GSI 38
Auto Tymp

Instruction Manual

Instruction Manual 1738-0100, Rev 9
Revised January, 2006

VIASYS™ HEALTHCARE
Excellence For Life

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Electromagnetic compatibility (EMC)

Please refer to the Electromagnetic Compatibility Reference Guide on CD (part number 482-6387xx) for EMC information concerning your system.

Compatibilité électromagnétique (CEM)

Veuillez vous reporter au guide de référence de compatibilité électromagnétique sur CD (numéro de pièce 482-6387xx) pour des informations sur la CEM relatives à votre système.

Elektromagnetische Verträglichkeit (EMV)

Informationen über die EMV des Systems finden Sie im Referenz-Handbuch Elektromagnetische Verträglichkeit auf der CD (Teilenummer 482-6387xx).

Compatibilità elettromagnetica (EMC)

Vedere la guida alla consultazione per la compatibilità elettromagnetica contenuta sul CD (numero di parte 482-6387xx) per informazioni sulla compatibilità elettromagnetica relativa al sistema in dotazione.

Compatibilidad electromagnética (CEM)

Consulte la Guía de referencia sobre compatibilidad electromágnetica incluida en el CD (número de pieza 482-6387xx) para obtener la información sobre la CEM de su sistema.

Electromagnetic compatibility (EMC)

Please refer to the Electromagnetic Compatibility Reference Guide on CD (part number 482-6387xx) for EMC information concerning your system.

电磁兼容性 (EMC)

有关系统的 EMC 信息，请参阅 CD 上的电磁兼容性 (EMC) 参考指南（部件号 482-6387xx）。

電磁適合性 (EMC)

お使いのシステムに関するEMC情報については、CD (パーツ番号482-6387xx)の『電磁適合性(EMC)リファレンスガイド』を参照してください。

전자파적 합성(EMC)

시스템에 관한 EMC 정보는 CD의 『전자파적 합성(EMC) 가이드』
(부품 번호: 482-6387xx)를 참조하십시오.

Compatibilidade Eletromagnética (EMC)

Favor consultar o Guia de Referência à Compatibilidade Eletromagnética no CD (número de peça 482-6387xx) para informações da EMC relativas ao seu sistema.

CE 0344 CE Mark per Medical Device Directive (93/42/EEC)

European Representative:
VIASYS Healthcare
Welton Road
Warwick
CV34 5PZ
U.K.

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ILLUSTRATIONS

Warranty

We, Grason-Stadler 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 expenses 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 ALL OTHER WARRANTIES, EXPRESSED 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, the GSI 38 is equipped with a specific power transformer (8000-0250, 8000-0260, 8000-0261, or 8000-0262) which should not be interchanged with any other transformer or supply.**

The above symbol, found inside the probe battery compartment, indicates the location of a service adjustment part and is intended for service personnel use only. 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.**

SPECIFICATIONS

Standards: UL STD. 544 Standard for Safety, ETL Listed
IEC 601-1 Medical Electrical Equipment Requirements for Safety
CSA C22.2 No.601-1-M90 Electromedical Equipment Warnock Hersey Listed
ANSI S3.39-1987 Aural Acoustic Impedance Admittance (Type 3)
IEC 1027-1991 Aural Acoustic Impedance/ Admittance (Type 3
ANSI S3.6-1989 Audiometers (Type 4)
IEC 645-1 Pure Tone Audiometers (Type 4)
PTB Certificate No. 15.11-94/53 Pure Tone Audiometers (Type 4)

Tympanometry/Reflex Modes

Probe Tone: 226 Hz, +/- 3%

Sound Pressure Level: 85.5 dB SPL, +/- 2.0 dB, measured in a 2.0 cm^3 coupler

Harmonic Distortion: <5%

Admittance (Compliance) Range: 0 to 1.5 cm^3
0 to 3.0 cm^3

NOTE: 1. The range is automatically selected based upon the amplitude of the compensated (tymp only) tympanogram.
2. The maximum uncompensated (ECV + tympanogram peak) admittance (compliance) range is 0 to 5.0 cm^3.
3. ECV/cavity limits for initiating pressurization is 0.2 to 6.0 cm^3.

Compliance Accuracy: +/- 0.1 cm^3 or +/- 5%, whichever is greater

Pneumatic System

Pressure Range: +200 to -400 daPa

NOTE: 1. 1 daPa = 1.02 mmH_20
2. Pressure sweeps to at least -100 daPa. To save test time, pressure sweep stops once tympanogram returns to baseline after -100 daPa.
3. Full pressure sweep for 6 cm^3 from sea level to 7000 ft. altitude with no leak.

Pressure Accuracy: +/- 10 daPa or +/- 15%, whichever is greater

Rate of Sweep: 600 daPa/sec except near tympanogram peak where sweep rate slows to 200 dapa/sec to provide better definition of peak compliance.

Direction of Sweep: Positive to negative

Tymp Test Time: approximately 1 second

NOTE: High compliance tympanograms will take somewhat longer

Gradient: Tympanogram pressure width at 50% of peak compliance.

Acoustic Reflex Stimuli:

Frequencies: 500, 1000, 2000, and 4000 Hz
Accuracy: +/- 3%
Total Harmonic Distortion: <5%
Rise/Fall Time: 5 to 10 msec

Output Levels:

IPSI:	500 and 4000 Hz	80, 90, 100 db HL
	1000 and 2000 Hz	85, 95, 105 dB HL
CONTRA:	500, 1000, 2000,4000 Hz	90, 100, 110 db HL

NOTE:1. Ipsi stimuli are time multiplexed with probe tone (106 mS ON, 53 mS OFF).
2. Contra stimuli are steady tones.
3. Stimuli are presented at lowest level first. If there is no response, the intensity is increased by 10 dB until a response is detected or the maximum dB HL is reached.
4. Contra is available with Versions 2 and 3 only.

Pressure: Automatically set to pressure at peak compliance with an offset of -20 daPa.

Reflex Determination: Compliance change of 0.05 cm^3 or greater.

Reflex Test Time: 1 to 12 seconds depending upon the number of ipsi and/or contra test frequencies selected (4 maximum) and intensity required.

Probe LED Indicators

Steady yellow:	occlusion
Blinking green:	ready to start testing
Steady green:	test in progress
Steady orange:	leak

AUDIOMETRY MODE (Versions 3 and 4 only)

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

Accuracy: +/- 3%

Total Harmonic Distortion: < 3% (125 to 3000 Hz measured acoustically at maximum dB HL; 4000 & 6000 Hz measured electrically)

POWER

Line Voltage: 120 V (+/-10%) or 220 V (+/-10%) or 240 V (+/-10%)
NOTE: Wallmount power supply or internal power supply depending upon country.

Frequency Range: 50 - 60 Hz (+/- 5%)

Line Voltage Current: 0.2 amps at 120 V or 0.1 amps at 240 V AC

Power Consumption: 15 watts maximum while printing. Low voltage input for wallmount power supplies 10-11 VDC 970 mA

ENVIRONMENTAL

Temperature:

Operating: 60 F to 105 F
15 C to 40 C

Storage: -40 F to 140 F
-40 C to 60 C

NOTE: Warm-up time is required if storage temperature is different from room temperature.

