assures you that the normal box ill not appear on the tymp screen or printout.

AUDIOGRAM RANGE

All eleven frequencies are available during audiometry or the range can be abbreviated to eight frequencies. The default setting is Aud Range Normal. To select the abbreviated frequency range, position the square cursor in front of the feature Aud Range Narrow. Press the M+ pushbutton to save this narrow range for audiometric testing. Note that the word SAVED will appear in the lower right-hand margin and the asterisk now appears in front of the narrow range selection. The normal range of frequencies include 125 Hz through 8000 Hz. The narrow range of frequencies includes 500 Hz through 6000 Hz. Please note that in the Aud mode, if the narrow range is selected, the < and > Hz pushbuttons will allow you to scroll through this abbreviated frequency range only. Both the screen and printout will still be labelled with the full range of frequencies. i.e., 125 Hz through 8000 Hz.

EXIT PROGRAM MODE

Exit the program mode by selecting the PROG pushbutton. Note that you return to the test mode which was operational prior to entering the program mode.

TEST IN MEMORY

The Tymp and Tymp Reflex test results are automatically stored in memory when the test sequence ends. Audiometric test results are stored in memory when the M+ pushbutton is pressed a total of eight memory locations are available with the GSI 38. Each test result is assigned a memory location number in order of sequence obtained starting with Ml and continuing up to M8.

To review the individual test results, press the PAGE pushbutton. Note that the screen contains the appropriate format for each test type stored (e.g., tympanogram or audiogram). The memory number is located in the upper right-hand corner of each screen. If, for example, only five tests were stored in memory, only five memory locations can be scanned. The memory can be scanned a page at a time by pressing the PAGE pushbutton once and observing the results. The entire memory can be scrolled through by holding the PAGE pushbutton down continuously.

MEMORY ERASE

If there is a particular test result that you wish to delete before printing, PAGE to this test result and press the M- pushbutton. This causes that particular test result to be erased from memory. The erase mode is accessed when the operator selects a test to erase and presses the M- pushbutton. The LCD displays a blank screen for erased memories with the memory location number located at the top right corner. Upon exit form the erase mode the stored memories reshuffle and replace the empty memory with the remaining tests in the order in which they were run. The erase mode will be exited once the operator presses the PRINT ALL or ERASE ALL pushbuttons or any pushbutton that would normally begin the setup of a new test. Please note that when the erase mode is entered, a current audiogram is no longer accessible to change or to store new HL values.

NOTE

The instrument is programmed to default to the right ear at 0 dB and 1000 Hz upon selection of a new audiometric test.

If you should wish to erase all tests from memory, press the M-(ERASE ALL) pushbutton. (For example, the test results have been printed and you wish to test another person).

NOTE

Be certain that you wish to remove all tests from memory before pressing the M-- pushbutton because the erasure occurs immediately upon pressing the M-- pushbutton!

PRINTING TEST RESULTS

The printout will begin with a header if it is selected during the program mode (i.e., GSI 38 or a custom header designed by you). The next two lines contain space for entering the individuals name and the test date. This is followed by the test results in the order that they were obtained/selected.

Either a single test can be printed from memory or the entire group of tests in memory can be printed. To print a single test from memory, use the PAGE pushbutton to arrive at the desired test result to print. Once this test is displayed, press the PRINT SCREEN pushbutton.

To print all tests in memory, simply select the PRINT ALL pushbutton. When PRINT ALL is pressed and two audiogram tests are stored in memory, they will combine under the following conditions. There must be one left test and one right test sequentially stored in memory. A left and right audiometric pair of tests will not be combined if they are separated in the memory by a tymp test. Therefore, when tests are erased, the resorting could cause a change in left, right or right, left combined when PRINT ALL is selected. Prior to selecting PRINT ALL the operator should scroll through the tests in memory to determine where the audiometric tests are located. This will help the operator to avoid combining tests from different patients.

CIRCUIT THEORY

The Microprocessors

The GSI 38 operation is controlled by two MC68HC11E1 microcontrollers. The microcontrollers have an 8 bit CPU and additional built in peripheral devices. It was designed using HCMOS technology which combines smaller size and higher speeds with the lower power and high noise immunity of CMOS. On chip memory includes 512 bytes of RAM and 512 bytes of EEPROM. The built in peripheral functions include:

- An eight channel/8 bit analog to digital convertor
- A 16 bit timer system
- An 8 bit pulse accumulator circuit
- A real time interrupt circuit
- Parallel input/output ports
- A computer operating properly (COP) watch dog system which protects against software failures.
- A serial peripheral interface (SPI)
- A serial communications interface (SCI)
- Power saving wait and stop modes

The many functions incorporated by the microcontroller helps to reduce board space requirements and the need for additional support circuitry.

The audio microprocessor (U34) is the master of the system and has control over the tymp microprocessor (U7) which functions as a slave.

THE AUDIO MICROPROCESSOR CONTROLS THE FOLLOWING FUNCTIONS:

Communication **to the** Tymp Microprocessor: Asynchronous serial communications data is transmitted and received using the processors built in serial communications interface. The interface is located within port D of the microprocessor. PDO is the receive data (ARXD) line and PD1 is the transmit data (ATXD) line. The bi-directional communication allows the transfer of information, test results, parameters and control functions to occur between the two processors.

Display Drive Information: Display information to and from the liquid crystal display (LCD) display board RAM is latched via the bi-directional latch (U29). After the information is loaded into the LCD board RAM the display board drives the associated pixels and the audioprocessor is free to perform other tasks. The display area is 240 pixels wide by 64 pixels high.

Monitoring of the Switch Matrix Keys: The processor routinely checks the status of the front panel keys for a change in state. The key panel switch inputs buffers U26, U27, U28 and U31 are read every 24 msec. If a switch change has occurred the processor executes the commands associated with the key function. The +10dB (extended range) key and the reflex control keys (Ipsi, Contra, 500, 1K, 2K, 4K) are active toggle controls (ie., push on/push off).

Monitoring of the Switch Matrix Keys Continued:

The present bar, subject response switch, frequency up/down key, paper advance key, and page key all function as press and hold controls where the corresponding function is active only as long as the control is pressed. Single action controls include the mode control keys (Prog, Aud, Tymp, Tymp/Reflex) tone type keys (FM, Steady, Pulsed), routing keys (L,R), memory control keys (Page, M-, M-), and the printer control keys (Print Screen, Print All, Paper Advance).

Normal/Calibration Mode Switch: The slide switch is monitored by the processor thru the switch input buffer U31. It is utilized for entry to the calibration and diagnostic modes.

Dip Switches: Dip switches 1 thru 4 are connected directly to the microprocessor A/D convertor. Dip switches 5 thru 8 are connected to the switch input buffer U31. These dip switch selections are read or processed upon entry to the calibration mode. When calibration mode is selected the dip switch status is verified and processed according to the individual selections. Any change in the dip switch status after entry to the calibration mode will be ignored by the processor.

Hearing Level Control (HL): The hearing level control dial is connected to a 36 position 2 bit encoder (RE1) located on the HL Board. The encoder output from the HL board is connected to port A of the audio processor. In the audiometer mode this rotary knob selects the stimulus hearing level based on the relative position change of the knob from the previous hearing level selection.

Pure Tone Stimulus

The Audio microprocessor controls the frequency generator for the associated Left Earphone, Right Earphone, Ipsilateral, or Contralateral outputs. The foundation of the pure tone stimulus generator is a Programmable Timer (U24). Output 0 (SQWIN) is a square wave with a 50/50 duty cycle equal to the selected front panel frequency. Out 1 (SCFCLK) is a square wave that is either fifty or one hundred times greater than the front panel frequency and is used to set the band pass of the switched capacitor filter. Out 2 is tied back to the micro controller IRQ and is used as an interrupt for the microprocessor so that it can update the COP (computer operating properly) circuit.

The SQWIN signal is a 0 to 5 volt square wave which is level shifted by (U44) to a plus and minus 5 volt square wave. The signal then passes through an anti - aliasing filter that eliminates high frequency harmonics and "rounds" the edges of the sine wave. The signal then passes through the switched capacitor filter (U49) which reduces harmonics and other noise. This is the process that produces the clean sine wave product.

Attenuator and + 10dB Range Extender

The attenuator (U56) is a Voltage Controlled Amplifier (VCA). This device has amplification gain but most of its dynamic range is used as an attenuator. The total range of the attenuator is 112 dB The output of the attenuator may be set to any level within this range by adjusting the DC voltage present at the EC line pin 3. This input pin is connected to a Digital to Analog Convertor (DAC/U53) that controls the output level of the attenuator. Calibration of the output levels is accomplished by storing a Hearing Level to Sound Pressure Level value, per frequency and transducer, in a look up table in EEPROM. This information is then latched (U25) to the DAC that drives the attenuator to the appropriate output level. The resolution or step size is controllable to within a .5 dB increment. The +10 Range Extender may be selected any time that the hearing level is within 1 0dB of the maximum non-extended hearing level for all frequencies. This selection allows an additional +10dB of range above the normal maximum hearing level limit. After the attenuator but before the routing of the signal to the left or right earphone is the 1 0dB gain or attenuator circuit. The control line (+1 ODB) that selects the extended range (U51) is enabled or disabled by the latch (U20).

Output Routing Control

The output of the attenuator (ATTENOUT) is routed to either the Left amplifier (U48) Right Amplifier (U52), or the Ipsi / **Probe Tone** Speaker Amplifier (U66). When contra is selected the output is routed through the right output amplifier and is then switched to the contra phone by the routing relay The output amplifiers have a special control line (pin 1) that allows the output to be disabled or shut off to conserve power. This power saving feature also eliminates any unwanted noise from a non selected output.

Print Function / Control

The test results are printed using a thermal print head printer on paper that is 112mm wide. When the print function is selected the processor starts building a graphical bit mapped image of the printout in the Audio RAM (U32). The printout is formatted as specified by the selections made in the program mode and stored in EEPROM. Before printing takes place the A/D port E of the micro controller measures the ambient temperature and adds it to the calibrated Dot on time stored in EEPROM. This routine assures consistent print quality regardless of the ambient temperature or the print head resistance.

The serial print data is transferred from the RAM through port D of the micro controller to the serial to parallel convertor (U19). The dot drivers (U16 & U17) that are connected to U19 sink the current through the associated print head dot element. Information for the print head motor driver (U15) and the paper feed motor driver (U14) is received from the micro controller port A. The latch (U13) assures that the print head dot drivers are off when the print head motor is inactive or when the paper feed motor is advanced. The printer has a built in switch that is closed when the print head is returned to the home position. During the power up initialization and after each print out the print head motor is returned to the home position. The printer also has independent power supplies used for the print head (U38/ V +5P) and the print motors (U39/ +VM). The +VM power supply is also connected to the left right routing relay Kl.

The Tymp Microprocessor controls the following functions:

Communication to the Audio Microprocessor: Asynchronous communications data is transmitted and received using the processors built in serial communications interface. The interface is located within port D of the microprocessor. PDO is the Tymp receive data line **(TRXD)** and PD1 is the Tymp transmit data line (TTXD). The bidirectional communication allows the transfer of information, test results, parameters, and control functions to occur between the two processors.

Pump Drive Control: The Pump assembly consists of a DC step motor, an air reservoir, a piston, and an infra photo eye/detector pair. After power-up (during the instrument initialization period) and at the end of a test the pump piston is returned to the home position. The home position (HOME) is determined by a state transition of the infra red photo detector of the pump assembly which is monitored by the Tymp microprocessor (U7) A/D input PE4 (pin 44). The pump motor coils are driven by the motor driver (U37) which is clocked by the pump drive timer (U21). The timer controls the step rate of the pump assembly which varies with the pressure sweep rate. The pump sweeps at a rate of 600 daPa/sec until the slope of the tympanogram is sensed then the sweep rate slows to 200 daPa/sec. If a leak is detected during the pump sweep the pump stops until the probe is removed from the ear canal. When the probe is removed from the ear canal the pump returns to the home position.

Monitoring of the Pressure Transducer Output ; The pressure Transducer output is monitored by the Tymp Microprocessor (U7) A/D input PE6 (pin 48). In the Ambient Pressure calibration mode the CMOS Switch (U64) is used to adjust the gain of the pressure transducer circuit so that the input voltage at the A/D is equal to 1.5 vdc. This gain adjustment places the pressure transducer output at ambient or zero pressure in the optimum operating range for the A/D convertor. When the ambient gain has been established the processor will set the switches to the stored values at all times. The pressure span calibration (+200/-400) is controlled by the technician and is stored by the microprocessor as a software offset.

Probe Tone Oscillator (226 Hz) and Speaker Drive ; The Probe tone Frequency is generated by the Microprocessor (U7) Internal Timer System (Port A). This produces a 226 Hz Square wave at PA3 of the Tymp Microprocessor (U7 pin 31). The Square wave level or gain **is** determined by the CMOS switch settings of (U45 and (U46). These switches select the appropriate output levels based on controls from the microprocessor. The output levels or switch settings are determined by the calibration data and the external volume as measured by the probe microphone. The appropriate level is then routed through a 226 Hz band pass filter (U61). The signal is then routed to the Probe Tone / Ipsi speaker amp (U66).

Microphone Input level Monitoring ; The microphone signals that are measured in the ear canal must be filtered to remove as much unwanted signal as possible. This filtering

is performed by the 226 Hz band pass filter (U65). The filtered RMS microphone signal is rectified to a dc level for input to the Microprocessor A/D convertor. This filtered signal is level adjusted (U59) by the Microprocessor to establish an optimum operating range for the system during the tymp sweep or reflex testing.

CALIBRATION

EQUIPMENT REQUIRED FOR CALIBRATION

TYPE 1 SOUND LEVEL METER

ARTIFICIAL EAR

2 cc COUPLER (GSI #1700-2005 OR B&K #DB0138)

9A (6 cc) COUPLER OR B&K ARTIFICIAL EAR (B&K #4153)

MANOMETER

VOLTMETER (RMS)

FREQUENCY COUNTER

1700-l 030 TEST CAVITY

SMALL STANDARD (SLOTTED) SCREWDRIVER

SMALL PHILLIPS (CROSS) SCREWDRIVER

CALIBRATION PROCEDURE

CONFIG. REGISTER: During routine Calibration it is not necessary to program the Config. Register. Programming the Config. Register establishes the microprocessors mode of operation and once programmed should never change. If a new microprocessor is installed in location XU7 or XU34 its Config. Register must be programmed. To program the Config. Register install temporary jumpers (shorts) on JP1 and JP3 then power up the unit. Almost immediately after power up the unit will display Config. Register Programmed. At this point power down and remove the previously installed jumpers. The Config. Register is now programmed.

DEFAULT DATA LOADING: Durina routine calibration it is not necessary to load Default Data. Defautt Data Loading allows the technician to quickly store an averaged set of calibration values into EEPROM. Also, if a new microprocessor has been installed the Default Data loads critical power-up information that the processor requires for operation into EEPROM. When a new microprocessor or Auto/Tymp Board is installed Default Data should be loaded. Load Default Data by setting Dip Switch positions 6, 7, and 8 to the "ON" position. Set the Cal/Norm Switch to the Cal Mode, then power up the unit. At power-up the display should indicate the unit model and version number (GSI 38 Version X), the Tymp/Reflex Software Revision Number (Tymp/Reflex Rev XXX), the Audiometer Software Revision Number (Audiometer Rev XXX), and the Default Parameters which are currently being loaded into EEPROM (Loading Audiometer Defautts, Loading Programmed Defautts, or Loading Tymp/Reflex Defaults). When the Default Data Loading sequence is complete the display will update to the Main Calibration Mode Menu. At this point Dip Switches 6, 7, and 8 should be returned to their normally OFF position.

The technician may also load an individual set of Default Data by first setting the desired Dip Switch to the ON position then setting the Cal/Norm Switch to the Cal Mode position. Dip Switch assignments are as follows:

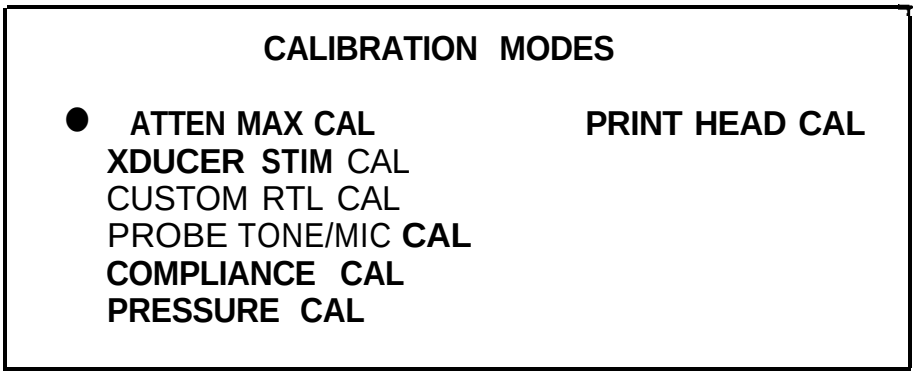
Dip Switch	Function	Location Loaded
6	Tymp/Reflex Defaults	Tymp EEPROM
7	Audiometer Defaults	Audio EEPROM
8	Programmed Defaults	Audio EEPROM

ENTERING THE CALIBRATION MODE DIRECTLY (ROUTINE CALIBRATION)

1) Verify that Dip Switches 6, 7, and 8 are in the OFF position.

2) Power up the unit.