Humidity: 5% to 90%

MECHANICAL

Dimensions: 13.15" W x 14.5" D x 4.3" H
33.66 cm W x 35.56 cm D x 9.53 cm H

Weight: 10 lbs (5.0 kg) net
14 lbs (5.0 kg) shipping

SUPPLIED ACCESSORIES	CATALOG NUMBERS
Probe (all versions)	1738-3200
Contra Insert Phone (Versions 2 and 3 only)	8000-0079
TDH-39 Headset (Versions 3 and 4 only)	8000-0175
Test Cavity (all versions)	1700-1030
Eartips, (Probe) 6 sizes, 2 each (all versions)	1700-9622
Eartips, (Contra Insert Phone) color coded, 8 sizes, 4 each (Versions 2 & 3 only)	1700-9660
Paper - 3 rolls thermal 4" (10.16 cm) wide (all versions)	
Instruction Manual (all versions)	1738-0100

Intensity Levels:

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

NOTE: An additional +10 dB is available per frequency via the +10 dB pushbutton.

Accuracy:	125 to 4000 Hz	+/- 3 dB
	6000 and 8000Hz	+/- 5 dB
Step Size:	5 dB	

Signal-to-Noise Ratio: > 70 dB in 1/3 octave; less than -10 dB HL for levels less than 60 dB HL

Rise/Fall: Time: 20 to 50 msec

Tone Format:*

Continuous - steady when present bar is depressed
Pulsed - 2.5/sec (i.e., 200 msec ON, 200 msec OFF)
FM (frequency modulated) 5 Hz, +/- 5%
*Tone is normally off until present bar is depressed.

TRANSDUCERS

IPSI: GSI design

CONTRA: single Audiovox Model SM-N insert phone (Version 2 and 3 only)

Audiometric Headset:

Pair TDH-39 earphones with MX41AR cushions
(60 ohms impedance) - Versions 3 & 4 only,
Headband force per ANSI S3.6 and IEC 645 (4.5 +/- 0.5)N

PRINTER

Paper Roll Length: approximately 80 feet (960")

Tests/Roll:

Versions 1 and 2: approximately 420 Tymps/Reflex or 210 people
Versions 3 and 4: approximately 230 tests or 115 people
(Assumption: 2 Tymps/Reflex + 1 Audiogram per person)

Speed: approximately 1.5 minutes to print three screens
Tympanogram
Tympanogram + reflex (4)
Audiogram

OPTIONAL ACCESSORIES

Carrying Case	1738-9680
Dust Cover	1738-9620
Patch Cord (1)	4204-0505
Subject Response Handswitch	7874-0156
Earphone Sound Enclosures	8000-0155
Service Manual	1738-0110
RS-232 Interface	1738-9650
RS-232 Cable (10' - DB-25 M/F Straight Through)	1700-0445
RS-232 Cable Adaptor (DB-25M/DB-09F)	1700-0450

CATALOG LISTING

Tymp and Ipsi Reflex

GSI 38 Auto Tymp Version 1 (USA)	1738-9700
GSI 38 Auto Tymp Version 1 (Export)	1738-9705
GSI 38 Auto Tymp Version 1 (Export, 100 V)	1738-9706
GSI 38 Auto Tymp Version 1 (Export, 240 V)	1738-9708
GSI 38 Auto Tymp Version 1 (Includes RS-232 Interface)	1738-9800

Tymp and Ipsi/Contra Reflex

GSI 38 Auto Tymp Version 2 (USA)	1738-9710
GSI 38 Auto Tymp Version 2 (Export)	1738-9715
GSI 38 Auto Tymp Version 2 (Export, 100 V)	1738-9716
GSI 38 Auto Tymp Version 2 (Export, 240 V)	1738-9718
GSI 38 Auto Tymp Version 2 (Includes RS-232 Interface)	1738-9810

Tymp and Ipsi/Contra Reflex and Screening Audiometer

GSI 38 Auto Tymp Version 3 (USA)	1738-9720
GSI 38 Auto Tymp Version 3 (Export)	1738-9725
GSI 38 Auto Tymp Version 3 (Export, 100 V)	1738-9726
GSI 38 Auto Tymp Version 3 (Export, 240 V)	1738-9728
GSI 38 Auto Tymp Version 3 (Includes RS-232 Interface)	1738-9820

Tymp and Ipsi Reflex and Screening Audiometer

GSI 38 Auto Tymp Version 4 (USA)	1738-9730
GSI 38 Auto Tymp Version 4 (Export)	1738-9735
GSI 38 Auto Tymp Version 4 (Export, 100 V)	1738-9736
GSI 38 Auto Tymp Version 4 (Export, 240 V)	1738-9738
GSI 38 Auto Tymp Version 4 (Includes RS-232 Interface)	1738-9830

SECTION 1 - INTRODUCTION

1.1 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.

An optional soft-sided carrying case can be purchased if portability is required. Also, a dust cover, patient handswitch, patch cords, and earphone sound enclosures may be purchased as optional accessories.

1.2 Tympanometry and Gradient

Tympanometry is an objective technique used since the late 1960's to measure the mobility (compliance) and the pressure within the middle-ear system. During tympanometry, a low pitch tone (i.e., 226 Hz probe tone) is presented to the ear canal via the light-weight probe. The probe tone is used to measure the compliance changes within the middle-ear system while air pressure within the hermetically sealed ear canal is varied from a positive to a negative value. A positive pressure within the ear canal space, in the absence of middle-ear pathology, causes the middle-ear system to stiffen up or become less mobile. This is caused by the pressure difference between the sealed ear canal space and the middle-ear space which forces the tympanic membrane to stretch inward. A stiffened middle-ear system displays little or no compliance. As the pressure within the ear canal is brought back toward atmospheric (ambient or 0 daPa) pressure, the pressure difference between the ear canal space and the middle-ear space is reduced in normal ears. At or near atmospheric pressure (0 daPa), the greatest amount of sound (probe tone) enters the middle-ear system. In other words, this is the air pressure value where the middle-ear system displays the maximum amount of compliance.

When the air pressure within the ear canal is then reduced to a negative value with respect to the middle-ear space, a pressure difference is once again established and the middle-ear system becomes less compliant. Therefore, by varying the pressure within the ear canal, it is possible to make a series of compliance measurements by means of the probe tone. The tracing which depicts these compliance changes is referred to as a tympanogram. The point of the tympanogram which represents the point of maximum compliance is the compliance peak of the tympanogram. The air pressure (pressure at the peak) where this compliance peak occurs approximates the pressure within the middle-ear system, since maximum mobility is only possible when there is little or no pressure difference between the ear canal and the middle-ear space. Compliance is measured with respect to the ability of an equivalent volume of air to conduct sound and the scientific quantity used is cm^3. Air pressure is measured in decaPascals (daPa).

NOTE

1.02 mm H_2O = 1.0 daPa

The presence of a pathological condition which interferes with the mobility of the tympanic membrane, the ossicular chain, or the air pressure within the middle-ear space can be detected during tympanometry. For example:

- If the air pressure within the middle-ear space becomes negative due to a blocked eustachian tube, tympanometry permits the measurement of this negative pressure and its effect on middle-ear compliance.

- If fluid builds up within the middle-ear space, this fluid will restrict the ability of the ossicular chain to conduct sound to the cochlea. If small air pockets exist within the fluid, the tympanogram will indicate the negative pressure where the restricted mobility occurs. With a totally fluid-filled middle-ear space, no mobility will be measured during tympanometry at any pressure value.

- In the case of a "glue-ear", the ossicular chain is restricted in mobility but the air pressure within the middle-ear space is at atmospheric pressure. This tympanogram would depict a restricted compliance peak at or near 0 daPa.

Gradient measurements are used to describe the shape of a tympanogram in the vacinity of the ak. Often, the presence or absence of fluid in the middle ear is not clearly indicated by otoscopy d tympanometry alone. This evaluation is especially difficult when the peak pressure is in the rmal range.

The presence of fluid within the middle-ear space alters the shape of a tympanogram, i.e., makes e tympanogram wider near its peak. A larger-than-normal gradient can indicate the presence of id in the middle ear when other parameters are within normal limits. In this way, the gradient ts as an adjunct to the tymp and ear canal volume measurements by helping to differentiate tween tymps with similar peak values.

The GSI 38 uses tympanometric width to determine the gradient by measuring the pressure erval at one-half of the tymp peak height. Differing tymp peak widths can point to different mid-e-ear conditions, even when peak height and pressure are within normal range. For example, ddle-ear effusion brought on by secretory otitis media might result in an increased tympanogram dth and, therefore, an increased gradient value. This would occur because the ossicular chain nnot react to the change in pressure introduced during the tympanogram in the same way that it uld if the middle ear were properly aerated. The continued presence of effusion, leading eventu-y to a completely fluid filled middle-ear cavity, will reduce the magnitude of the tympanogram to e point where no change in compliance is detectable across the pressure range. Under this con-ion, no gradient measurement is possible.

3 Screening Acoustic Reflex

An acoustic reflex occurs when a very loud sound (stimulus) is presented to the auditory path-y. During acoustic reflex testing, the stimulus is presented to the ear canal through a probe silateral) or through an insert phone (contralateral). This stimulus then travels through the mid-e ear to the cochlea. From the cochlea, frequency and intensity information is transmitted via the

8th nerve to the brain stem where a determination is made as to whether or not the intensity of the stimulus is high enough to elicit the reflex response. If it is, a bilateral response occurs i.e., the right and left 7th nerves innervate their respective middle-ear muscles (stapedial muscles) causing them to contract. As these muscles contract, they stiffen their respective ossicular chains. This stiffening of the ossicular chain reduces the compliance of each middle-ear system. As in tympanometry, a probe tone is used to measure this decrease in compliance.

When the stimulus is presented to the same ear where the measurement takes place, the test is referred to as an ipsilateral (same side) acoustic reflex test. When the stimulus is presented to the opposite ear from where the measurement takes place, the test is referred to as a contralateral (opposite) acoustic reflex test.

During ipsilateral acoustic reflex testing, both the stimulus and the probe tone are presented via the hand-held probe. With contralateral testing, the stimulus is presented via an insert phone or earphone and the probe tone is presented via the hand-held probe. In both cases, the measurement is made from the ear where the probe is positioned. For best results during these tests, the air pressure within the ear canal where the probe is positioned is set to the pressure value measured at the point of maximum compliance for that ear during tympanometry with an offset of -20 daPa.

Acoustic reflex measurements are useful to determine the integrity of the neuronal pathway involving the 8th nerve, brainstem, and the 7th nerve. Since the acoustic reflex test (ipsilateral or contralateral) is performed at high intensity levels and since it involves a measurement of middle-ear mobility, acoustic reflex testing is not a test of hearing.

The acoustic reflex also serves as a good validation of tympanometric results since an acoustic reflex cannot be measured in the absence of a compliance peak. In other words, if the tympanometric results indicate no mobility over the pressure range available with the GSI 38, no reflex can be measured. If the test results indicate a reflex response in the absence of a compliance peak, one has cause to question the validity of the tympanometric test results. This indicates that the tympanogram should be repeated.

Clinical middle-ear instruments allow the measurement of the acoustic reflex threshold since they provide the ability to manually change the intensity of the stimulus to a level where a reflex response is just barely detectable for each patient tested. However, the GSI 38 automatically presents the stimulus in a very definite stimulus intensity sequence. This preset intensity sequence may start at a level above an individual's acoustic reflex threshold level. Also, since the GSI 38 uses a hand-held probe and noise from hand motion can be detected by the instruments circuitry, the magnitude of a detectable response must be somewhat higher than the criterion generally used during clinical acoustic reflex threshold testing to avoid artifact caused by hand motion. Thus, the acoustic reflex measurements made with the GSI 38 are referred to as screening acoustic reflex testing. The purpose of these screening reflex tests is to determine if a reflex is detectable or not rather than to determine the lowest intensity at which the reflex occurs (i.e., threshold testing).

1.4 Screening Audiometry

While tympanometry and acoustic reflex measurements check the integrity of the middle-ear system, audiometry provides a means for checking the integrity of the entire auditory pathway. Screening audiometry provides a method to check an individual's ability to hear a test signal at a particular intensity level or at the lowest possible intensity level without the use of masking.

uring screening audiometry, the test signal is generally presented through an earphone to the under test. Different screening test protocols define the frequencies and intensity sequence to used to obtain a response. Audiometric testing requires a behavioral response for the individual ng tested. This consists of having the individual raise a finger/hand or press a handswitch tional) whenever the test signal is heard. The finger/hand is lowered or the handswitch is ased when the test signal is no longer audible. Thus, the individual being tested must be able nderstand a set of simple instructions and have the ability to provide some physical sign when test signal is heard.

Glossary of Terms

mpanometry - an objective measurement of middle-ear mobility and middle-ear pressure ough the use of a low frequency sound (probe tone) and air pressure changes.

mpanogram - the tracing which depicts the results of tympanometry.

mpliance Peak - the point of maximum mobility in a tympanogram which indicates the ree of mobility within the middle-ear system.

essure Peak - pressure value where maximum mobility occurs in a tympanogram. This pres- e value approximates the pressure within the middle-ear space.

rmal Box - range of pressure peak and compliance peak values associated with normal mid- -ear function. (-150 daPa to +100 daPa, 0.2 cm^3 to 1.4 cm^3 per ASHA, 32, Supl. 2, 1990, 17-

r Canal Volume -volume measured between the tip of the probe and the tympanic mem- ne at the starting pressure for a tympanogram.

obe Tone - low pitch (226 Hz) tone used to measure middle-ear mobility.

coustic Reflex - reflex arc elicited in the presence of very loud sounds which cause a crease in middle-ear compliance as a protective mechanism for the cochlea.

silateral Acoustic Reflex - the acoustic reflex elicited when the stimulus is presented to same ear where the response is measured.

ntralateral Acoustic Reflex - the acoustic reflex elicited when the stimulus is presented he opposite ear from where the response is measured.

reening Audiometry - a hearing test performed with a variety of frequencies and intensi- s without the use of masking to determine if an individual can hear.

SECTION 2 - INSTALLATION

2.1 Unpacking and Inspection

Although your GSI 38 Auto Tymp was carefully packed for shipping, it is a good practice to examine the outside of the shipping container for any signs of damage. Notify your carrier immediately if any damage is noted.

Carefully remove your GSI 38 from its shipping container. Remove the plastic bag protecting the instrument. If the GSI 38 appears to have suffered mechanical damage, notify the carrier immediately so that a proper claim can be made. Be certain to save all packing material so that the claim adjuster can inspect it as well. As soon as the carrier has completed the inspection, notify your Grason-Stadler Distributor.

TABLE 2-1 ACCESSORIES SUPPLIED

Probe Assembly	Instruction Manual
Power Module or Internal Supply	Contralateral Insert Phone (Versions 2 and 3)
Test Headset (Versions 3 and 4 only)	Probe Eartips (6 sizes, 2 each)
Eartips for Insert Phone (8 sizes, 4 each) (Versions 2 and 3 only)	Paper (3 rolls)
	Test Cavity

NOTE

It is a good practice to keep the original packing material and shipping container so that the instrument can be well packaged if it needs to be returned to the local service center for repair or calibration.

Check that all accessories listed in Table 2-1 (per version ordered) are received in good condition. If any accessories are missing or damaged, notify your Grason-Stadler Distributor or the factory immediately. See Specifications Section of this manual for the catalog numbers of accessories and also for a listing of optional accessories.