3) Slide the Cal/Normal Switch to the Cal Mode position. The display should appear as follows:



AUDIOMETER CALIBRATION

ATTENUATOR MAXIMUM OUTPUT CALIBRATION: During routine calibration it should not be necessary to calibrate the Attenuator Maximum Output. However, if **the Audiometer Default Data has been loaded then the Attenuator Maximum Output must be calibrated.**

1) Connect the right phone output unloaded to an RMS Meter.

2) Use the ◄ Hz ► Keys to position the cursor on the 38 display at the ATTEN MAX CAL position.

3) Press the PROG Key to enter the ATTEN MAX CAL Mode.

4) Press the Present Bar ▭ to lock on the tone.
(The Tone Indicator 🔊 should now be present on the display.

5) Use the ◄ Hz ► to select the desired frequency for calibration. Adjust the dB HL knob until the output level for currently display frequency is within the minimum/maximum values listed in the following table. When the desired output level has been reached store the value by pressing the M+ **Key. Repeat** for all frequencies.

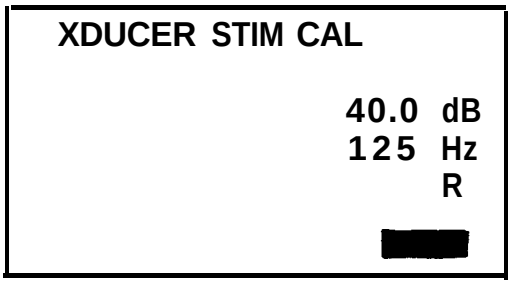
Frequency (Hz)	Minimum - Maximum
125	**2.05 - 2.30 vrms**
250	**2.05 - 2.30 vrms**
500	**2.33 - 2.5 vrms**
750	1.69 - 1.9 vrms
1000	2.28 - 2.5 vrms
1500	2.28 - 2.5 vrms
2000	2.55 - 2.70 vrrns
3000	2.28 - 2.50 vrms
4000	2.55 - 2.70 vrms
6000	2.28 - 2.50 vrms
8000	2.28 - 2.50 vrms

After all frequencies have been calibrated press the PROG Key to the Main Calibration Mode Menu.

AUDIOMETER SPL OUTPUT LEVEL CALIBRATION

1) Use the ◄ Hz ► Keys to position the cursor on the **38** display at XDUCER STIM CAL.

2) Press **the** PROG **Key to** enter the **XDUCER STIM CAL MODE.**
The display should now indicate:



NOTE: Tone Bar is OFF **or Inactive**

40.0 dB	Indicates the Current Hearing Level (HL) selected.
125 Hz	Indicates the Current Frequency (Hz) selected.
R	Indicates the Current Transducer selected.
▬▬	Indicates a Steady Tone Presentation

The Tone Bar is active in this mode and serves a dual function. When the Tone Bar is OFF or inactive the current hearing level is displayed as shown above.

When the Tone Bar is pressed ON or active the stim on indicator will appear on the display and the 40.0 dB (HL) indicator will update to the ANSI Standard Reference Threshold Level (RTL) measured in Sound Pressure Level (SPL) for the selected frequency and hearing level.

Example: 40.0 dB (HL) at 125 Hz (Freq) will update to 85.0 dB SPL when the Tone Bar is depressed.

Given: The ANSI Standard (RTL) correction value for 125 Hz at 0 HL is equal to 45.0 dB SPL.

Therefore: At 40 dB HL which **is** 40 dB SPL higher that 0 dB HL the output for 125 **Hz** will equal 85.0 dB SPL.

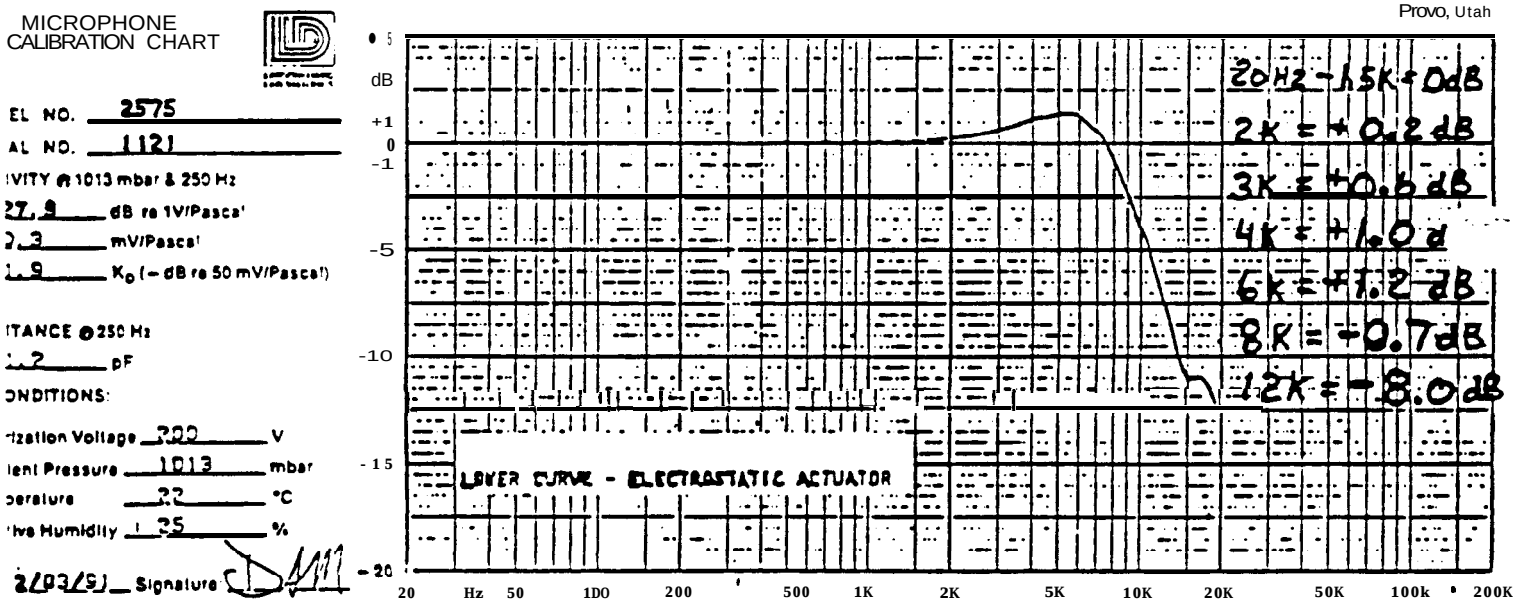
For 125 Hz

ANSI Standard RTL for 0 dB HL	45.0 dB SPL
(+)40 dB HL =	(+)40.0 dB SPL
40 dB HL =	85.0 dB SPL

For 8 KHz

ANSI Standard RTL for 0. dB HL =	13.0 dB SPL
(+)60 dB HL =	(+) 60.0 dB SPL
60. dB HL =	73.0 dB SPL

When calibrating using a Sound Level Meter (SLM) it is important to add or subtract the appropriate microphone correction. When the microphones are calibrated the manufacturer or calibration facility should supply the microphone's frequency response curve. The microphone is then calibrated to the SLM which has a flat frequency response by using a piston phone or similar standard device. Below is an example of a microphone frequency response curve.



The curve shows that the microphone response is flat between 20 Hz and 1.5 KHz, high between 2 KHz and 6 KHz, and low at frequencies 8 KHz or greater. Using 4 KHz **as** an example when a standard force is applied to the surface of this microphone its output is 1 dB high. Therefore, when calibrating 4 KHz using this microphone we must add 1 dB to our expected value. Our formula for determining the proper calibration level for 4 KHz is as follows:

4 KHz ANSI Standard RTL for	0. dB HL =	9.5 dB SPL
Reference HL for Calibration	(+)80. dB HL =	(+)80.0 dB SPL
(+) or (-) Microphone Correction	NA.	(+) 1.0 dB SPL
	80. dB HL =	90.5 dB SPL

The following table contains the ANSI Standard Reference Threshold Levels RTL's at 0 HL for each frequency when using TDH-39P earphones.

Frequency (Hz)	125	250	500	750	1000	1500	2000	3000	4000	6000	8000
ANSI Standard **RTL** **Measured in dB SPL**	45.0	25.5	11.5	7.5	7.0	6.5	9.0	10.0	0.5	15.5	13.0

Standard Reference Threshold Levels re: 20 μPa for Telephonics TDH-39P earphones as measured on the National Bureau of Standards 9-A coupler. Reference ANSI S3.6 - 1989, ISO 389 - 1975 Standards.

Grason-Stadler has made an effort to minimize calibration time by defaulting the Reference HL Levels for Calibration to maintain an expected SPL Calibration Level of between 85 and 95 dB SPL. The Default HL Levels are as follows:

Frequency (Hz)	125	250	500	750	1000	1500	2000	3000	4000	6000	8000
Default HL	40	60	80	80	80	80	80	80	80	80	60

Because the 38 automatically adds the ANSI RTL and reference HL values on the display (when the Tone Bar, is active) the technician needs only to add or subtract the appropriate microphone correction to the displayed value when calibrating.

3) Connect the right ear phone to the Sound Level Meter Artificial Ear.

4) Press (TONE BAR) the display will update from the selected hearing level to the ANSI Standard RTL value for calibration and the indicator will appear).

5) Adjust the HL knob until the SPL Level measured on the SLM for the selected frequency and transducer equals the value indicated on the 38 display (+ or - Microphone Correction).

6) Press the [M+] Key to store the data in memory.

7) Repeat for all frequencies, right phone, left phone, ipsi and contra by selecting the appropriate key on the 38 front panel.
NOTE: Both left phone and right phone must be calibrated.

8) When finished press the [PROG] Key to return to the Main Calibration Mode Menu.

CUSTOM RTL CAL

This mode is used primarily if a customer wants to calibrate using transducers other than TDH-39P earphones. This mode allows the technician to program different RTL values to be displayed when calibrating using the XDUCER STIM CAL MODE. Once programmed, the Custom RTL values will be displayed each time the XDUCER STIM CAL MODE is entered. The range of allowable RTL's is -5 dB to 63.5 dB A # sign will appear next to the dB HL indicator on the display when Audiometry Mode is selected to indicate to the customer that Custom RTL values have been programmed. To return to the ANSI Standard Values and extinguish the # sign, the technician must load Audiometry Default Calibration Data.

1) Use the ◄ Hz ► Keys to position the cursor at Custom RTL Cal on the display.

2) Press the PROG Key to enter the Custom RTL Cal Mode.

3) Press the ◄ Hz ► Keys to select the desired frequency.

4) Adjust the dB HL dial to achieve the desired RTL value.

5) Store the value into memory by pressing the M+ Key.

6) Repeat for all desired frequencies.

7) Press the PROG Key to return to the Main Calibration Menu.

NOTE: Adjusting the Custom RTL values has no effect on the earphone output level. After storing the Custom RTL's the technician must calibrate to the appropriate levels using the XDUCER STIM CAL MODE.

PROBE TONE/MIC CAL

1) Use the ◄ Hz ► Key to position the cursor at the Probe Tone/Mic Cal Mode position.

2) Press the PROG Key to enter Probe Tone/Mic Cal Mode. The display will update to the following "flashing" display.

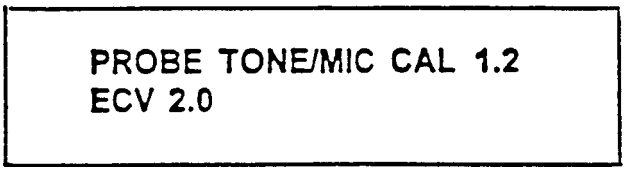
PROBE TONE/MIC CAL **1.1** **ECV** SLM

At this point place the probe in the 2 cc coupler on the Sound Level Meter.

3) Press the [M+] Key and the display will stop flashing.

4) Use the dB HL dial to adjust the Probe Tone Level to 85.5 dB SPL (+/- 0.9 dB). At this point the Probe Tone Frequency may be verified. It should equal 226 Hz (+/- 6 Hz).

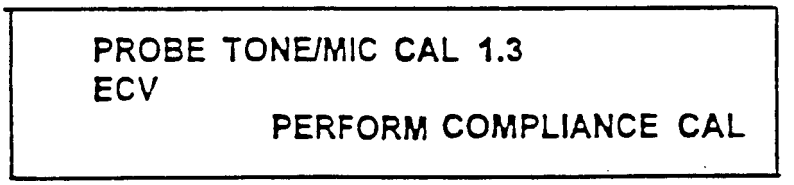
5) Press the [M+] Key to store the data in memory. The display will update to the following 'Washing" display.



At this point place the probe in the 2 cc test cavity.

6) Press the [M+] Key to start the microphone calibration process. The display will update to the following steady state display.

After a few seconds the SAVED indicator will extinguish and the 1.2 indicator will change to 1.3. When the cycle is complete the display will update to the following "flashing" display.



7) Press the [PROG] Key to return to the Main Calibration Mode Menu.

COMPLIANCE CAL

1) Use the [◄] Hz [►] Keys to position the cursor at the Compliance Cal Mode position.

2) Press the [PROG] Key to enter the Compliance Cal Model The display will update to the following "flashing" display.

```
COMPLIANCE CAL 2.1
ECV 0.5
cm3
```

3) Place the probe into the 0.5 cc calibration cavity then press the [M+] Key to start the 0.5 cc calibration. The display will stop flashing and remain in steady state to indicate that calibration is in progress.

NOTE: If the wrong cavity size is used the display will indicate E74 in the lower right hand corner. After approximately 5 seconds the ERROR MESSAGE will extinguish and the calibration process may be continued by placing the probe into 0.5 cc cavity and then pressing the [M+] Key.

When the 0.5 cc calibration is complete the display will update to the following "flashing" display.

```
COMPLIANCE CAL 2.2
ECV 2.0
cm3
```

At this point place the probe into the 2.0 cc test cavity.

4) Press the [M+] Key to start the 2.0 cc calibration. The display will stop flashing and remain in steady state to indicate that calibration is in progress.

NOTE: If the wrong cavity size is used the display will indicate E74 in the lower right hand corner. After approximately 5 seconds the ERROR MESSAGE extinguish and the calibration process may be continued by placing the probe into the 2.0 cc cavity and then pressing the [M+] Key.

When the 2.0 cc calibration process is complete the display will update to the following steady state display.

```
COMPLIANCE CAL 2.3
ECV 2.0
cm3 X.XX
```

X.XX is equal to the current volume measurement.

The calibration of compliance measuring devices is affected by air density. As the air gets thinner, the volume measurement in a hardwall cavity increases. Therefore, as you go up in altitude, barometric pressure decreases making the hardwall cavity appear larger than it is. The GSI 38 allows the flexibility to display the real altitude effect or to correct the ear canal measurements relative to sea level.

A) If the customer prefers to correct the ear canal volumes relative to sea level then adjust the [◄] Hz [►] Keys until the cm3 XXX value equals 2.00 (±.1). After adjusting to the desired level store the value by pressing the [+M] Key. The display will start "flashing" indicating that the compliance calibration process is complete.

B) If the customer prefers uncorrected ear canal volumes (actual at altitude measurements) then adjust the [◄] Hz [►] Keys until the cm' XXX value indicates the appropriate volume measurement for the customer site elevation according to the following altitude table.

Altitude (ft)	Barometric Pressure (mm Hg)	Expected Volume Reading at Altitude (cc)	Calibration Volume at Altitude (cc)
0	759.97	2.00	2.0±0.1
500	746.51	2.01	2.0±0.1
1000	733.04	2.03	2.0±0.1
1500	719.84	2.05	2.0±0.1
2000	706.63	2.07	2.1±0.1
2500	693.93	2.09	2.1±0.1
3000	681.23	2.11	2.1±0.1
3500	668.78	2.13	2.1±0.1
4000	656.34	2.15	2.2±0.1
4500	644.40	2.17	2.2±0.1
5000	632.46	2.20	2.2±0.1
5500	620.78	2.22	2.2±0.1
6000	609.09	2.25	2.2±0.1
6500	598.00	2.27	2.3±0.1
7000	588.00	2.30	2.3±0.1
7500	578.00	2.34	2.3±0.1
8000	568.00	2.37	2.4±0.1
8500	555.00	2.40	2.4±0.1
9000	544.00	2.44	2.4±0.1
9500	533.00	2.49	2.5±0.1
10000	522.00	2.54	2.5±0.1

Press the [M+] Key to store the customer altitude volume measurement. The display will start "flashing" indicating that the Compliance Calibration process is complete.

5) Press the [PROG] Key to return to the Main Calibration Mode Menu.

PRESSURE CAL

1) Use the [◄] Hz [►] Keys to position the cursor at the Pressure Cal position.

2) Press the [PROG] Key to enter the Pressure Cal Mode. The display will update to the following "flashing" display.

```
'PRESSURE CAL        3.1
 ECV OPEN
 A/D
 daPa
```

At this point make sure that the probe tip is in open air.

3) Press [M+] Key to start the Ambient Pressure Calibration. When the Ambient Pressure Calibration is complete the display will update to the following "flashing" display.

```
PRESSURE CAL         3.2
ECV MANOMETER
A/D XXXX
daPa -200
```

At this point connect the probe tip to a manometer.
NOTE: Manometer internal volume must be less than 5 cc's.