2.2 Probe Indicators

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

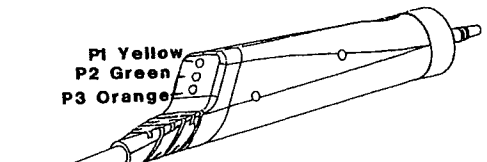


FIGURE 2-1: Probe Indicators

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

P2 **Green lamp:** blinking - GSI 38 Auto Tymp 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

e front panel controls and indicators are shown in Fig. 2-2 and are described below.

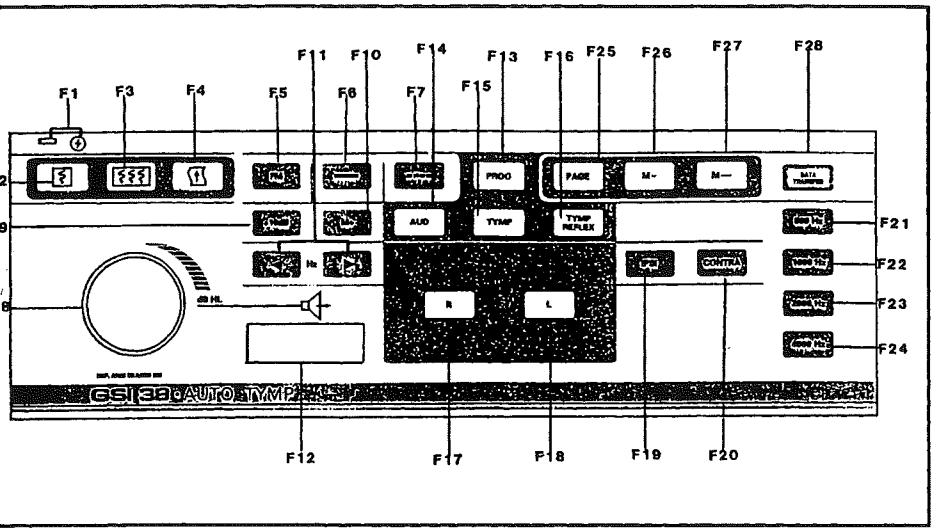


Figure 2-2: Front Panel

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

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

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

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

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.

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.

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.

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.

+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.

0 **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.

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

2 **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 settings available for 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 to select Tympanometry 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 Hz 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.

F28 Data Transfer: used to transfer test results to an attached computer.

2.4 Printer & 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.

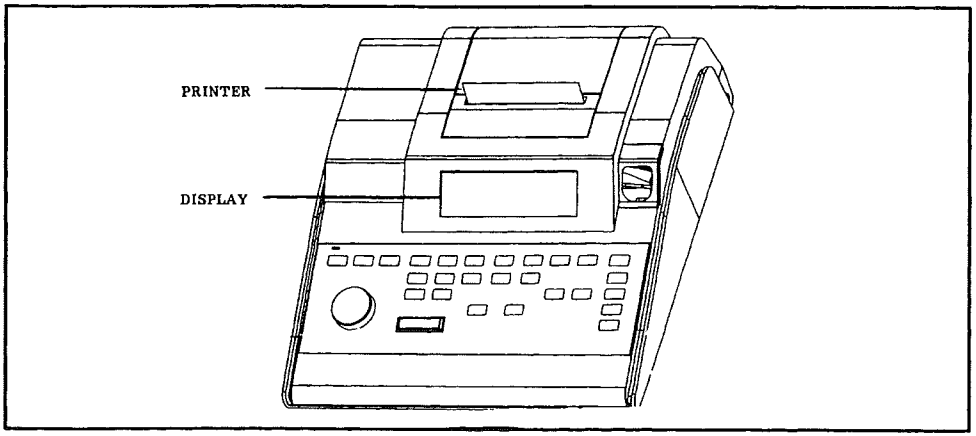


FIGURE 2-3: Printer and Display

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.

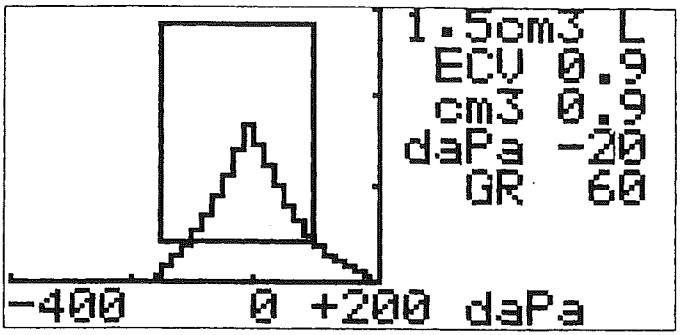


Figure 2-4: Display Format for TYMP Only Test

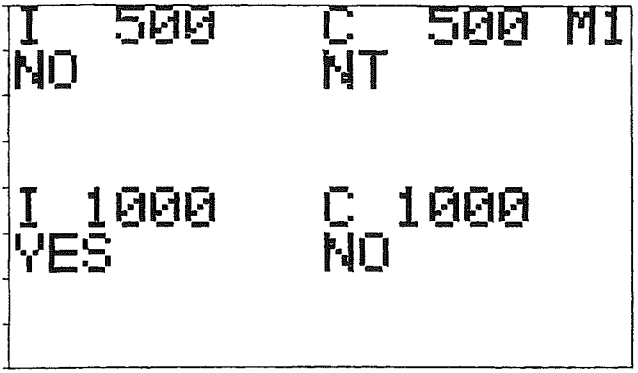


Figure 2-5: Display Format for TYMP/REFLEX Test (Reflex test results given as "Yes" or "No".)

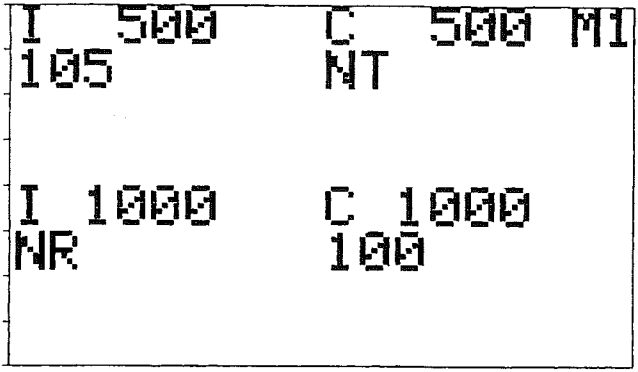


Figure 2-6: Display for TYMP/REFLEX Test (Reflex test results given in "dB HL".)

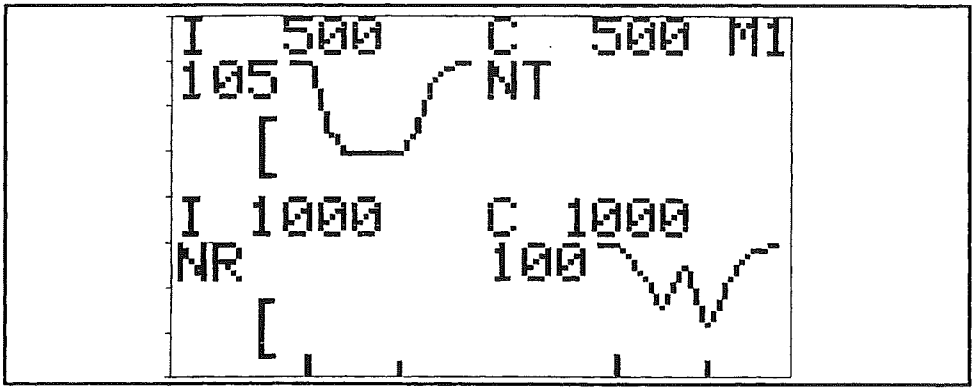


Figure 2-7: Display Format TYMP/REFLEX Test
(Reflex test results given in "dB HL" and also shown with a "tracing")