4) Press the [PAGE] Key. At this point the pump will pressurize to -200 daPa

5) Use the [◄] Hz [►] Keys to adjust the pressure on the external manometer to -200 daPa (±15%)

6) Press the [M+] Key to store the -200 daPa Calibration data. The messages saved will appear in the lower right hand corner of the display. After 3 to 5 seconds the saved indicator will be extinguished and the display will update to a steady state display as follows.

At this point verify that the leak rate is less than 2 daPa/sec:

7) Press the [PAGE] Key and the 38 will pressurize to +200 daPa. manometer reading is within (±15%) of the pressure value indicated on the 38 display.

8) Press the [PROG] Key to return to the Main Calibration Mode Menu.

PRINT HEAD CAL

1) Use the [◄] Hz [►] Keys to move the cursor at the Print Head Cal position.

2) Press the [PROG] Key to enter the Print Head Cal Mode.

3) Press the [◄] Hz to lighten the printout and the [►] Hz Key to darken the printout. When either key is pressed the printer will print a test pattern (the alphabet) on a single line. When the center of the adjustment range is crossed the In Range indicator on the display will appear (when adjusting from a light intensity to a dark intensity) or extinguish (when adjusting from a dark intensity to a light intensity).

EXAMPLE OF PRINT INTENSITY ADJUST RANGE.
TOTAL RANGE = 20 STEPS OR 20 DIFFERENT INTENSITY LEVELS.

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z :
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z :
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z :
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z :
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z :
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z :
A B C D E F G H I J K L R N O P Q R S T U V W X Y Z :
A B C D E F G H I J K L R N O P Q R S T U V W X Y Z :
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z :
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z :
● A B C D E F G H I J K L N N O P Q R S T U V W X Y Z :
● A B C D E F G H I J K L M N O P Q R S T U V W X Y Z :
● A B C D E F G H I J K L M H O P Q R S T U V W X Y Z :
• A B C D E F G H I J K L M N O P Q R S T U V W X Y Z ;
● A B C D E F G H I J K L M N O P Q R S T U V W X Y Z :
● A B C D E F G H I J K L M N O P Q R S T U V W X Y Z :
● A B C D E F G H I J K L M N O P Q R S T U V W X Y Z :
● A B C D E F G H I J K L M N O P Q R S T U V W X Y Z :
● A B C D E F G H I J K L M N O P Q R S T U V W X Y Z :
● A B C D E F G H I J K L M N O P Q R S T U V W X Y Z :

• "In Range" indicated on display.

4) Press the [M+] Key to store the desired intensity value.

5) Press the [PROG] Key to return to the Main Cal Mode Menu.

6) Slide the Cal/Norm Switch to Norm to return to Normal Mode Operation.

S4 DIP SWITCHES.		
	O N	OFF
S1	Unused	Unused
S2	Factory Auto Cal	Norma! Cal Mode Operation
S3	To Be Defined	Normal Cal Mode Operation
S4	To Be Defined	Normal Cal Mode Operation
S5	To Be Defined	Normal Cal Mode Operation
S6	Tymp/Reflex Default Data	Normal Cal Mode Operation
S7	Audiometer Default Data	Normal Cal Mode Operation
S8	Program Default Data	Normal Cal Mode Operation

TROUBLE SHOOTING

ERROR MESSAGES (EXX)

NOTE: If an Error Message is observed the associated code number should be recorded for future reference. The Error Code Number is designed to point to a specific block of circuitry which will enable the technician to repair the problem in a fast, efficient manner. Most software errors are related to poor environmental conditions such as static electricity and power line interference and will generally clear with power down/up. Contact your local sales and service organization and supply them with the Error Code Number if the error will not clear with power down/up.

AUDIOMETER PROCESSOR RELATED MESSAGES

Code Number	Description/Possible Cause
01	EPROM Checksum Error on power up / if non-recoverable possible defective Auto/Tymp Board EPROM U30 or Microprocessor U34.
02	Microprocessor Internal RAM Error on power up / if non-recoverable replace Microprocessor U34.
03	Watch Dog Timer Timeout / the Watch Dog Timer Circuit monitors the Microprocessor's operation. The Processor must periodically send an "I'm Okay" message 'to the watch dog or the watch dog will halt all operations. If non-recoverable try replacing. Microprocessor U34 or Audiomymp Board.
04	Microprocessor Clock Failure / if non-recoverable possible defective crystal Y2 or Microprocessor U34.
05	Undefined Interrupt Error / this type of soft error should always be recoverable. It relates to an Interrupt that the Processor does not acknowledge or cannot execute. If non-recoverable replace Audiomymp Board.
06	Opcode Trap Interrupt Error /this type of error code should always be recoverable. If non-recoverable replace Microprocessor U34 or Audiomymp Board.
07	External RAM Error / if non-recoverable possible defective Audio RAM U32 or Microprocessor U34.
08	Normal or Swap Stack Overflow into the Global Variables / should always be recoverable. If non-recoverable replace Audio/Tymp Board.

Code Number	Description/Probable Cause
09	Conf. Register Error / if non-recoverable re-calibrate Config, Register then replace Microprocessor U34.
10	Halt in Response to Remote Command / if non-recoverable possible defective Audio/Tymp Communications Chip U36 or Microprocessor U34.
11	Invalid Keycode detected in CMDTSK / if non-recoverable possible defective Switch Panel, Switch Buffer U26, U27, or U28, or Microprocessor U34.
12	Invalid Keysource detected in CMDTSK / same as above.
'13	Invalid Queue Power Error detected in CMDTSK /same as above.
'14	Bad Pointer to EEPROM Routine'/
'15	Collision of the Normal Stack and Swap Stack /
'16	Invalid function for a Banded Swapped Function /
'17	Printer RAM Error on power up / internal or micro
'18	Tymp Hardware State is unknown /
'19	Non-Fatal Audiometer related error messages
'20	Calibration Data Read Error occured /
'21	HL Limit exceeded /
22	Invalid Extended Range Selection due to HL not in range where the Extend Range is valid /
23	Calibration Data Write Error occurred /
24	Invalid Present Bar Operation due to a Calibration Data Error /

Code Number	Description/Probable Cause
25	Remote Record received with a Bad Record Format, invalid Key Code, or Invalid Record Type /
26	EEPROM Checksum Error /
27	EPROM TO EEPROM Data Load Error /
28	Remote Command received from an external remote device (factory auto cal) which is invalid due to mode or is an unsupported record type /
29	Remote command received from an external remote device (factory auto cal) which is ignored due to mode /
30	GSI vs Custom RTL Calibration status Read Error from EEPROM /
31	Printer Calibration Data Read Error /
32	No test available to print /
33	Tymp/Reflex Processor not responding to a command from the Audio Processor or the Tymp/Reflex Processor is not setting the Synch ___ Stimo line on power up /
34	No Free Memory available when going to a new test /
35	Invalid test type read from memory when trying to display
36	Print Head initialization failed /
37	Printer Ambient temperature out of Range /
38	Record was received from the Tymp/Reflex Processor which has a valid format but the record type was not the type expected /
39	Call Factory for instruction
40	Audiometry mode not enabled

TYMP PROCESSOR RELATED MESSAGES

Code Number	Description/Probable Cause
51	EPROM Checksum Error on power up /
52	Internal RAM Error on power up /
53	Watch Dog Timer Time Out /
54	CPU Clock Failure /
55	Undefined Interrupt Error /
56	Opcode Trap Interrupt Error /
57	External RAM Error /
58	Stack Overflow Error /
59	Config. Register Error /
60	Bad Pointer to EEPROM Routine /
61	EEPROM Read Error in Norm or Alt Mode /
62	Couldn't Home Pump /
63-69	Undefined Non Fatal Errors
70	Probe is occluded or in cavity at power up /
71	Probe not in 2.0 mL cavity during Altitude Adjustment Cal Mode
72	End of gain reached in Microphone Cal Mode /
73	Probe Tone Gain Error during Probe Tone Gain Verification /
74	Cavity Error during Calibration /
75	Compliance Calibration Error /
76	Unused

Code Number	Description/Probable Cause
77	A/D Pressure Value out of range of Pressure Transducer Gain Error /
78	Remote Record Error /
79	Non-Fatal Cal Data Read/Write Error /
80	Reflex Test info not received for the Audio within the allotted time /
81	Remote Command invalid for the mode /
82	Leak or Occlusion Error /
83	Pump end of stroke /
84	Undefined Error Number Reported /

DISASSEMBLY

CAUTION STATIC SENSITIVE DEVICES/USE STATIC PROTECTION

DISASSEMBLY

OPENING CASE

TO GAIN ACCESS TO INTERNAL COMPONENTS. REMOVE 2 SCREWS MARKED “A” LOCATED UNDER FRONT EDGE OF UNIT AS SHOWN IN DRAWING 1. NOTE: IT MAY BE EASIER TO STABILIZE UNIT AND LOCATE COMPONENTS IF UNIT IS PLACED ON LER SIDE PRIOR TO REMOVING SCREWS AND OPENING CASE.

TO REMOVE PROBE

DISCONNECT REAR PANEL POWER CONNECTOR. OPEN CASE. DISCONNECT AUDIO/TYMP BOARD CONNECTORS J8 AND SHIELD 1. DISCONNECT THE PNEUMATIC TUBING FROM THE PUMP PNEUMATIC FITTING BY GENTLY PULLING ON TUBING NEAR THE PNEUMATIC FITTING. REMOVE CABLE CLAMP SCREW MARKED"C" AS SHOWN IN DRAWING 1 AND ENLARGED DETAIL VIEW “A”. GENTLY LIFT THE CABLE STRAIN RELIEF OUT OF THE BOTTOM CASE SIDE PANEL.

TO REMOVE HL BOARD ASSEMBLY

DISCONNECT REAR PANEL POWER CONNECTOR. REMOVE HL KNOB AND THE HL SWITCH MOUNTING HARDWARE (7116” HEX NUT & WASHER) AS SHOWN IN DRAWING 2. OPEN CASE. REMOVE SCREW MARKED "D" AS SHOWN IN DRAWING 1. GENTLY LIFT BOARD AWAY FROM TOP CASE.

TO REMOVE AUDIO/TYMP BOARD

DISCONNECT ALL REAR PANEL CONNECTORS OPEN CASE. DISCONNECT AUTO/TYMP BOARD CONNECTORS J2 THRU J8 AND SHIELD 1 (ie ALL). LOOSEN OR REMOVE 2 SCREWS MARKED "B" AS SHOWN IN DRAWING 1. PULL BOARD CAREFULLY FORWARD THEN UP AND OUT OF CASE.

TO REMOVE TIP-UP FEET

DISCONNECT REAR PANEL POWER CONNECTOR. OPEN CASE. REMOVE SCREWS MARKED "E" AS SHOWN IN DRAWING AND DRAWING 2.

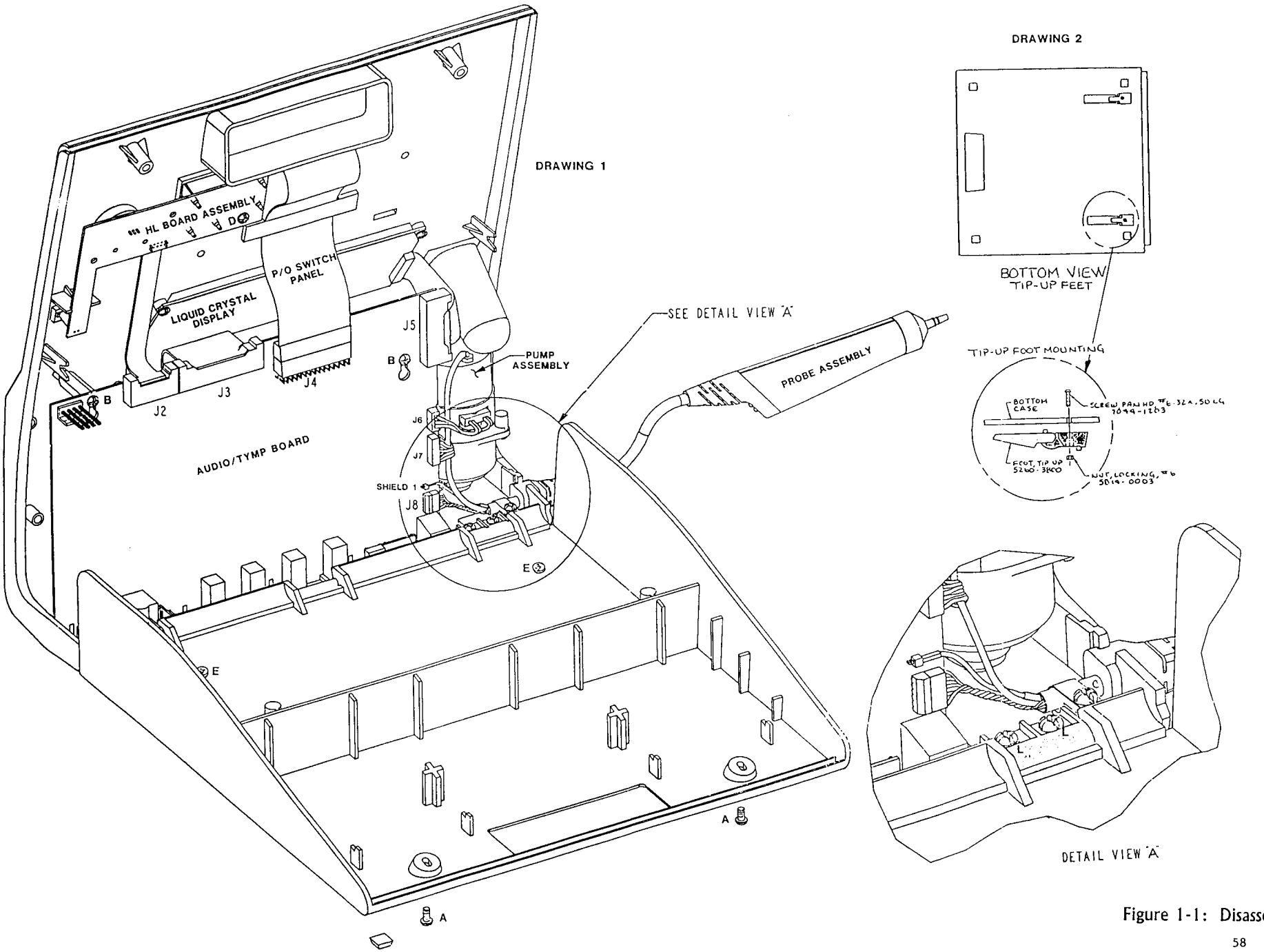
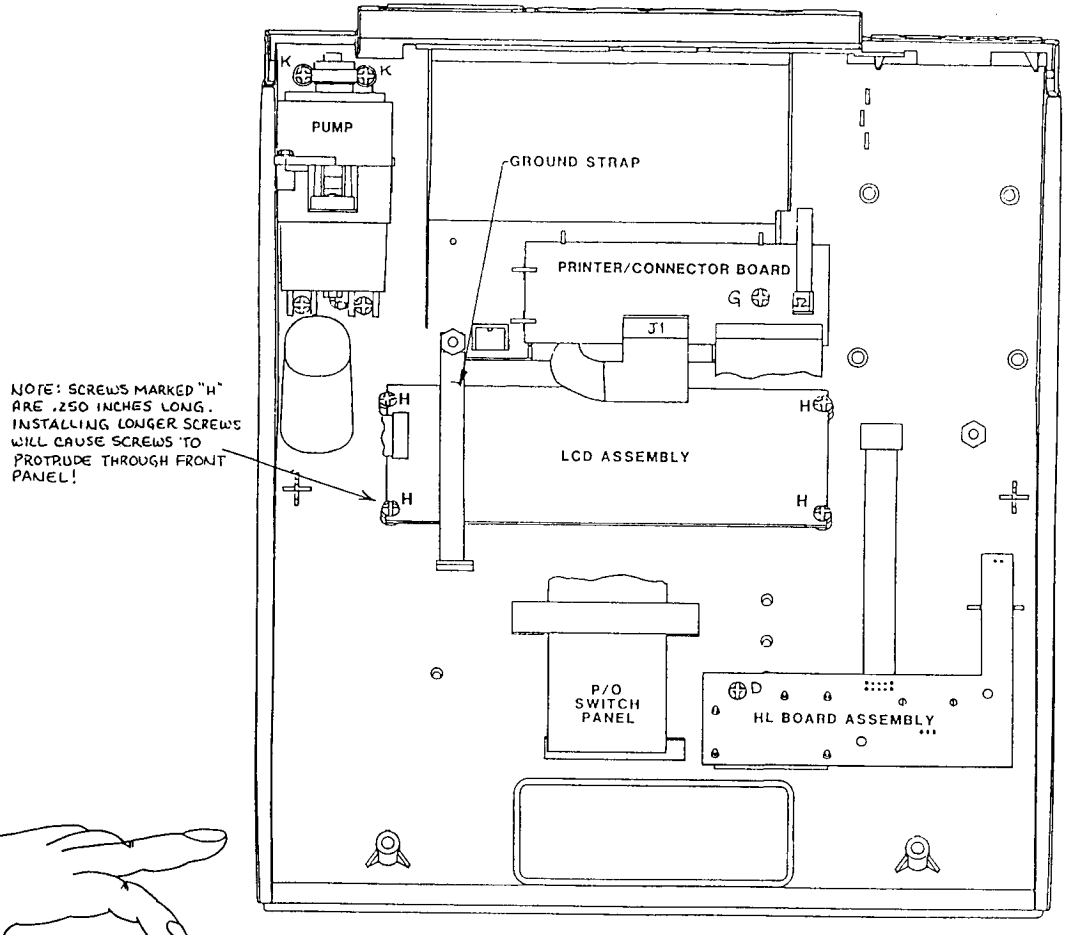


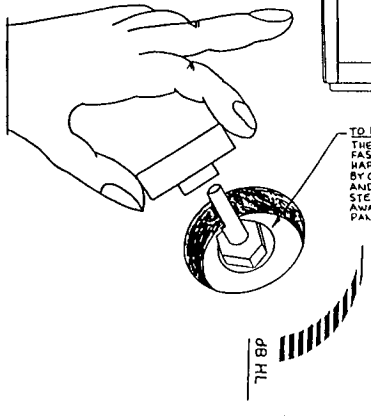
Figure 1-1: Disassembly

DRAWING 3

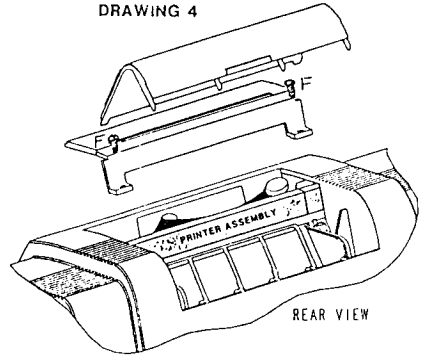


NOTE: SCREWS MARKED "H" ARE .250 INCHES LONG. INSTALLING LONGER SCREWS WILL CAUSE SCREWS TO PROTRUDE THROUGH FRONT PANEL!