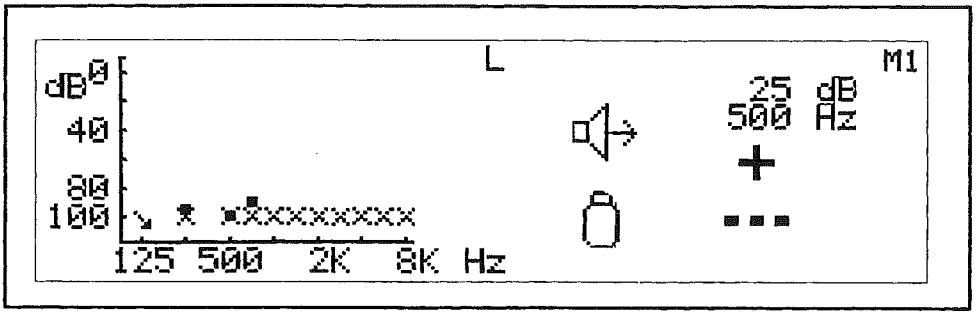


Figure 2-8: Display Format for AUDIOMETRY

2.5 Rear & Bottom Panel Labels/Connectors

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

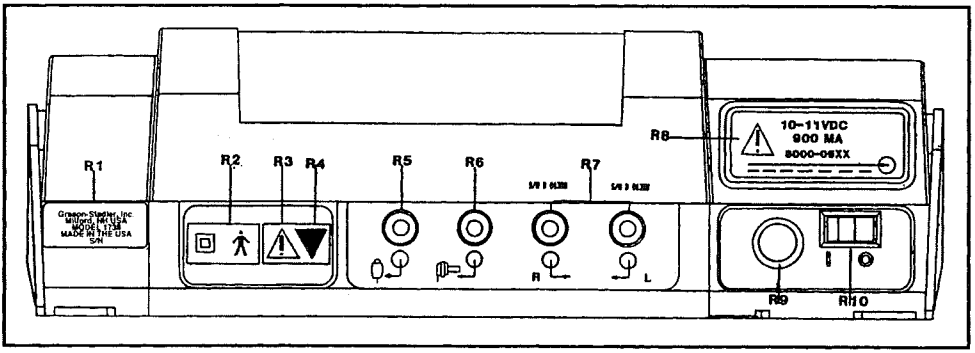


FIGURE 2-9: Rear Panel

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.

4 Symbol indicates a service adjustment part that is intended for service personnel use only.
5 Connector for handswitch. Input impedance -47 K ohm pulls up to 5 volts.
6 Connector for contralateral insert phone. < 1 ohm, 2.5 volts rms maximum open circuit.
7 Connectors for right and left earphone. 130 ohm, 2.50 volts rms maximum open circuit.
8 Label describing low input voltage and current from wall mounted power supply.
9 Power Input Jack. 5-pin DIN connector for external wall mounted power supply.
10 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.

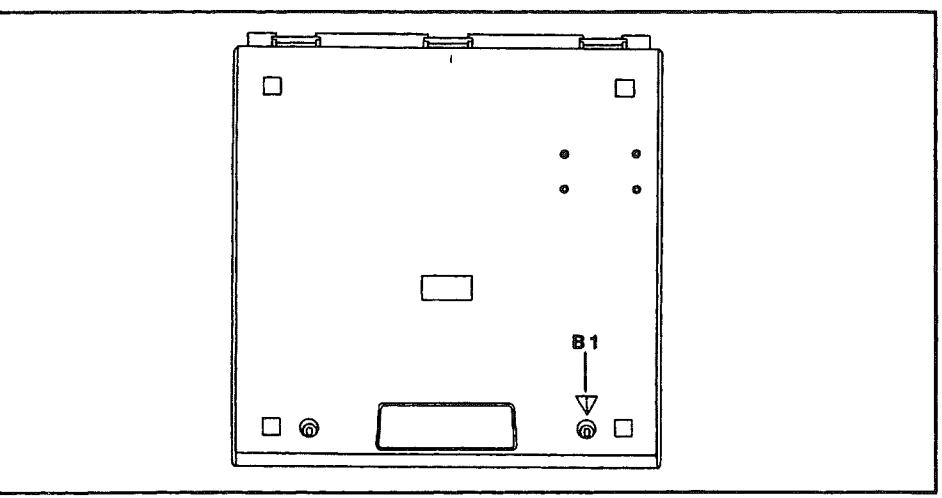


FIGURE 2-10: Bottom Panel

6 Initial Set-up

Place the GSI 38 on a stable counter or table where it will subsequently be used. The location ould be near a properly grounded wall outlet. Carefully attach purchased accessories to their ropriately labelled connector on the rear panel of the GSI 38 (see Figure 2-9).

ocate the **power** switch on the rear panel of the GSI 38 and move the switch to the **on** sition. Note that the lamp (F1) on the front panel is illuminated indicating the GSI 38 is receiv- power. Once the power switch is activated, the GSI 38 symbol will appear on the display along h a listing of the revision number for the Tymp/Reflex and Audiometry (if purchased) software. xt, the display will default to the Tymp/Reflex mode and the probe green lamp will begin to blink icating that the GSI 38 is ready to begin the tymp. If both the green and yellow lamps are illumi- ed at the same time following power on, the probe is occluded or the tymp/reflex software did get properly initialized. Simply move the power switch to the off position, inspect the probe tip any signs of an occlusion, and reposition the power switch to **on**. If both green and yellow ps are still illuminated and you are certain that the probe is not occluded, contact your local vice representative or the Grason-Stadler service department for repair. In the mean time, it is

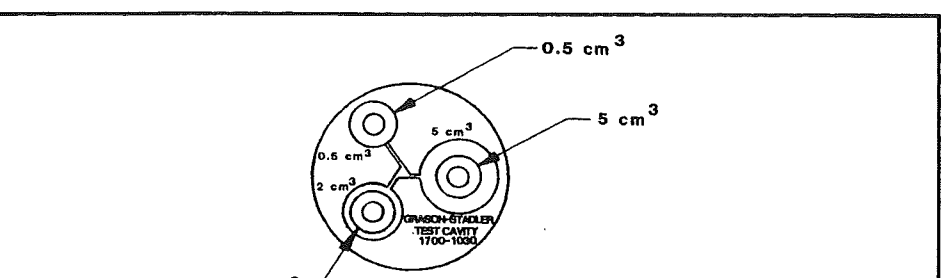


Figure 2-12: Test Cavity

7 PreTest Tymp Checks

For your convenience, a test cavity is provided with your GSI 38 AutoTymp. This test cavity ables you to quickly verify, on a daily basis, the proper calibration of your unit. GSI strongly commends that you make this quick check a part of your daily routine.

7.1 Calibration

To initiate the quick check, select the Tymp only mode and insert the probe into the 0.5 cm^3 ening on the test cavity. See Figure 2-12.

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 proper- This is confirmed by the green lamp changing from blinking to a steady condition. If the orange mp is illuminated, the probe is not properly positoned within the cavity so that a large pressure ak exists. If the yellow lamp is illuminated, the probe tip has been occluded. In either case, move the probe and wait for the blinking green lamp. Insert the probe once again. Clean the obe tip if necessary (see Section 3.2).

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

still possible to select the Audiometry mode (if purchased).

Allow the instrument to warm-up for about 5 minutes before conducting a test. This allows the electronic circuits to stabilize prior to use. If the storage temperature is lower than the room temperature, allow some additional time for the instrument to reach room temperature.

2.6.1 Loading the Paper

Remove the printer cover (see Fig. 2-3 for location) by placing your fingers along the back edge of the printer and pulling upward on the cover. Cut the printer paper so that the leading edge of paper is straight across. Place the roll of paper inside the paper well so that the paper will unroll from the lower surface. See paper loading label for additional help (Figure 2-11).