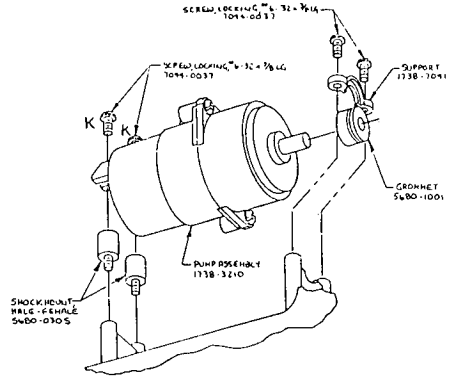
BOTTOM VIEW



DRAWING 4



DRAWING 5



DRAWING 6

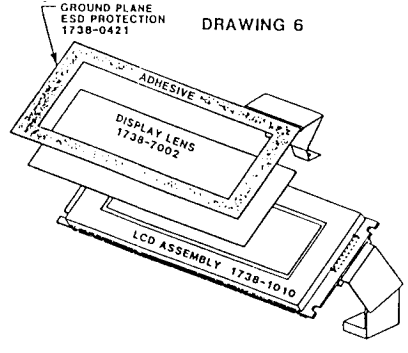


Figure 1-2: Disassembly

SWITCH PANEL REMOVAL

DISCONNECT REAR PANEL POWER CONNECTOR. REMOVE HL KNOB. OPEN CASE. DISCONNECT AUDIO/TYMP BOARD CONNECTOR J4. REMOVE THE ADHESIVE CABLE CLAMP WHICH SECURES THE SWITCH PANEL CABLE BY GRASPING FIRMLY AND GENTLY PULLING AWAY FROM THE TOP COVER. THE SWITCH PANEL IS SECURED TO THE TOP COVER BY ADHESIVE BACKING. START LIFTING THE SWITCH PANEL BY INSERTING A SMALL KNIFE BLADE BETWEEN THE SWITCH PANEL AND TOP CASE AT ANY CORNER. ONCE A CORNER IS LIFTED GRASP THE PANEL FIRMLY AND GENTLY PEEL AWAY FROM THE TOP CASE.

PRINTER REMOVAL

DISCONNECT ALL REAR PANEL CONNECTORS. OPEN CASE. REMOVE AUDIO/TYMP BOARD. DISCONNECT J1 AND J2 FROM PRINTER CONNECTOR BOARD. REMOVE PAPER COVER. REMOVE 2 SCREWS MARKED "F" AS SHOWN IN DRAWING 4. REMOVE PRINTER COVER. REMOVE PRINTER BY LIFTING REAR OF PRINTER ABOVE THE 2 REAR HOLDING PINS OF CASE, THEN SLIDE PRINTER TOWARDS THE REAR UNTIL THE PRINTER IS CLEAR OF THE 2 FRONT HOLDING PINS. ONCE CLEAR OF THE HOLDING PINS LIFT PRINTER OUT OF CASE.

PRINTER CONNECTOR BOARD REMOVAL

DISCONNECT ALL REAR PANEL CONNECTORS. OPEN CASE. REMOVE AUDIO/TYMP BOARD. DISCONNECT Jl & J2 FROM PRINTER CONNECTOR BOARD. REMOVE SCREW MARKED "G" **AS SHOWN IN** DRAWING 3.

LCD REMOVAL

DISCONNECT ALL REAR PANEL CONNECTORS. OPEN CASE. REMOVE AUDIO/TYMP BOARD. REMOVE 4 SCREWS MARKED "H" AS SHOWN IN DRAWING 3. (NOTE: THESE SCREWS ARE .250 INCHES LONG. INSTALLING LONGER SCREWS WILL CAUSE SCREWS TO PROTRUDE THROUGH FRONT PANEL!).

PUMP REMOVAL

DISCONNECT REAR PANEL POWER CONNECTOR. OPEN CASE. DISCONNECT J7 & J8 FROM AUDIO/TYMP BOARD. DISCONNECT PNEUMATIC TUBING FROM PUMP FITTING. REMOVE 4 SCREWS MARKED "K" AS SHOWN IN DRAWING 3 AND DRAWING 5. NOTE: ACCESS TO PUMP **SCREWS WILL BE** EASIER IF BOTTOM CASE IS REMOVED. APPLY SLIGHT REARWARD PRESSURE WHILE LIFTING PUMP FROM CASE TO ALLOW PUMP TO CLEAR SHOCK MOUNT STANDOFFS.

BOTTOM CASE REMOVAL

DISCONNECT REAR PANEL POWER CONNECTOR. OPEN CASE. LOOSEN 4 SCREWS MARKED **"L" AS SHOWN IN DRAWING 1 BY APPROXIMATELY 3 TURNS. THIS SHOULD ALLOW SUFFICIENT CLEARANCE TO SLIDE BOTTOM CASE PINS** FROM BETWEEN THE TOP COVER AND THE HINGE BLOCKS.

INSTRUMENT ASSEMBLY PARTS LIST

DESCRIPTION	PART NUMBER
INSTRUMENT ASSEMBLY, GSI 38 CONSISTING OF:	1738-3100
LABEL SET, GSI 38	1738-0480
CASE, BOTTOM	1717-7001
KNOB, CONTROL	1717-7006
GOUND PLANE, ESD PROTECT	1738-042 1
PRINTER, 112mm, HIGH SPEED	1738-0430
SWITCH PANEL, GSI 38	1738-0435
LABEL, JACK PANEL	1738-0440
ASSEMBLY, CASE, TOP	1738-1005
ASSEMBLY, LIQUID CRYSTAL DISPLAY	1738-l 010
ASSEMBLY, PROBE	1738-3200
ASSEMBLY, PUMP .	1738-3210
ASSEMBLY, AUDIO/TYMP BD.	1738-4705
ASSEMBLY, PRINTER CONNECTOR BD.	1738-4710
ASSEMBLY, H.L. BD.	1738-4715
LENS, DISPLAY	1738-7002
COVER, PAPER	1738-7020
SUPPORT, PUMP	1738-704 1
COVER, CALIBRATION	1738-7042
BLOCK, HINGE	1738-7055
PANEL, POWER, BLANK	1738-7060
PANEL, POWER	1738-7065
COVER, PRINTER	1738-7080
CLAMP, CABLE, FIAT, ADHESIVE	4314-0009
CLAMP, INSULATING, .25 NOM. I.D.	4320-0300
RETAINER, KNOB	5220-0101
FOOT, ADHESIVE, BLACK	5260-2250
SHOCK MOUNT, MALE-FEMALE	5680-0305
GROMMET	5680-l 001
SCREW, LOCKING, #6-32 x .375 LG.	7044-0037
STANDOFF, M/F	7574-0050
FOOT, Tl P-UP	5260-3800
NUT, LOCKING, #6-32	5814-0003
SCREW, PAN HD., 36-32 x .500 LG.	7044-1203
SCREW, LOCKING, #6-32 x LG.	7044-0024

AUDIO/TYMP BOARD

ASSEMBLY DRAWINGS/SCHEMATICS

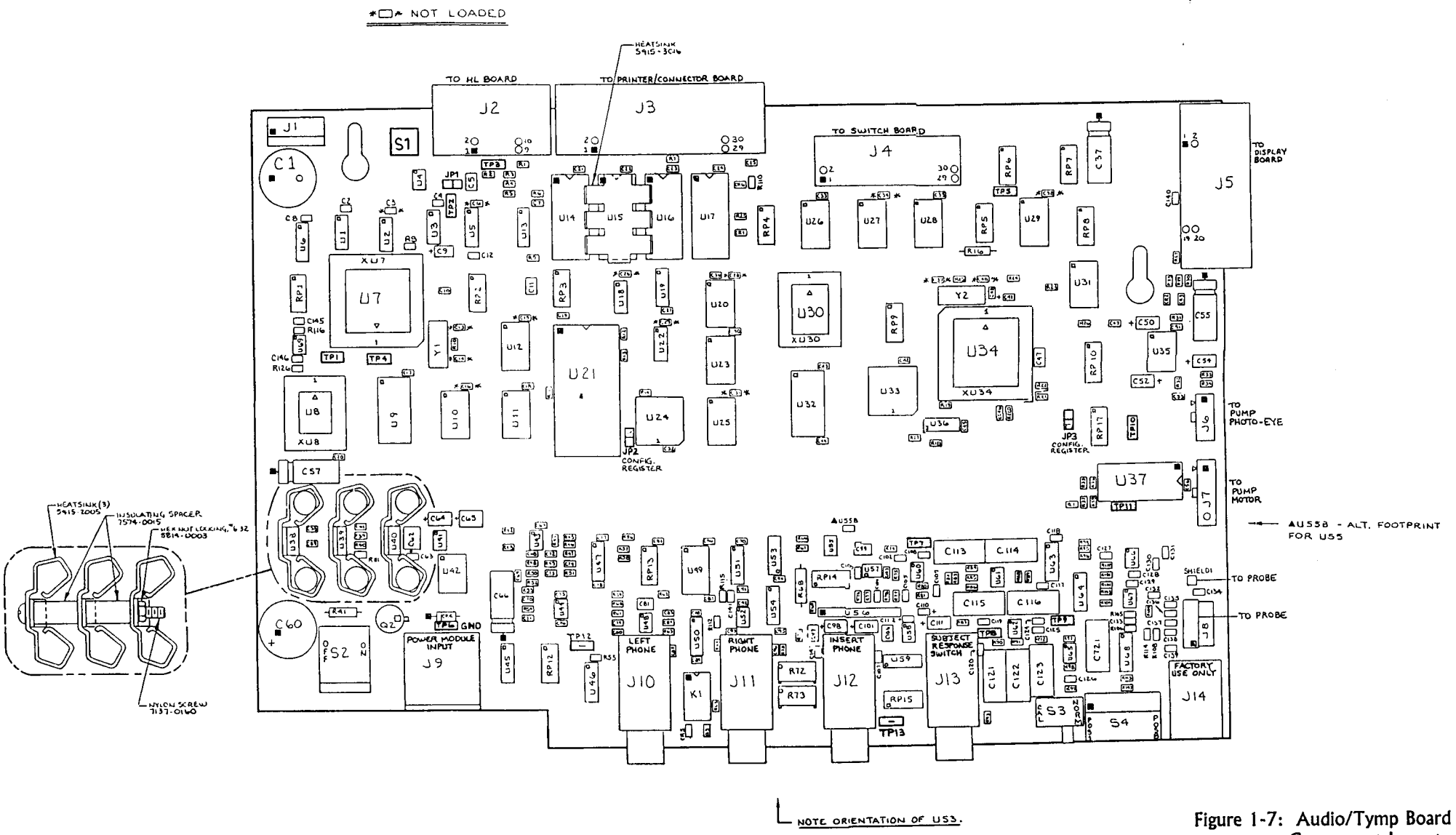
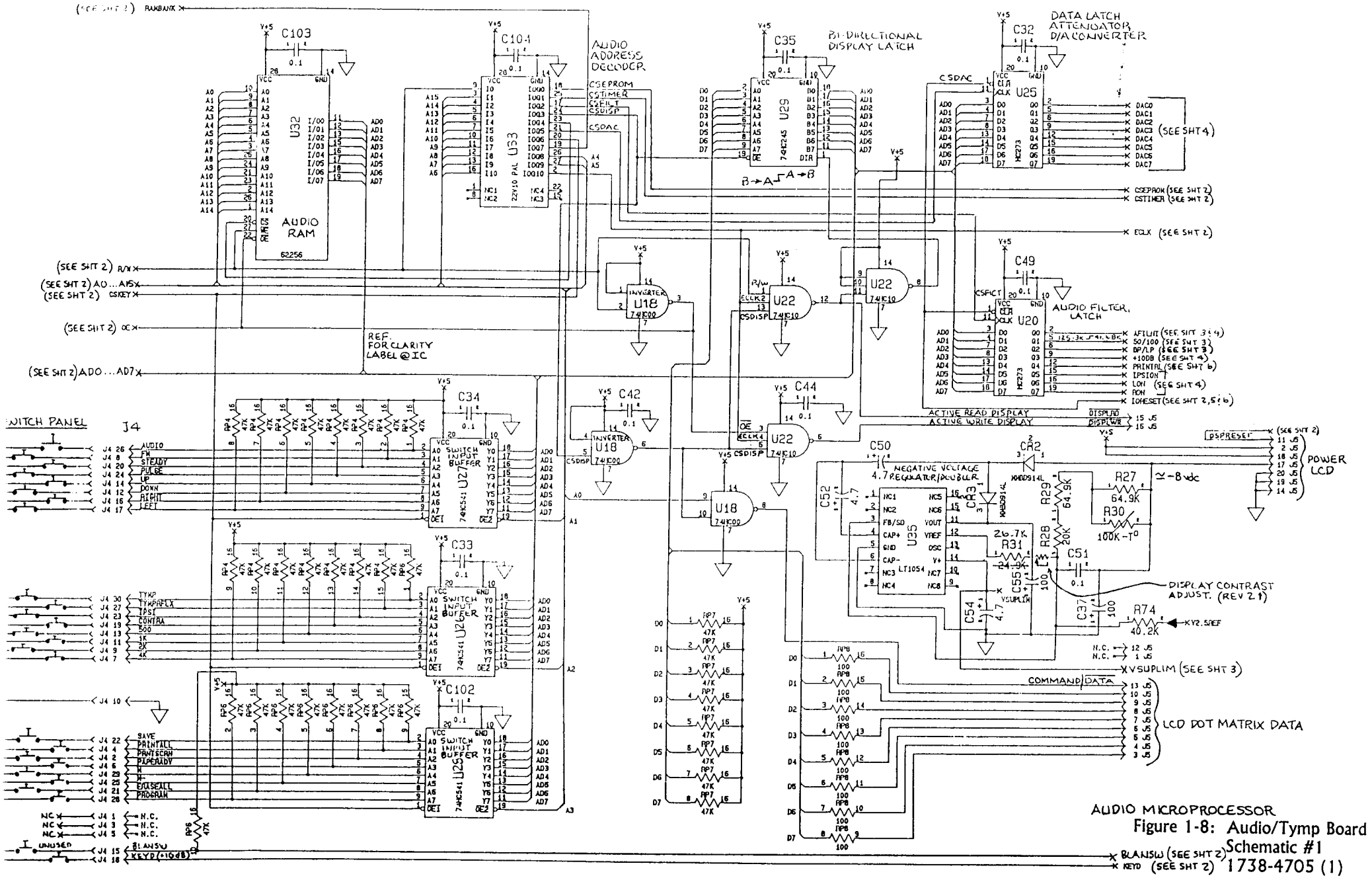


Figure 1-7: Audio/Tymp Board Component Layout



AUDIO MICROPROCESSOR

Figure 1-8: Audio/Tymp Board Schematic #1 1738-4705 (1)

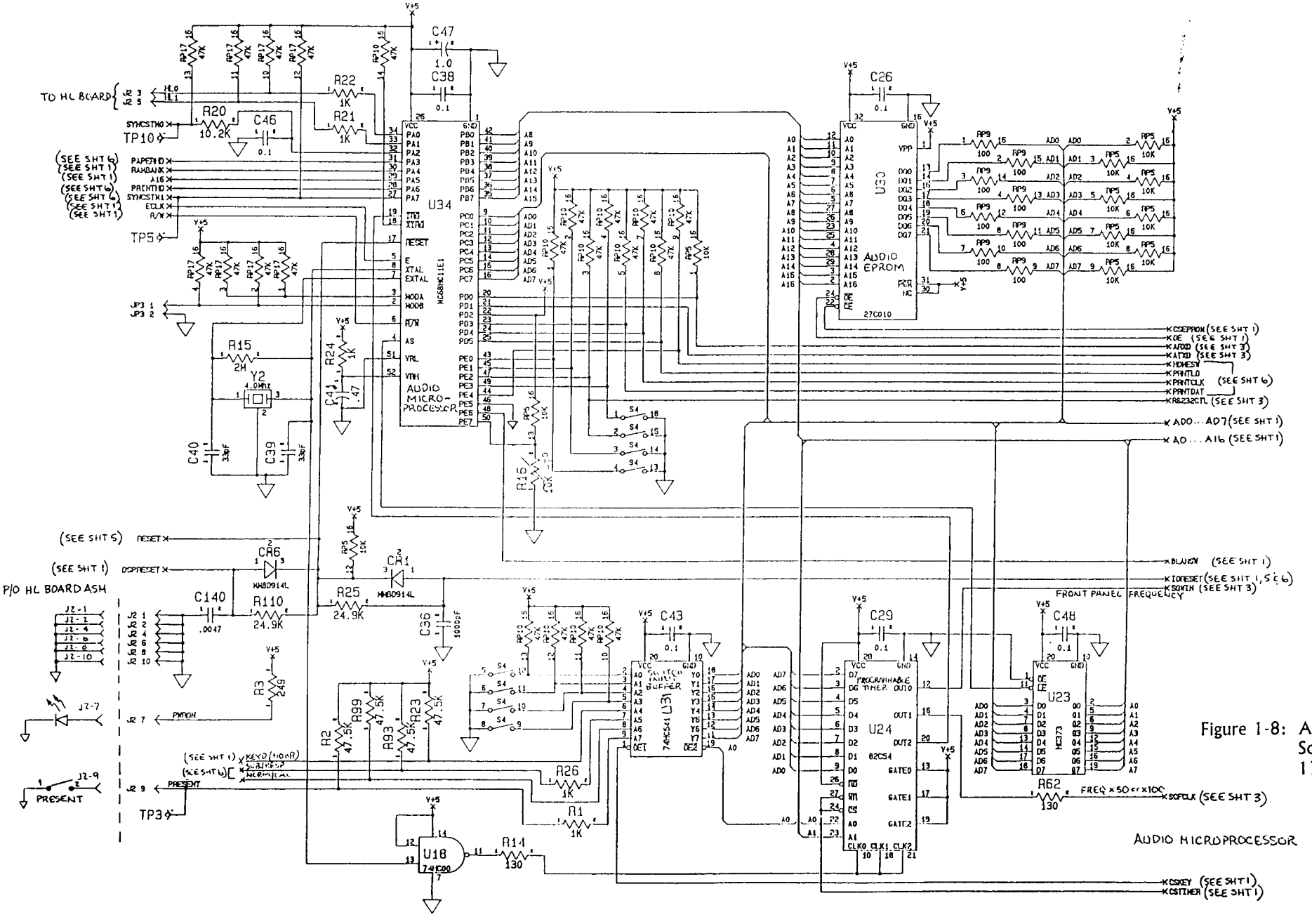


Figure 1-8: Audio/Tymp Board Schematic #2 1738-4705 (1)

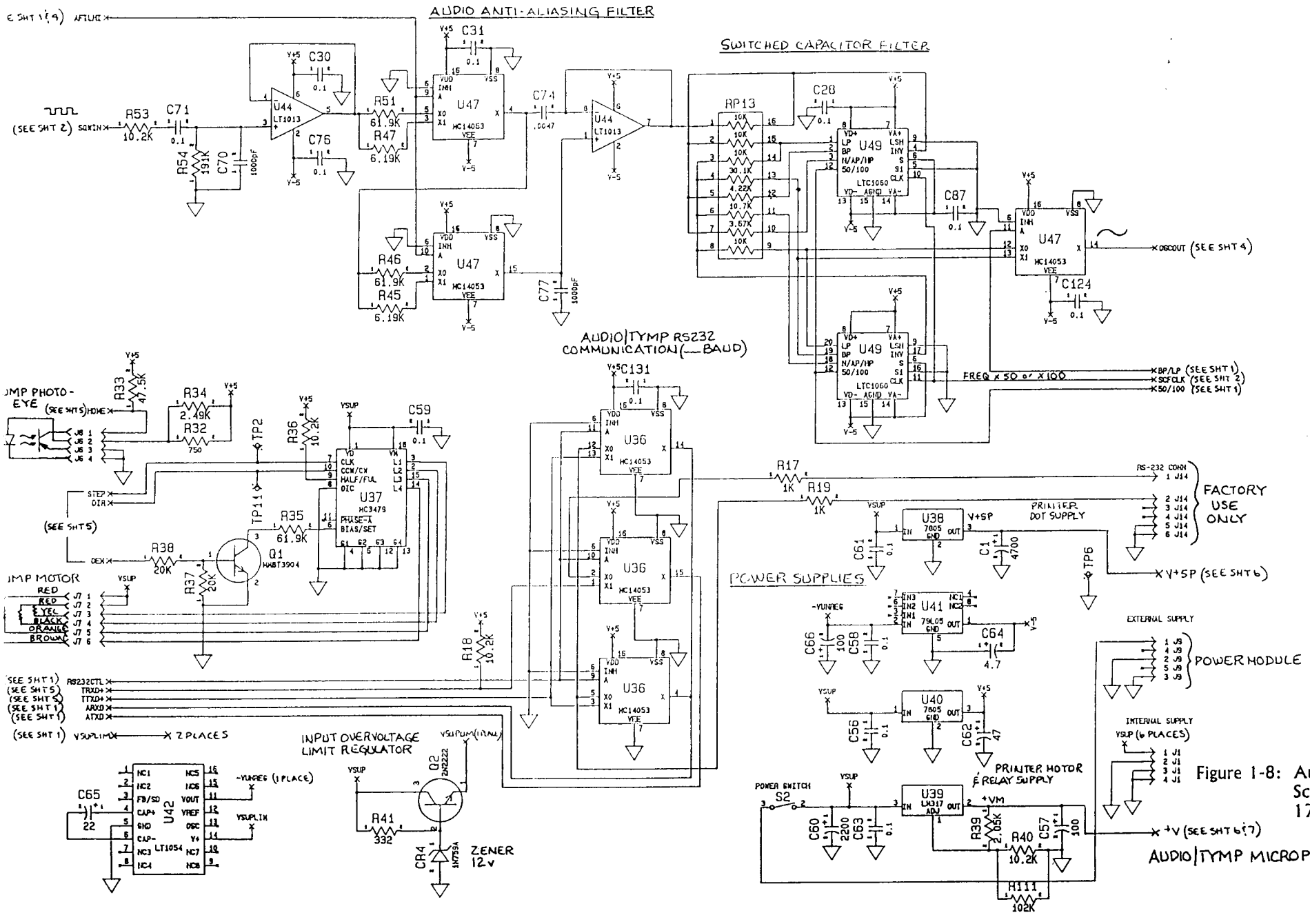


Figure 1-8: Audio/Tymp Board Schematic #3 1738-4705 (1)

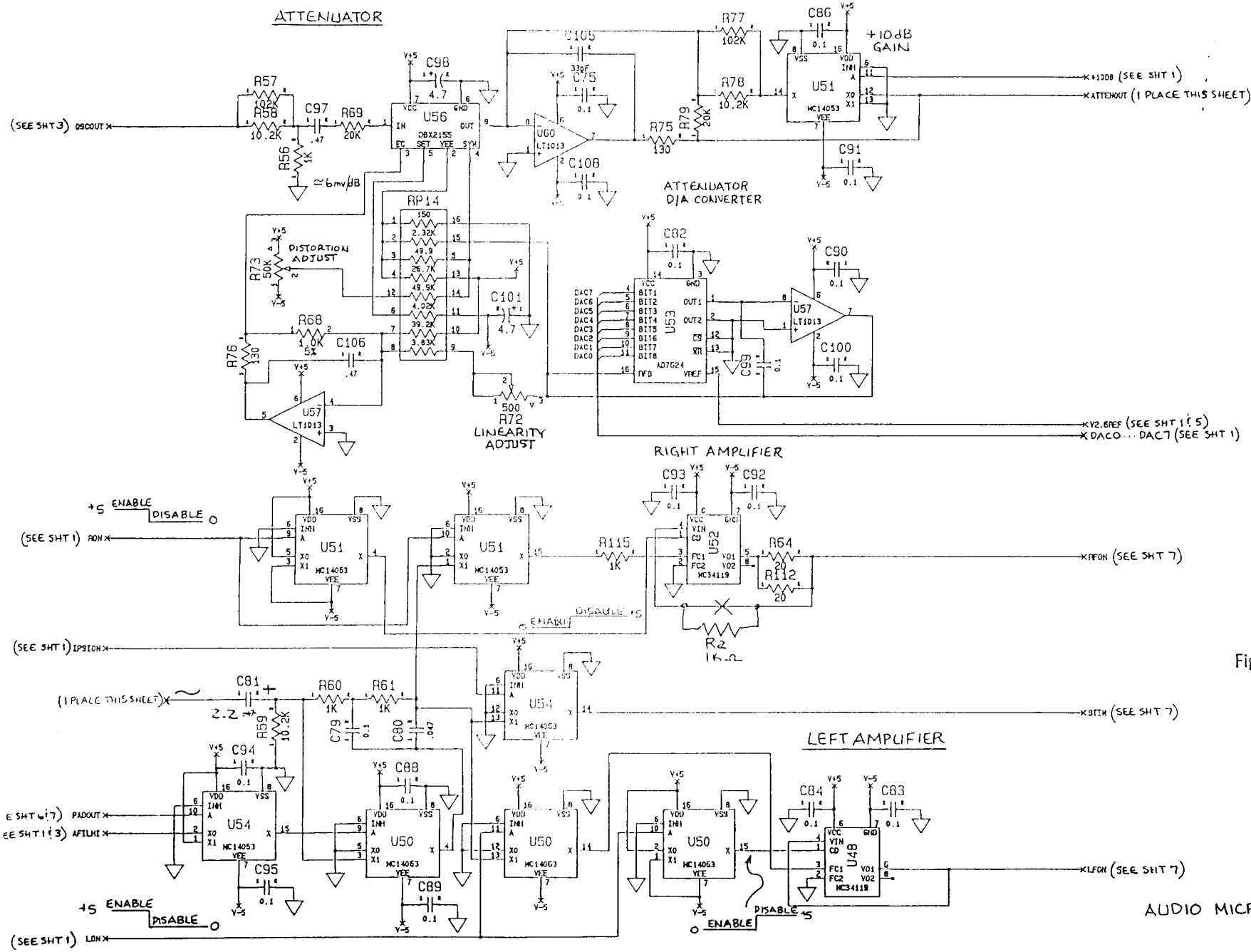


Figure 1-8: Audio/Tymp Board Schematic #4 1738-4705 (1)

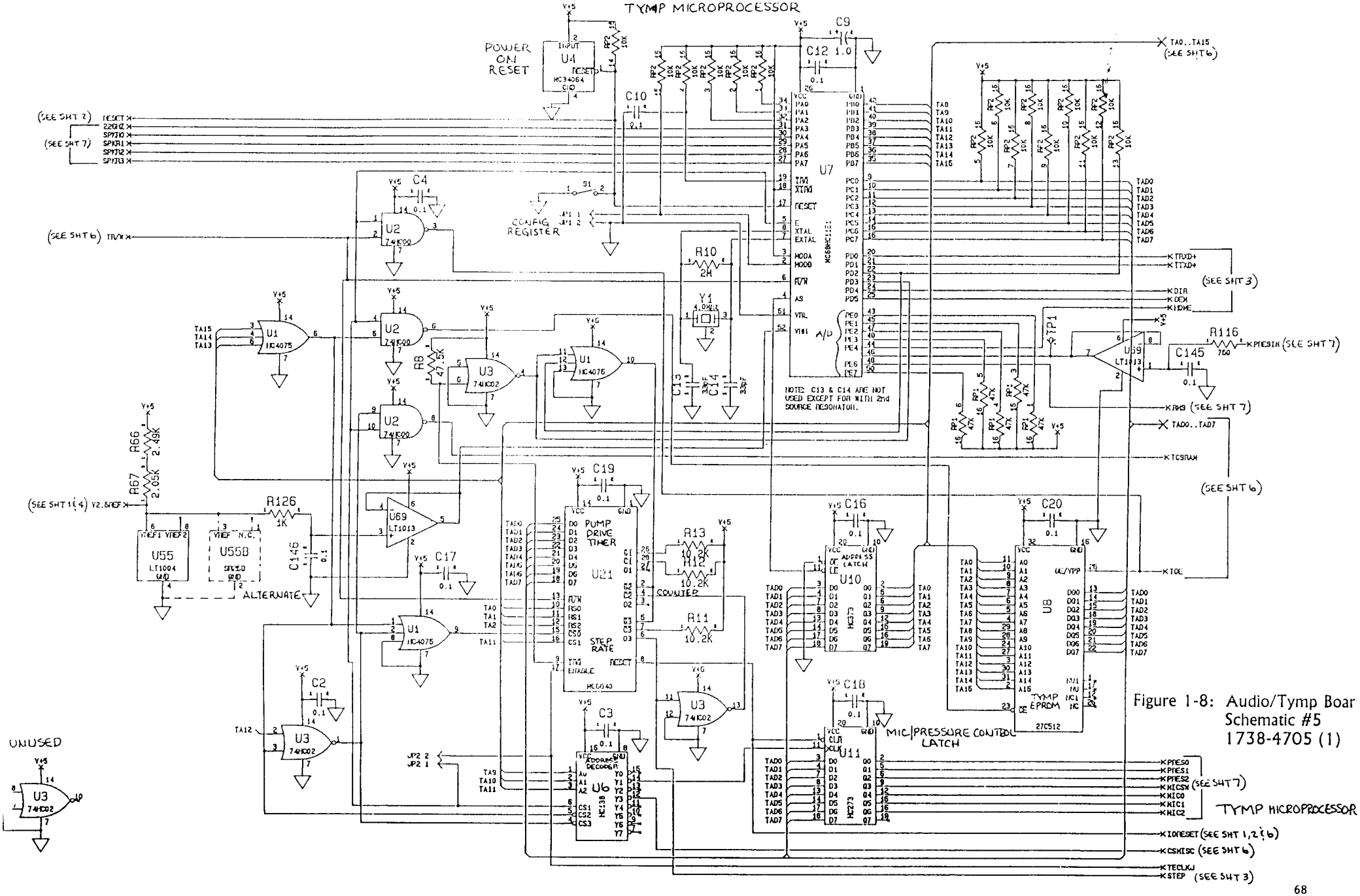


Figure 1-8: Audio/Tymp Boar Schematic #5 1738-4705 (1)

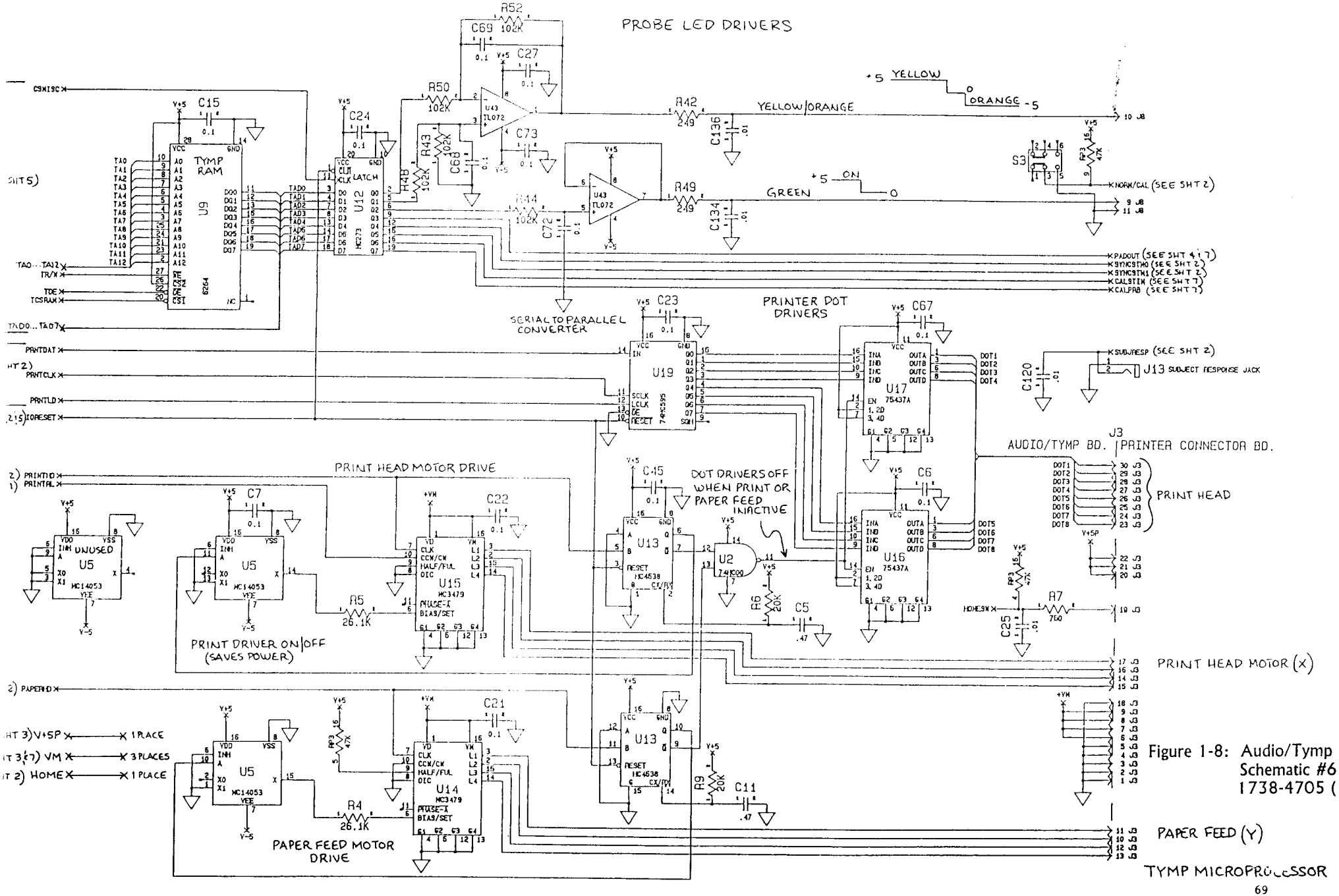


Figure 1-8: Audio/Tymp Boar
Schematic #6
1738-4705 (1)