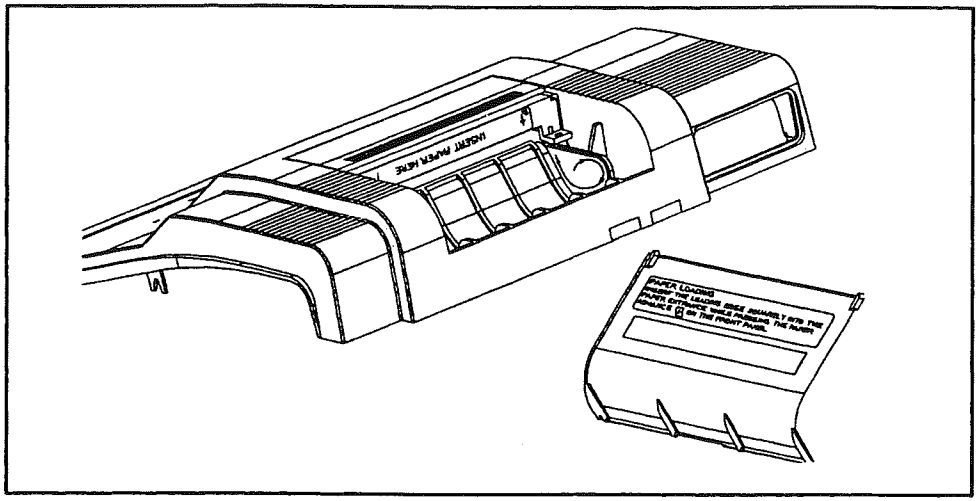


Figure 2-11: Paper Loading

Position the leading edge of the paper roll into the paper entrance while pressing the paper advance pushbutton. The paper will begin to appear out of the printer mechanism. Continue to advance the paper so that a section of paper is long enough to pass through the printer cover once it is repositioned over the printer.

2.6.2 Paper Storage

The GSI 38 Auto Tymp is supplied with a thermal printer. This type of printer requires a heat-sensitive paper to create an image. For maximum paper life, any spare rolls of paper should be stored as follows:

1) Store in the dark, i.e., in a drawer or cabinet
2) Do not store above 77 F (25 C)
3) Store at less than 65% relative humidity

The above recommendations are for the maximum paper life (greater than five years). Storing your GSI 38 thermal paper at high temperatures or high humidity levels will only shorten the total paper life somewhat, depending on the actual temperature and humidity the paper is subjected to. The paper will show some darkening if stored for 24 hours at 113 F (45 C) and a relative humidity of greater than 90%, so avoid leaving your GSI 38 paper in a hot car or other hot area overnight. Always avoid storing unused paper or printed tests in a lighted area.

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 2.7.2). It 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.

2.7.2 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 cm^3 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 allows the operator to adjust his/her Auto Tymp without the services of a qualified GSI representative.

TABLE 2-2: 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 - 7,500	2.3 +/- 0.1
8,000 - 9,000	2.4 +/- 0.1
9,500 - 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 follows:

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

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

STEP 3

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

STEP 4

h the probe still in the 2.0 cm^3 cavity, select the PAGE pushbutton to enter the custom calibra- mode. Custom will appear on the fourth line of the display.

STEP 5

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

STEP 6

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

3 Pre-Test Audiometric Checks (Version 3 and 4 only)

3.1 Noise Recovery Period

xposure to high levels of sound (e.g., unmuffled lawn mowers, loud music, gunfire) tends to cre- a temporary threshold shift (TTS) which diminishes with time after exposure. Any subject/ ent tested soon after such exposure may exhibit a hearing loss that does not reflect his or her mal hearing threshold. It is, therefore, important that the testing procedure prescribe some time rval - usually at least 16 hours- between the last exposure to high-level sounds and the admin- ation of any hearing test.

3.2 Elimination of Ambient Noise

xcessive noise in the test environment during audiometric testing such as that produced by versation, typewriters, public address systems reduces test validity because it tends to mask test signals particularly at the lower frequencies where earphone cushions provide less effec- attenuation. An acoustically treated room may be required if ambient noise reaches objection- e levels i.e., sufficient to cause apparent hearing loss at the low frequencies. Also, Audiocups available from GSI as an optional accessory. If the person being tested is in the same room as audiometer, it is recommended that he/she be seated about three feet (1 meter) away from the l 38.

aximum permissible noise levels are specified by the American National Standards - Criteria Permissible Background Noise during Audiometric Testing, ears covered with earphones (S3.1)1 revised). Table 2-3 shows the maximum background levels that can be present inside the m while a valid hearing test is being conducted. For more comprehensive information about ring testing and hearing conservation the user is referred to the Bibliography.

Table 2-3: Permissible Noise Levels

Frequency (Hz)	Test Room - Maximum dB SPL * in 1/3 Octave Band
125	29.0
250	17.5
500	14.5
750	16.5
1000	21.5
1500	21.5
2000	23.0
3000	28.5
4000	29.5
6000	33.0
8000	38.5

2.9 Biological Check

The best way to determine that your GSI 38 is functioning properly is to perform a daily check on a normal ear - your own if possible. This allows you to listen for the probe tone and the stimulus tone (during reflex) and to determine if the air pressure system is working properly. Keep a copy of your chart for a day-to-day reference in checking your GSI 38.

If you purchased the GSI 38 Version 3 or 4, select the Audiometry (AUD) mode pushbutton located in the center section of the front panel. Note that the display changes from the tympanogram format to an audiogram format. The < and > Hz pushbuttons allow you to select each frequency and the dB HL knob allows you to alter the intensity of each frequency. Position the test headset on your head so that each earphone is covering the appropriate ear (i.e., red is right and blue is left). Select the right earphone by pressing the front panel pushbutton labelled R and check for the following while depressing the present bar:

- Depressing the < Hz pushbutton causes the frequency to change to a lower frequency; depressing the > Hz pushbutton causes the frequency to change to a higher frequency.
- Each frequency or tone is pure; i.e., there is no distortion or crackling sound present.
- Rotating the dB HL knob in a clockwise direction causes the tone to increase (become louder) in intensity; rotating the dB HL knob in a counter-clockwise direction causes the tone to become quieter (less intense).

SECTION 3 - OPERATION

3.1 Eartip Care

Eartips may be washed with warm soapy water to remove cerumen after the eartip is removed from the probe. Use an alcohol swab to disinfect the eartips. Be sure that the eartips are completely dry before reuse.

NOTE

Eartips may crack or otherwise deteriorate if left submerged in alcohol for a long period of time. Eartips should not be placed in an autoclave as they will melt and lose their shape.

3.2 Probe Care

With use, cerumen can work its way up inside the probe nose cone (probe tip). During the warm-up period each day and throughout the day, inspect the probe tip to make sure it is clean and free of cerumen. If any cerumen is detected, refer to the following instructions for cleaning and maintaining the GSI 38 probe.

3.2.1 Probe Nose Cone Cleaning

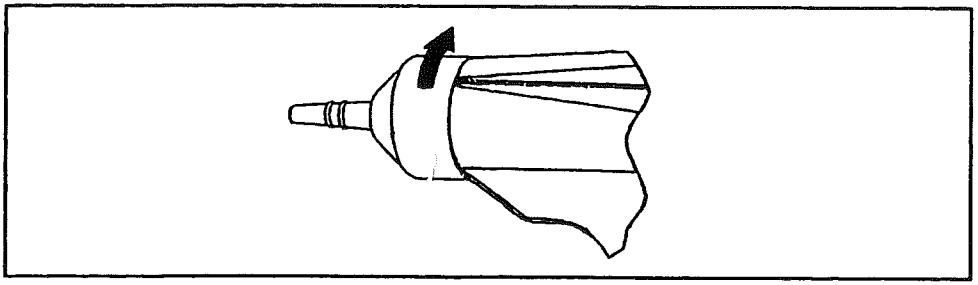


Figure 3-1: Probe Nose Cone Removal

Refer to Figure 3-1 and remove the nose cone portion of the probe as follows:

- Hold the body of the probe in one hand (e.g. left) near the tip and grasp the nose cone of the probe in the other hand (e.g. right).
- Rotate the nose cone portion of the probe counterclockwise until the nose cone is completely separated from the probe.
- Place the probe body securely on a table and inspect the nose cone for cerumen. Use a pipe cleaner to remove any cerumen by inserting the pipe cleaner through the back portion of the nose cone and pulling it through the front opening. It may be necessary to repeat this several times to remove all the cerumen.

NOTE

The probe nose cone can be sterilized via many conventional methods including autoclaving.

2 The O-Ring

re is an O-Ring seated at the end of the threads on the probe. As a preventative mainte-
e measure, and to ensure that the nose cone of the probe unscrews easily, do not clean
move the lubricant from the O-Ring. If the O-Ring appears to be void of any lubricant,
the nose cone itself was difficult to remove, apply a high-quality synthetic lubricant such
ose considered "food-grade." Refer to Figure 3-2 and apply as described in the instruc-
that follow.

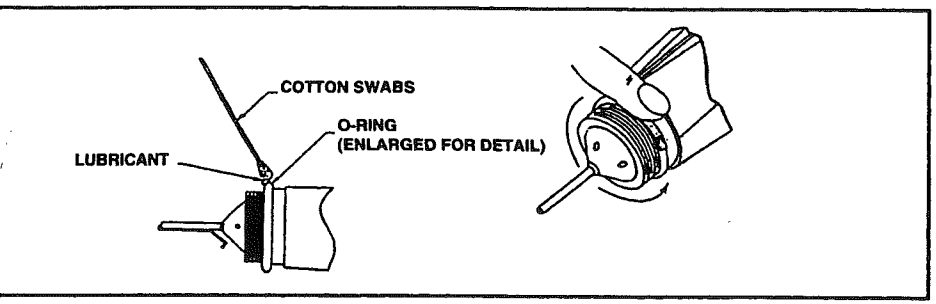


Figure 3-2: O-Ring Care

lace a small drop of lubricant at the front outer surface of the O-Ring.
sing the finger or a cotton swab spread a thin layer of lubricant completely around the front
nd outer surface of the O-Ring. Assure that no lubricant spreads into the threaded area of the
osecone. Only a thin layer of lubricant is necessary. Excessive application or build-up may
ffect test results.

3 The Probe Wire

de the probe body there is a metal tube which contains a wire required for cleaning purposes.
fully remove this wire from the metal tube. (See Figure 3-3)

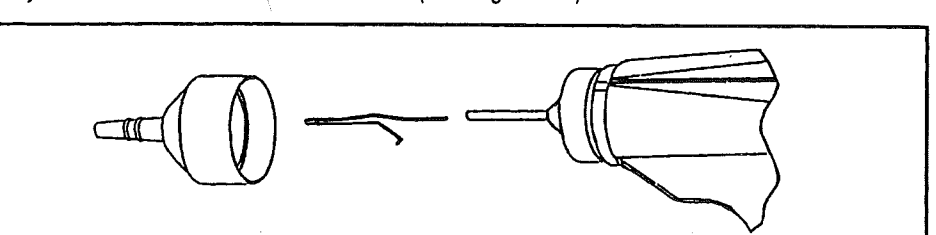


Figure 3-3: Probe Wire Removal

s will pull any cerumen out of the metal tube. Examine the wire for cerumen. Clean the wire
a lint-free tissue if necessary. Reinsert the wire into the metal tube and push it in as far as it
go. **The wire must be inserted into the metal tube for the GSI 38 to function properly.**

4 Probe Reassembly

r cleaning, re-assemble the probe nose cone to the probe body by screwing the cone back
the probe. Take care to align the threads on both the probe body and the nose cone before
ing the pieces together. Only screw the nose cone on until it is finger tight. You might find it
ul to gently squeeze the two sides of the probe case together while screwing the nose cone
lace.**The probe nose cone must be screwed firmly in place to prevent any air leaks.**

3.3 Earphone Care (Versions 3 and 4 only)

The earphone and cords provided with the GSI 38 (Versions 3 and 4) should last a long time with proper care. To clean the earphones and cords, use only a dry cloth or tissue. Moisture should not be allowed anywhere near the earphone itself as this will damage the diaphragm and grill cloth, requiring its replacement.

With extended use, earphone cords tend to fray internally at the connectors i.e., between the cord and the GSI 38 connector and between the cord and the earphone connector. This fraying will ultimately either decrease the signal level or cause the signal to be intermittent. To check for this, position the test headset over your ears and select a frequency (e.g., 1000 Hz) at 35 dB HL. Select the right earphone and press the present bar. While the present bar is depressed, flex the earphone cord next to the connector at both ends. Listen for an intermittent signal, an abrupt change in signal intensity level or a scratchy sound superimposed over the selected frequency that coincides with the flexing of the cord. The presence of any of these conditions indicates that the cord should be replaced.

Also, examine the earphone cord for cuts or tears in the covering shield and the earphone cushion for signs of damage. If either problem is noticed, the earphone cord or cushion should be replaced. Both parts are easily replaced without the need for recalibration. However, if the earphone receives shock damage or is replaced for any reason, the GSI 38 will need to be recalibrated.

Repeat this same sequence with the left earphone.

3.4 Paper Supply

To streamline each testing session, it is a good idea to check the amount of paper left inside the printer compartment. Extra rolls of paper should be kept nearby so that the paper can be easily changed without upsetting your schedule.

NOTE

The number of tests per roll of paper will vary with the version Auto Tymp that is being used and the type of tests being performed. See Printer Description in the Specification Section of this manual for approximations. Replacement paper can be purchased from your local Grason-Stadler Distributor or from the factory. Use Catalog number 1738-9600 (a box of 5 rolls) when ordering.

3.5 Tympanometry Testing information

As mentioned, it is a good idea to perform a test on a normal ear each day to make certain that your GSI 38 Auto Tymp is functioning properly. See Section 2.9 for details.

3.5.1 Helpful Hints

Tympanometry and acoustic reflex testing can be performed at any age. However, the technique used will vary with age. From three years through adult, tympanometry can be performed with little difficulty due to the cooperative nature of this age group. With the under-three-year population, a bit of ingenuity is required to keep the patient relatively quiet during the seconds required for the test. In all cases, distraction is the key to success! Anything which provides a sound and/or visual distraction should work. Examples are only limited by your imagination!

ucking on a pacifier or a bottle will help with the younger population. However, the tym-
iogram tracing will not appear as smooth due to the movement artifact. Having a parent hold an
int during testing will also help.
he key to success in all cases is to make sure that you are at eye level with the ear canal. Keep
ir hand steady and your eyes on the ear canal and probe lights until the test is over.
is a good idea upon first receiving your GSI 38 Auto Tymp to practice on a cooperative patient
gain confidence in its use. Once you feel comfortable with the probe, you are ready to handle
situation. Remain calm and success will follow.

5.2 Obtaining a Seal

ix different size eartips are provided with your GSI 38 AutoTymp. The size eartip will vary with
letal size of the individual it is to be used on. Generally speaking, the following criteria applies:

Preemie	-8 mm
Newborn	-8 mm, 11 mm
Pre-school	-11 mm, 13 mm
School age	-11 mm, 13 mm, 15 mm
Adult	-15 mm, 17 mm, 19 mm

efore attempting to seal the entrance of the ear canal, visually inspect the opening to make
e that the canal is free of any obstruction. If the canal is completely plugged at the entrance or if
d is running from the ear canal, tympanometry should not be attempted until the condition is
ared.