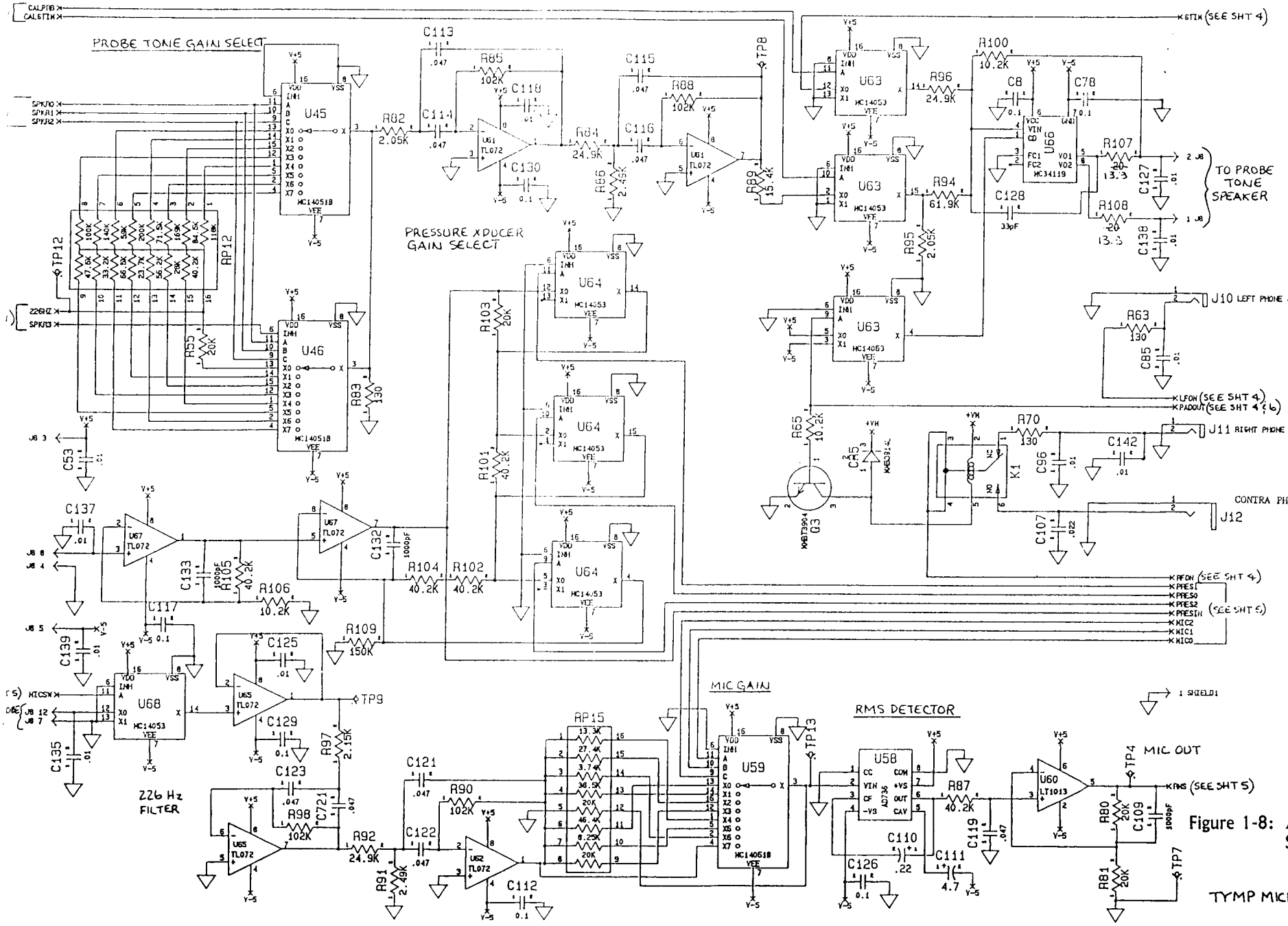


Figure 1-8: Audio/Tymp Board Schematic #7 1738-4705 (1)

RE1 2 BIT ENCODER
36 POSITION

CLOCKWISE ROTATION

POSITION NUMBER	SHORT TO COMMON 1	2
1	0	0
2	1	0
3	1	1
4	0	1
5	0	0
6	1	0
7	1	1
8	0	1
9	0	0
10	1	0
11	1	1
12	0	1
13	0	0
14	1	0
15	1	1
16	0	1
17	0	0
18	1	0
19	1	1
20	0	1
21	0	0
22	1	0
23	1	1
24	0	1
25	0	0
26	1	0
27	1	1
28	0	1
29	0	0
30	1	0
31	1	1
32	0	1
33	0	0
34	1	0
35	1	1
36	0	1

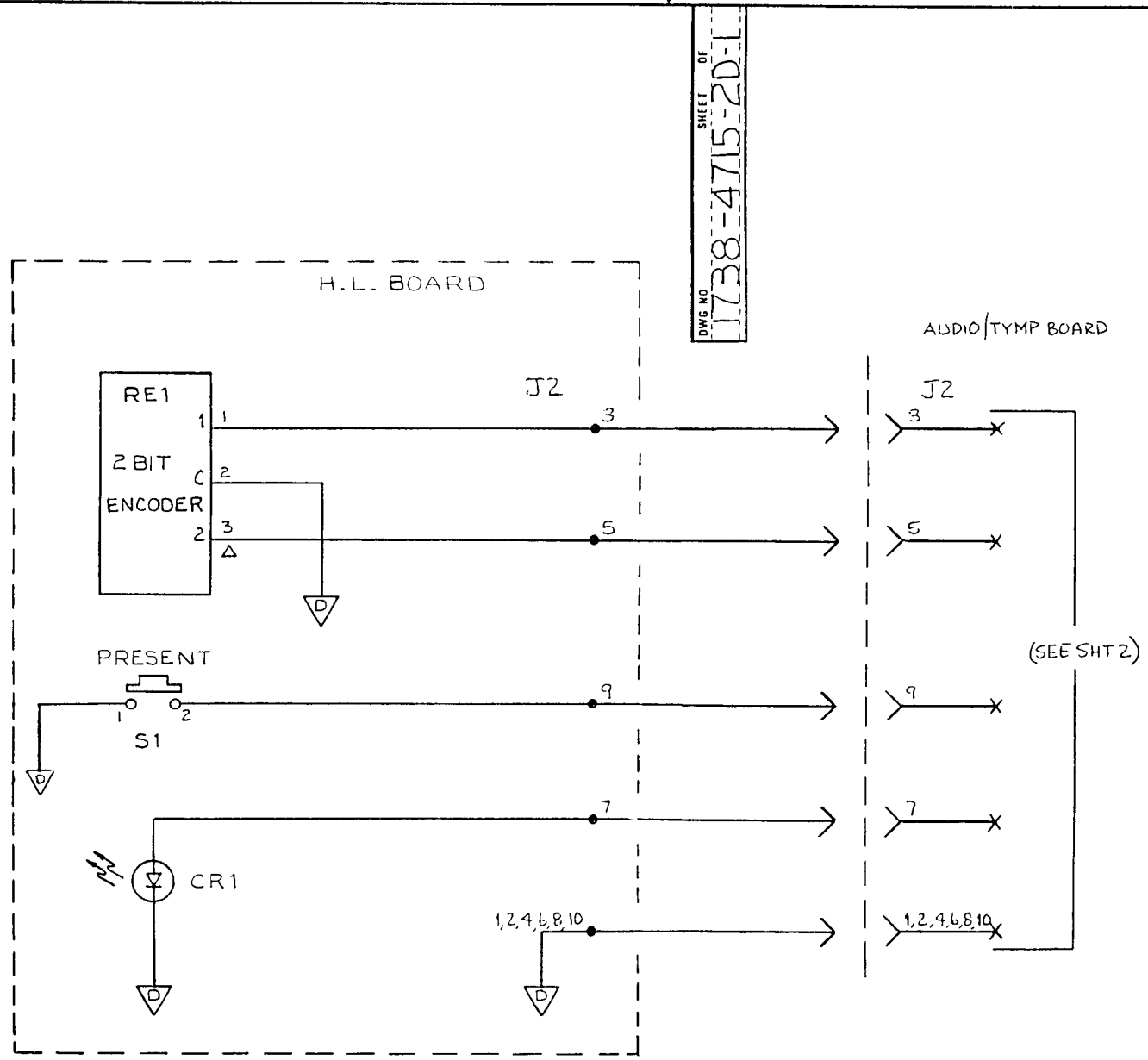


Figure 1-9: H L Board Schematic
1738-4715 (1)

AUDIO/TYMP BOARD PARTS LIST

DESIGNATION	DESCRIPTION	PART NUMBER
INTEGRATED CIRCUITS		
U1	IC, SMT, 74 HC 4075, 3 INPUT OR	5905-4075
U2	IC, SMT, 74 HCOO, QUAD 2 INPUT NAND	5905-0000
U3	IC, SMT, 74 HC02, QUAD 2 INPUT NOR	5905-0002
U4	IC, SMT, MC 34064, UNDER VOLTAGE SENSOR	**59334064**
U5	IC, SMT, MC 14053, TR1-2 CH MUX/DEMUX	5904-4053
U6	IC, SMT, 74HCC138, 1 OF 8 DECODE/DEMUX	5905-0138
U7	IC, SMT, 68HC11E1, 8 BIT MICRO	
U8	EPROM, PROGRAMMED	1738-0510
U9	IC, SMT, 6264, 8K X 8 STATIC RAM	5904-6264
U10	IC, SMT, 74 HC 373, 3 STATE OCTAL LATCH	5905-0373
U11	IC, SMT, 74 HC 273, OCTAL D FLIP-FLOP	5905-0273
U12	SEE Ull	
U13	IC, SMT 74 HC 4538, DUAL MULTIVIBRATOR	5905-4538
U14	IC, MC 3479, STEP MOTOR DRIVER	5431-9697
U15	SEE U14	
U16	IC, SN 754377, QUAD PERIPHERAL DRIVER	5431-9697
U17	SEE U16	
U18	SEE U2	
U19	IC, SMT, 74 HC 595, 8 BIT I/O SHIFT REG.	5909-0595
U20	SEE U11	
U21	IC, MC 6840, PROGRAMMABLE TIMER	5431-9018
U22	IC, SMT, 74 HC 10, 3 INPUT NAND	5905-0010
U23	SEE U10	
U24	IC, SMT, 82 C 54, PROGRAMMABLE TIMER	5929-8254
U25	SEE Ull	
U26-U28	IC, SMT, 74 HC 541, OCTAL BUFFER/DRIVER	5905-054 1
U29	IC, SMT, 74 HC 245, 3 STATE BUS X-CIEVER	5905-0245
U30	EPROM PROGRAMMED	1738-0505
U31	SEE U26 - U28	
U32	IC, SMT, MS 62256, 32KX8, STATIC RAM	5904-2256
U33	IC, SMT, CMOSPAL, PROGRAMMED	1738-0515
U34	SEE U7	
U35	IC, SMT, LT 1054, VOLTAGE CONV/REG	5908-l 054
U36	SEE U5	
U37	SEE U14	
U38	IC, MC 7805, +5V REG	5432-l 066
U39	IC, 317, REGULATOR	5432-l 024

1.50

DESIGNATION	DESCRIPTION	PART NUMBER
INTEGRATED CIRCUITS CONTINUED...		
U40	SEE U38	
U41	IC, SMT, MC 79L05, -5V REG	5908-7905
U43	IC, SMT, TL072, JFET OP AMP	5909-0072
U44	IC, SMT, LT1013, DUAL OP AMP	5909-1013
U45	IC, SMT, 140518, ANALOG MULTI PLXR	
U46	SEE U45	
U47	SEE U5	
U48	IC, SMT, MC 34119, LOW POWER AUD. AMP	5904-4 119
U49	IC, SMT, LTC1060CS, SWITCHED CAP FILTER	5904-l 060
U50 - U51	SEE U5	
U52	SEE U48	
U53	IC, SMT, AD7524, 8 BIT D/A CONVERTER	5907-7524
U54	SEE U5	
U55	IC, SMT, SR25D, 2.5V REF	5933-0025
U56	IC, DBX2150, VC AMP	5432-l 092
U57	SEE U44	
U58	IC, SMT. AD736. RMS/DC CONVERTER	5907-0736
U59	SEE U45	
U60	SEE U44	
U61 - U62	SEE U43	
U63 - U64	SEE U5	
U65	SEE U43	
U66	SEE U48	
U67	SEE U43	
U68	SEE U5	
U69	SEE U44	
DIODES		
CR1 - CR3	DIODE, SMT, MMB0914L	6082-2002
CR4	DIODE, ZENER, 1N759A, 12v	6083-1014
CR5 - CR6	SEE CR1 - CR3	
RESISTORS & POTENTIOMETERS		
RI	RES, SMT, 1K, 1%, .12W	6650-l 100
R2	RES, SMT, 47.5K, 1%, .12W	6650-2475
R3	RES, SMT, 249 OHM, 1%, .12W	6650-0249
R4 - R5	RES, SMT, 26.1K, 1%, .12W	6650-2261
R6	RES, SMT, 20K, 1%, .12W	6650-2200
R7	RES, SMT, 750 OHM, 1%, .12W	6650-0750
R8	SEE R2	
R9	SEE R6	
R10	RES, SMT, 2M, 1%, .12W	6650-4200
RII - R13	RES, SMT, 10.2K, 1%, 12W	6650-2102
R14	RES, SMT, 130 OHM, 1%, .12W	6650-0130
R15	SEE R10	

DESIGNATION	DESCRIPTION	PART NUMBER
RESISTORS 8 POTENTIOMETERS		
R16	THERMISTOR, 10K, 10%, 4.41%/C	6740-l 302
R17	SEE R1	
R18	SEE Rll - R13	
R19	SEE Rl	
R20	SEE R11 - R13	
R21 - R22	SEE R1	
R23	SEE R22	
R24	SEE R1	
R25	RES, SMT, 24.9K, 1%, .12W	6650-2249
R26	SEE R1	
R27	RES, SMT, 64.9K, 1%, .12W	6650-2649
R28	SEE R6	
R29	SEE R27	
R30	THERMISTOR, SMT, 100K, 10%	6740-l 350
R31	RES, SMT, 23.2K, 18, .12W	6650-2232
R32	SEE R7	
R33	SEE R2	
R34	RES, SMT, 2.49K, 1%, .12W	6650-1249
R35	RES, SMT, 61.9K, 1%, .12W	6650-2619
R36	SEE R11 - R13	
R37 - R38	SEE R6	
R39	RES, SMT, 2.05K, 1%, .12W	6650-l 205
R40	SEE R11 - R13	
R41	RES, FILM, 332 OHM, 1%, .25W	6350-0332
R42	SEE R3	
R43	RES, SMT, 102K, 1%, .12W	6650-3102
R44	SEE R43	
R45	RES, SMT, 6.19K, 1%, .12W	6650-1619
R46	'SEE R35	
R47	SEE R45	
R48	SEE R43	
R49	SEE R3	
R50	SEE R43	
R51	SEE R35	
R52	SEE R43	
R53	SEE Rll - R13	
R54	RES, SMT, 191K, 1%, .12W	6650-3191
R55	SEE R6	
R56	SEE R1	
R57	SEE R43	
R58 - R59	SEE R11 - R13	
R60 - R61	SEE Rl	
R62 - R63	SEE R14	
R64	RES, SMT, 20 OHMS, 1%, .12W	6650-9200
R65	SEE Rll - R13	
R66	SEE R34	
R67	SEE R39	
R68	RES, WW, TEMP. SENS, l.lK 3600 PPM, 5%	6700-0002
R69	SEE R6	

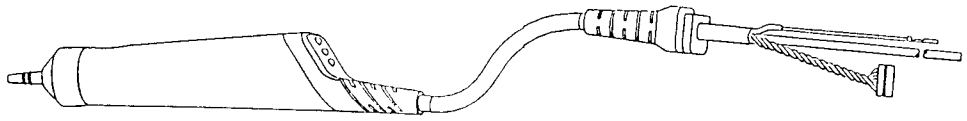
DESIGNATION	DESCRIPTION	PART NUMBER
RESISTORS 8 POTENTIOMETERS		
R70	SEE R14	
R72	POT, CER MET, 1K OHM, +/- 10%	6049-0500
R73	POT, CER MET, 50 K, +/- 10%	6049-0350
R74	RES, SMT, 40.2K, 1%, .12W	6650-2402
R75 - R76	SEE R14	
R77	SEE R43	
R78	SEE Rll - R13	
R79 - R81	SEE R6	
R82	SEE R39	
R83	SEE R14	
R84	SEE R25	
R85	SEE R43	
R86	SEE R34	
R87	SEE R74	
R88	SEE R43	
R89	RES, SMT, 15.4K, 1%, .12W	6650-2154
R90	SEE R43	
R91	SEE R34	
R92	SEE R25	
R93	SEE R2	
R94	SEE R35	
R95	SEE R34	
R96	SEE R4	
R97	SEE R39	
R98	SEE R85	
R99	SEE R2	
R100	RES, SMT, 8.25, 1%, .12W	6650-l 825
R101 - R102	SEE R74	
R103	'SEE R6	
R104 - R105	SEE R74	
R106	SEE R11 - R13	
R107	RES, SMT, 13.3 OHMS, 1%, .12W	6650-9133
R108	SEE R107	
R109	RES, SMT, 150K, 1%, .12W	6650-3150
R110	SEE R25	
R l l l	SEE R43	
RI12	SEE R64	
R115	SEE RI	
R116	SEE R7	
R150	POT, CER MET, 10K, +/- 20%	6049-0386
R151	SEE R1	
R200	SEE R7	
R201	SEE Rll - R13	
	SEE R34	

DESIGNATION	DESCRIPTION	PART NUMBER
CAPACITORS		
C1	CAP, ELECT, 4700uF, 20%, 16V	4450-6311
C2	CAP, SMT, CER, 01uF, 10%, 50V	4500-l 041
C4	SEE C2	
C5	CAP, SMT, CER, .47uF, 20%, 50V	4500-4742
C7 - C8	SEE C2	
C9	CAP, SMT, TANT, 1.0uF, 20%, 35V	4550-l 052
C10	SEE C2	
C11	SEE C5	
C12	SEE C2	
C13	CAP, SMT, CER	
C14	SEE C13	
C15		
C16		
C17 - C24	SEE C2	
C25	CAP, SMT, CER, .01uF, 10%, 50V	4500-l 301
C27	SEE C2	
C28		
C29		
C30 - C35	SEE C2	
C36	CAP, SMT, CER, 1000PF, 5%, 50V	4500-l 025
C37	CAP, TANT, AXAL LEAD, 100uF, 20%, 16V	4450-4515
C39 - C40	SEE C13	
C41	CAP, SMT, TANT, .47uF, 10%, 35V	4550-474 1
C42-C46	SEE C2	
C47	SEE C9	
C48-C49	SEE C2	
C50	CAP, SMT, TANT, 4.7uF, 10%, 25V	4550-4751
C51	SEE C2	
C52	SEE C50	
C53	SEE C25	
C54	SEE C50	
C55	SEE C37	
C56	SEE C2	
C57	SEE C37	
C58 - C59	SEE C2	
C60	CAP ELECT, 2200uF, 20%, 25V	4450-6310
C61	SEE C2	
C62	CAP, SMT, TANT, 47uF, 20%, 10V	4550-4762
C63	SEE C2	
C64	SEE C50	
C65	CAP, SMT, TANT, 22uF, 10%, 20V	4550-2261
C66	SEE C37	
C67 - C69	SEE C2	
C70	SEE C36	
C71 - c73	SEE C2	
C74	CAP, SMT, CER, .0047uF, 10%, 50V	
C75 - C76	SEE C2	
C77	SEE C36	
C78 - C79	SEE C2	

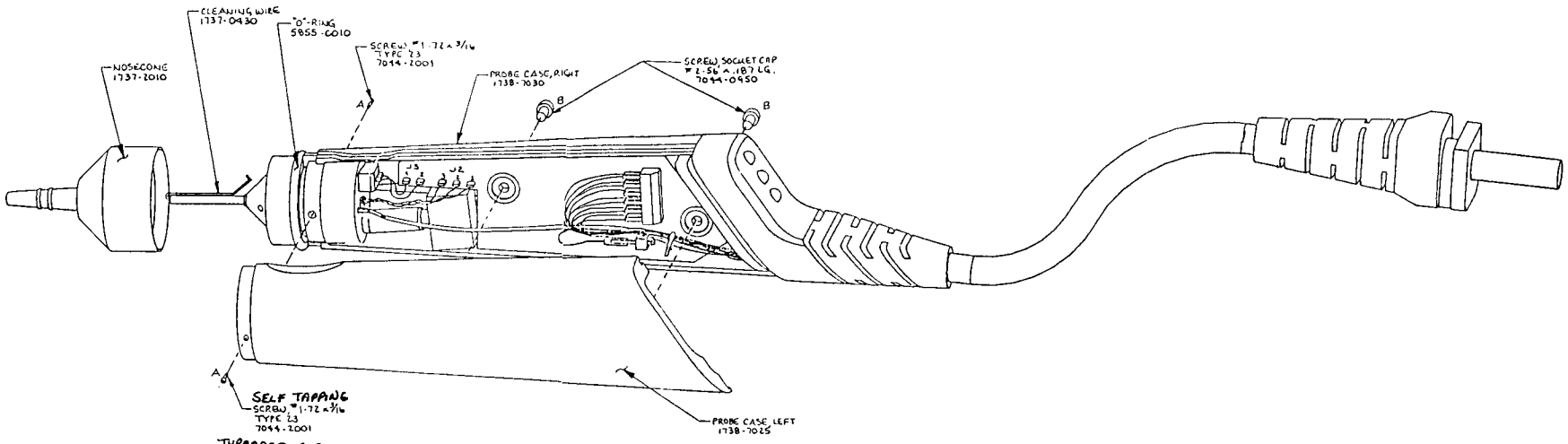
DESIGNATION	DESCRIPTION	PART NUMBER
CAPACITORS		
C80	CAP, SMT, CER, .047uF, 10%, 50V	4500-4731
C81	CAP, SMT, TANT, 2.2uF, 10%, 20V	4550-2251
C82 - C84	SEE C2	
C85	SEE C25	
C86 - c95	SEE C2	
C96	SEE C25	
c97	SEE C5	
C98	SEE C50	
C99 - C100	SEE C2	
C101	SEE C50	
Cl02 - Cl04	SEE C2	
C105	CAP, SMT, CER, 33pF, 5%, 50V	4500-3305
Cl06	SEE C5	
Cl07	CAP, SMT, CER, .022uF, 10%, 50V	4500-2231
C108	SEE C2	
Cl09	SEE C36	
Cl10	CAP, SMT, TANT, .22uF, 10%, 35V	4550-2241
Cl11	SEE C50	
Cl12	SEE C2	
Cl13 - C116	CAP, POLYPROP, .047uF, 5%, 50V	4862-2807
C117	SEE C2	
C118	SEE C25	
Cl19	SEE C80	
Cl20	SEE C25	
Cl21 - 123	SEE Cl13 - C116	
Cl24	SEE C2	
Cl25	SEE C25	
Cl26	SEE C2	
Cl27	SEE C25	
Cl28	SEE Cl05	
C129 - C131	SEE C2	
Cl32 - Cl33	SEE C36	
Cl34 - C139	SEE C25	
Cl40	SEE C74	
Cl45 - Cl46	SEE C2	
C200	SEE C25	
C201	SEE C9	
C202	CAP, SMT, CER, .0033uF, 10%, 50V	4500-3321
C721	SEE C113 - C116	
RESISTOR NETWORK		
RP1	RES, NETWORK, SMT, 47K PULL-UP	6740-2012
RP2	RES, NETWORK, SMT, 10K PULL-UP	6740-2011
RP3 - RP4	SEE RP1	
RP5	SEE RP2	
RP6 - RP7	SEE RP1	
RP8 - RP9	RES, NETWORK, SMT, 100 OHM SERIES	6740-2010

DESIGNATION	DESCRIPTION	PART NUMBER
RESISTOR NETWORK		
RP10	SEE RP1	
RP12	RES, NETWORK, SMT, CUSTOM X 15	6740-20 13
RP13	RES, NETWORK, SMT, CUSTOM X 8	6740-2016
RP14	RES, NETWORK, SMT, CUSTOM X 8	6740-2015
RP15	RES, NETWORK, SMT, CUSTOM X 8	6740-2014
RP17	SEE RP1	
TRANSDUCERS		
Q1	XSTR, SMT, MMBT 3904, NPN	8214-1035
Q2	XSTR, 2N222, NPN	8210-1222
Q3	SEE Q1	
SWITCHES		
S2	SWITCH, POWER	7874-0030
S3	SWITCH, SLIDE, DPDT, RT. ANGLE	7874-0175
S4	SWITCH, DIP, 8 POS, RT. ANGLE	7874-0169
MISCELANEOUS		
JI	POST HEADER ASSEMBLY, 4 POSITION	4230-3201
J2	HEADER, 10 PIN, RT ANGLE, LKG	4230-7310
J3	HEADER, 30 PIN, RT ANGLE, LKG	4230-7330
J4 (30 PINS)	CONN., STRIP, MALE, RT ANGLE	4230-7052
J5	HEADER, 20 PIN, RT ANGLE, LKG	4230-7320
J6	HEADER, SHROUDED, 1 ROW, 4 PIN	4230-2204
J7	'HEADER, SHROUDED, 1 ROW, 6 PIN	4230-2206
J8	HEADER, RT. ANGLE, 2MM SP, 12 POSITION	4230-I 540
J9	CONN., MALE, JACK, 5 PIN DIN	4230-4025
J10 - J13	JACK, PHONE, PC MTG, LOW PROFILE	4214-0155
J14	CONN., RT ANGLE, TELE., 6 CONTACT	4230-4031
JP1 - JP3	CONN., STRIP, SIP, 36 CONT.	4230-8069
TP1- TP15	JUMPER, TEST POINT, .020 DIA	5080-0001
Y1 -Y2	CRYSTAL, 4.00 MH2	5075-0045
KI	RELAY, SPST, 9V	6090-I 530
XY1 - XY2	INSULATION, CRYSTAL	7574-02 10
XU7	SOCKET, SMT, LOW PROFILE, PLCC52	7574-I 052
XU8	SOCKET, SMT, LOW PROFILE, PLCC32	7574-I 032
XU30	SEE XU8	
XU34	SEE XU7	
	CONN., STRIP, RT ANGLE, 1 PIN	42304633
	SHIELD 1	
	HEATSINK, 16 PIN DIP SLIDE - ON	5415-3016
	HEATSINK, TO-220	5415-2005
	NUT, HEX, LOCKING, #6-32	5814-0003
	SCREW, FIL. HD. INS, .138 X 32 X 1.5 LG	7137-0160
	SPACER, INS, LG	7574-0015

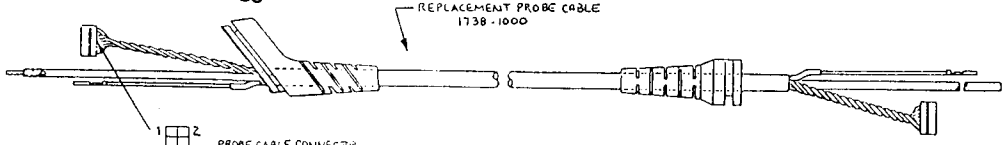
PROBE

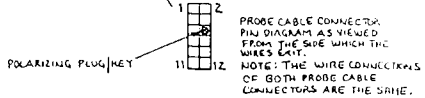


CONNECTION CHART		
FROM	TO	USING
SPEAKER	J3 PIN 1	BLACK
SPEAKER	J3 PIN 2	WHITE
MICROPHONE	J2 PIN 1	GRAY
MICROPHONE	J2 PIN 2	BLACK
MICROPHONE	J2 PIN 3	WHITE



THREADED SCREW
7044-2000





CONNECTION CHART	
FROM ITEM 20	TO ITEM 45
VIOLET	1
LT. RED	2
GRAY	3
ORANGE	4
BLACK	5
ITEM 50	6
BLUE	7
BROWN	8
LT. GREEN	9
GREEN	10
DK. RED	11
YELLOW	12

Figure 1-4: Probe Assembly

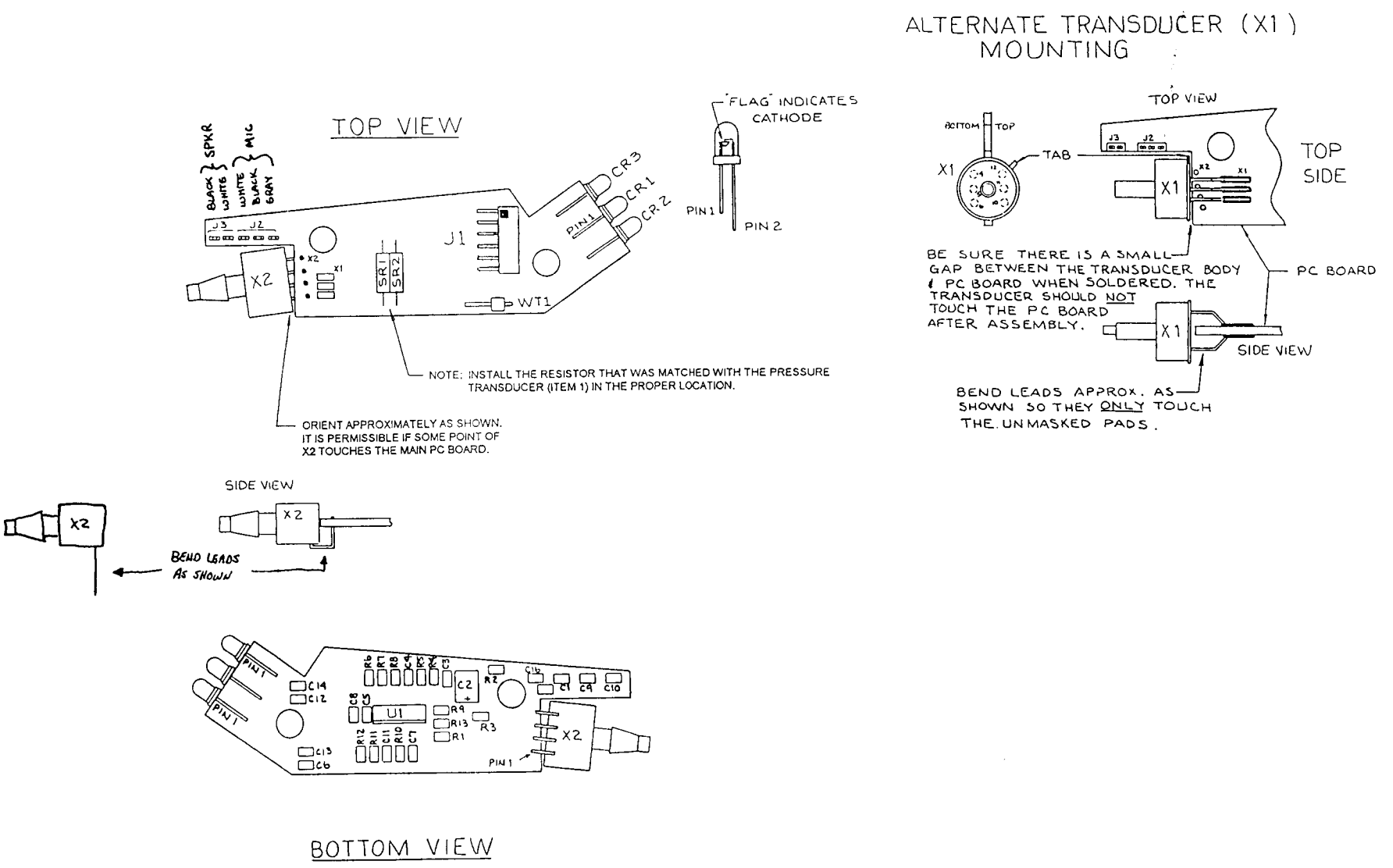


Figure 1-5: Probe Board Component Layo

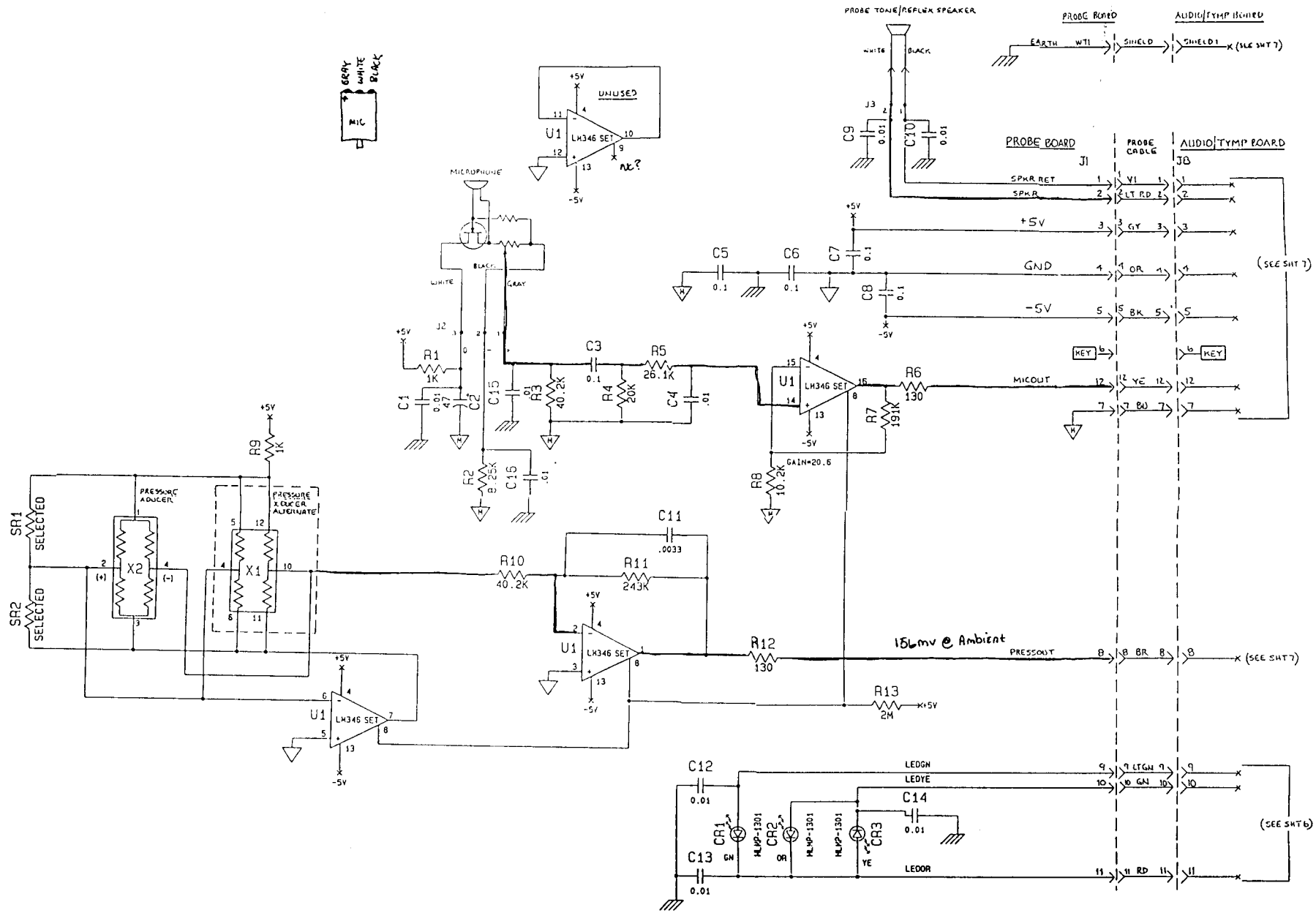


Figure 1-6: Probe Schemat

PROBE ASSEMBLY PARTS LIST

DESIGNATION	DESCRIPTION	PART NUMBER
	ASSEMBLY, PROBE	1738-3200
	CONSISTING OF:	
	WIRE, CLEANING	1737-0430
	ASSEMBLY, NOSECONE	1737-201 0
	NOSECONE, THREADED	1737-6004
	ASSEMBLY, PROBE CABLE	1738-1000
	ASSEMBLY, PROBE BOARD	1738-4700
	CASE, PROBE, LEFT	1738-7025
	CASE, PROBE, RIGHT	1738-7030
	TUBING, TYGON, .062 ID x .5 LG	0028-7576
	TUBING, TYGON, .125 ID x .5 LG.	0028-7577
	O-RING, 5/8 ID, 3/4 OD	5855-0010
	SCREW, SOCKET CAP, #2-56 x .187 LG.	7044-0950
	CLAMP, INSULATED	4314-0033
	SCREW, FIAT HEAD, #1-42 x 3/16, TYPE 23	7044-200 1

PROBE BOARD PARTS LIST

DESIGNATION	DESCRIPTION	PART NUMBER
INTERGRATED CIRCUITS		
U1	IC, SMT, LM346, PRG 1UAD OP-AMP	5909-0346
RESISTORS		
R1	RES, SMT, 1K OHM, 1%, .12W	6650-0110
R2	RES, SMT, 8.25K OHM, 1%, .12W	6650-l 825
R3	RES, SMT, 40.2K OHM, 1%, .12W	6650-2402
R4	RES, SMT, 20K OHM, 1%, .12W	6650-2200
R5	RES, SMT, 26.1K OHM, 1%, .12W	6650-2261
R6	RES, SMT, 130 OHM, 1%, .12W	6650-0130
R7	RES, SMT, 191K OHM, 1%, .12W	6650-3191
R8	RES, SMT, 10.2K OHM, 12W	6650-2102

DESIGNATION	DESCRIPTION	PART NUMBER
RESISTORS CONTINUED		
R9	SEE R1	
R10	SEE R3	
R11	RES, SMT, 243K OHM, 1%, .12W	6650-3242
R12	SEE R6	
R13	RES, SMT, 2 M OHM, 1%, .12W	6650-4200
CAPACITORS		
C1	CAP, SMT, CER, .01uF, 10% 50V	4500-1 031
c2	CAP, SMT, TANT 47 uF, 20%, 10V	4550-4762
c3	CAP, SMT, CER, 1uF, 10%, 35V	4550-1 041
C4	SEE C1	
C5 - C8	SEE C3	
C9 - C10	SEE C1	
C11	CAP, SMT, CER, .0033uF, 10%, 50V	4550-3321
C12 - C16	SEE C1	
LED		
CR1	LED, GREEN, .130 DIA	6084-1 071
CR2	LED, ORANGE, .130 DIA	6084-1 070
CR3	LED, YELLOW, .130 DIA	6084-1 072
HEADER		
J1	HEADER, DBL - ROW, 2 MMSP, 12 POS	4230-1 540
J2 - J3	'TERMINAL, WIRE WRAPPING	7924-0061
CONNECTOR STRIP		
WT1	CONN. STRIP, RT. ANGLE, 1 PIN	4230-4633
MISCELLANEOUS		
X2	TANSDUCER, PRESSURE	1738-0427
SR1 - SR2	SEE X2	

NOSECONE “0’‘-RING PARTS LIST

DESIGNATION	DESCRIPTION	PART NUMBER
	KIT, NOSECONE, W-RING, GREASE CONSISTING OF:	1738-9605
	KIT, GREASE, "O"-RING	1738-9610
	NOSECONE, THREADED	1737-6004
	W-RING	5855-0010

PUMP

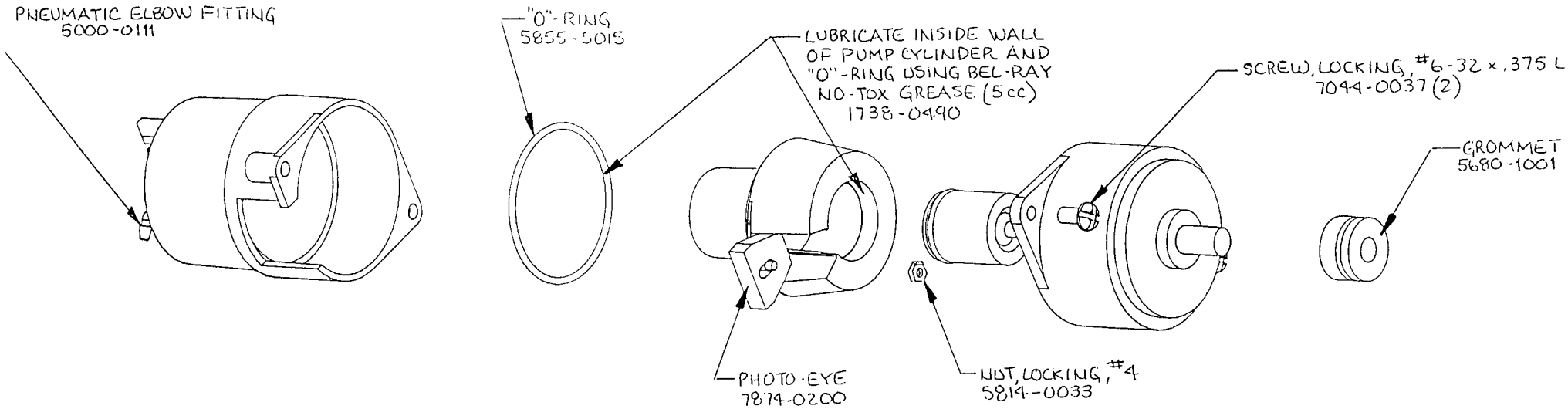
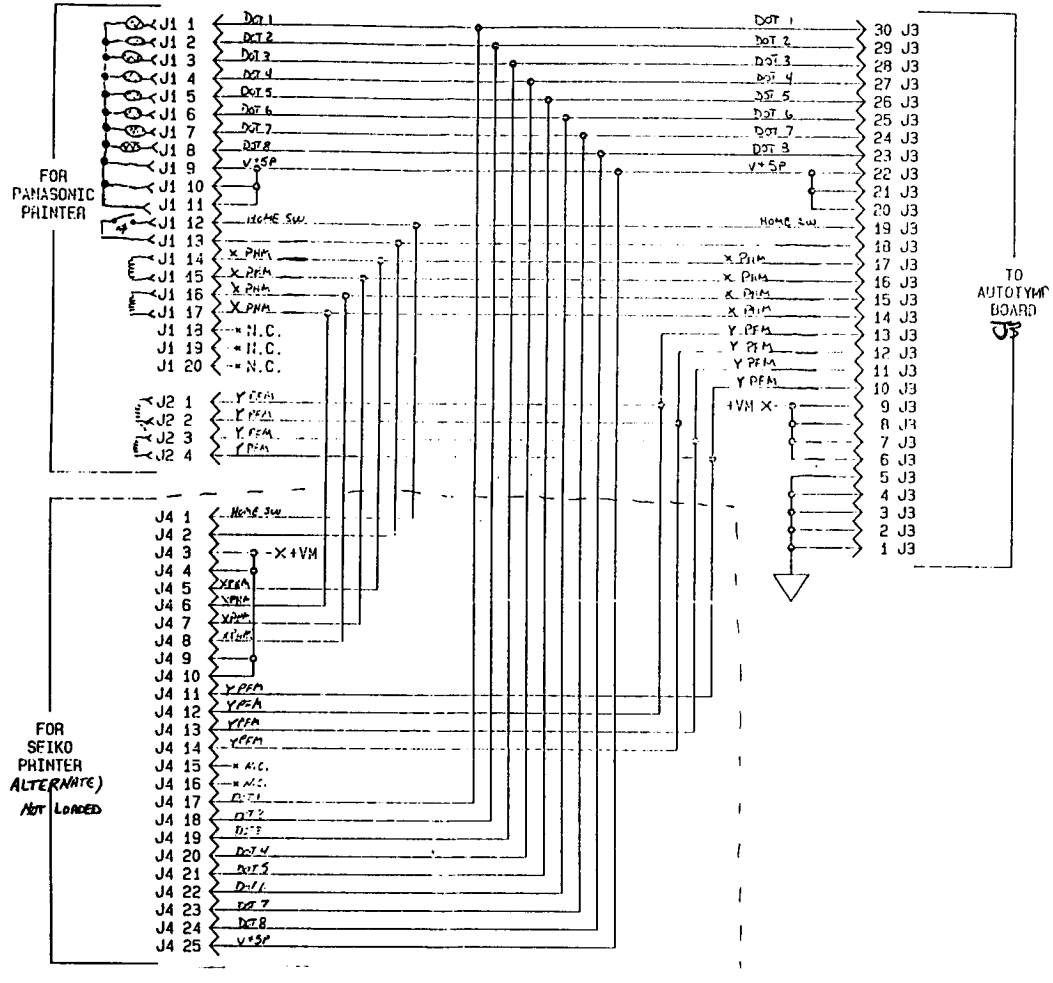
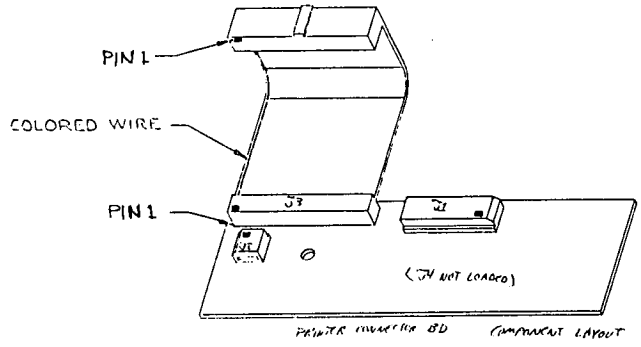


Figure 1-3: Pump Assembly

PRINTER





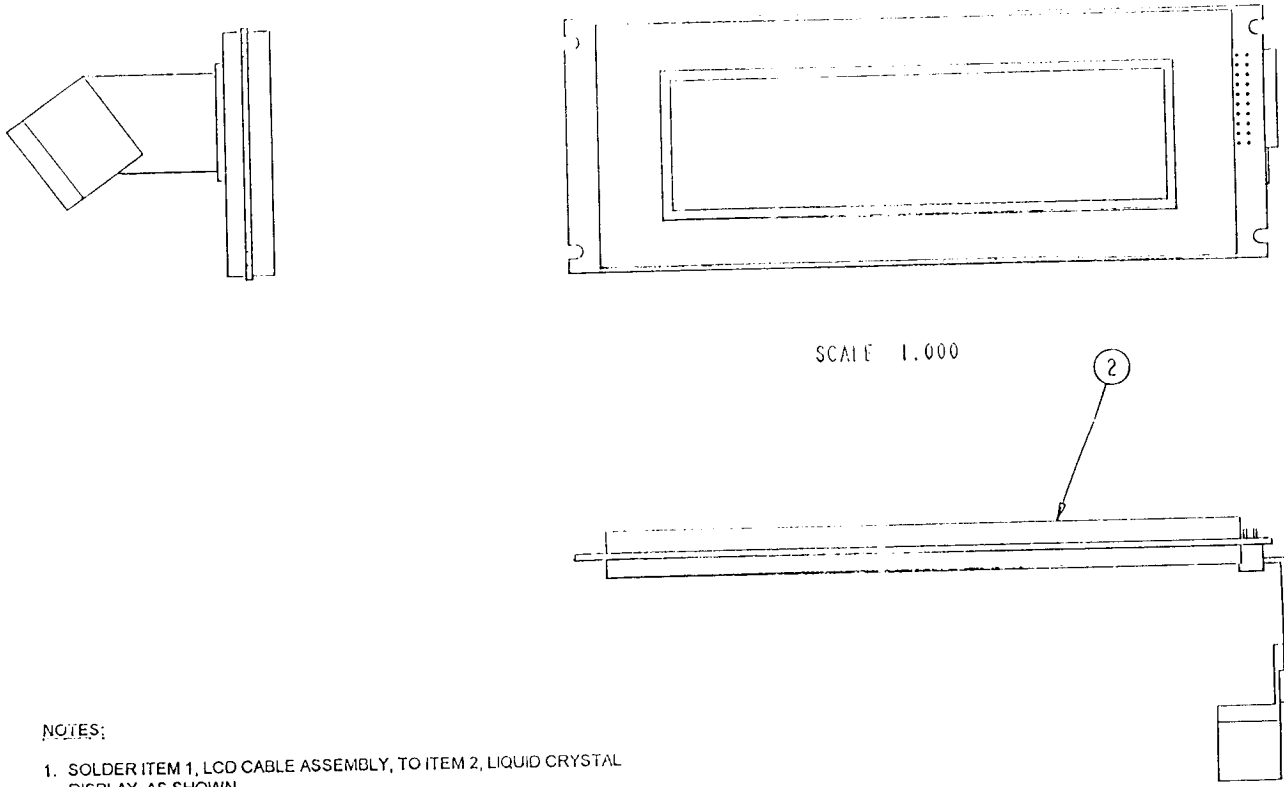
Schematic, Printer Connector Board

1738-4710

PRINTER CONNECTION BOARD PARTS LIST

DESIGNATION	DESCRIPTION	PART NUMBER
	ASSEMBLY, PRINTER CONNTECTOR BD. CONSISTING OF:	1738-4710
	ASSEMBLY, CABLE, PRINTER-CONN. BD.	1738-0205
	PRINTER CONNECTOR BOARD	1738-0710
J1	CONN, FIAT CABLE, 20 CONTACT	4230-1620
J2	CONN., FIAT CABLE, 4 CONTACT	4230-1604

DISPLAY



NOTES:

1. SOLDER ITEM 1, LCD CABLE ASSEMBLY, TO ITEM 2, LIQUID CRYSTAL DISPLAY, AS SHOWN.
2. IF NECESSARY, THE ASSEMBLY CAN BE TESTED ON FIXTURE 1738-3815.
3. PIN 1 OF CONNECTOR DOES NOT MATCH PIN 1 OF DISPLAY.

Assembly, Liquid Crystal Display

1738-1010

LIQUID CRYSTAL DISPLAY PARTS LIST

DESIGNATION	DESCRIPTION	PART NUMBER
	ASSEMBLY, LIQUID CRYSTAL DISPLAY CONSISTING OF:	1738-1010
	ASSEMBLY, CABLE, LCD	1738-0200
	DISPLAY, LIQUID CRYSTAL, 240 X 64	5437-1238

ASSEMBLY

ASSEMBLY CONTRA PHONE PARTS LIST

QUANTITY	DESCRIPTION	PART NUMBER
X	INSERT PHONE ASSEMBLY CONSISTING OF:	8000-0079
1	CABLE, COAXIAL, 6'	4204-0209
1	EARPHONE (AUDIOVOX) 470 ohm	8000-0037
1	EARTIP, MODIFIED	8000-0255

ASSEMBLY TDH-39 TEST HEAD SET PARTS LIST

QUANTITY	DESCRIPTION	PART NUMBER
X	ASSEMBLY, HEAD SET CONSISTING OF:	8000-0175
1	HEADBAND.	8000-0142
2	EARPHONE, 60 ohm, PLASTIC TDH-39	8000-0046
1	CORD, HEAD SET, DUAL	4204-0147
2	CUSHION, EARPHONE, MX41	8000-0143