NOTE

Damage to the probe can result if fluid is pulled up into the probe with negative pressure.

lip the appropriate size eartip onto the nose cone of the probe making sure that the rounded tip
he eartip sits flush with the tip of the nose cone. (See Figure 3-4.)

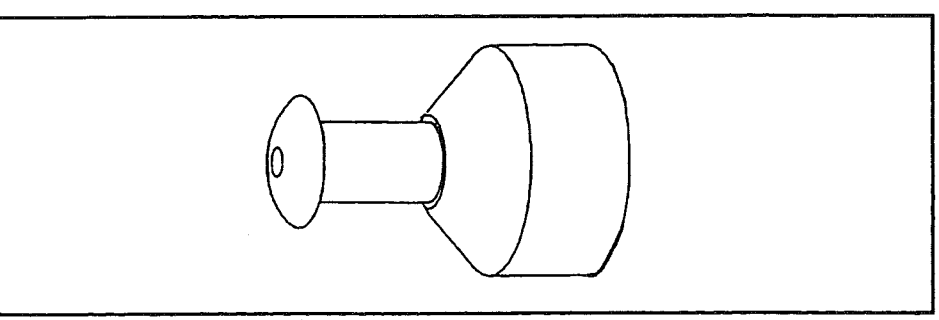


Figure 3-4: Positioning the Eartip

Move any hair away from the ear and pull upward and back on the pinna of the ear on an adult.
ull downward and back on the pinna of a young child.) This tends to straighten out the ear canal
d ensure better results. Keep the pinna in this position throughout the test sequence. Make sure
at the green lamp on the probe is blinking. Position the probe up against the entrance of the ear
nal applying a gentle pressure to maintain a tight seal. (See Figure 3-5.) Watch the probe lamp.
soon as a good seal is obtained, the green lamp will change from its blinking status to being on
continuously. This green light will remain on Steady while the test is in progress. Once the test

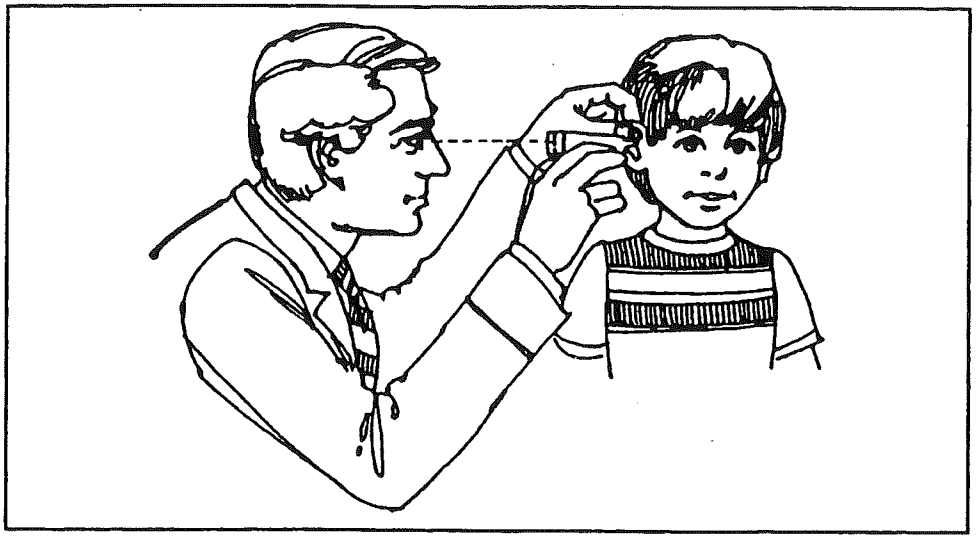


Figure 3-5: Positioning the Probe

sequence is over, all lamps on the probe will be turned off and the test result can be viewed on the instrument display before printing it out. It is now possible to remove the probe from the ear canal. Note that the green lamp is now blinking again signifying that it is possible to run another test.

Should you run into difficulty during the test, the probe lamps will inform you of a problem as follows:

Green lamp: Still blinking - seal has not been obtained to initiate the test sequence.
Orange lamp: The ear canal is not properly sealed and a large pressure leak exists.
Yellow lamp: The probe tip is occluded with cerumen or you are pressing too hard against the ear canal so that you have collapsed the canal at the tip of the probe.

In all cases, it is best to remove the probe, examine the tip for cerumen and clean it if necessary. A change of eartip size may also be appropriate. Start the test again!

3.6 Audiometry Testing Information (Versions 3 and 4)

Prior to testing, ensure that the earphone cords are plugged into their appropriate connectors on the rear panel of the GSI 38. Select the desired tone type (i.e., pulsed, steady, or FM).

CAUTION

Always handle earphones with care. Neither drop them nor permit them to be squeezed together. Severe mechanical shock may change their operating characteristics and require their replacement. Insert the earphone cords between the earphone cushions during storage to prevent damage from mechanical shock.

.1 Instructing the Patient/Subject

ne operator should put the patient/subject as much at ease as possible before the test begins. ddition, it is important to try to make them understand how the test is to be conducted and what y will hear. For sake of uniformity, an unvarying explanation is advisable - something close to following:

am going to place these earphones over your ears. You will hear a variety of tones - some n, some low, some loud, and some very soft. Whenever you hear, or think you hear one of se sounds raise your hand. Lower your hand when you no longer hear the sound."

Remember that although some of the tones will be easy to hear, others will be very faint. erefore, you should listen very carefully and raise your hand whenever you think you hear the e."

odify the instructions accordingly if the optional handswitch is to be used.

.2 Placement of Earphones

ne most important thing to remember is that a good seal is required between the earphone hion and the patient's/subject's head and ears. To increase the likelihood of a good seal:

a. Eliminate all obstruction between the earphones and the ears e.g., hair, eyeglasses, earrings, hearing aids, etc..
b. Adjust the headband so that it rests solidly on the crown of the subject's head and exerts firm pressure on both ears.
c. Center the earphones carefully over both ears. The earphone with the red connector goes on the right ear. Take care to eliminate any visible gaps between the earphone cushions and portions of the individual's head and the ear on which the cushion rests.

.3 Response Handswitch (optional accessory)

the optional handswitch is to be used, be sure that the handswitch connector is properly insertinto the jack on the rear panel. The GSI 38 will display an appropriate symbol whenever the ndswitch is operated.

Program Mode

o enter the program mode, select the PROGram pushbutton located on the front panel. The foling screen appears the first time you enter the Program mode after you receive your GSI 38 n the factory. (In other words, these are the default settings used at the factory during produc.)

Program Mode - User Selections

* Reflex HL + Curve	* Print - Audiogram
Reflex HL only	Print - Aud Table
Reflex Yes/No	* Normal Box ASHA
* Prn Header GSI	Normal Box Off
Prn Header Off	* Aud Range Normal
Prn Header Custom	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.

3.7.1 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:

a. **I** (Ipsi) or **C** (Contra) if available and selected
b. Frequency: **500, 1000, 2000,** or **4000 Hz**
c. **Intensity level** where response was detected
d. **Tracing** of actual response curve.

If reflex HL only is selected, the same information as itemized above except for d. will appear on the display and the printout. If reflex yes/no is selected, item d. will not appear and item c. will be replaced with the word yes (response detected at one of three levels) or no (no response detected).

To select a different setting for reflex format, note that a square cursor is located next to the reflex HL + curve option. Use the < Hz pushbutton to cursor down to the setting that you wish to select for your own default criterion. While the square cursor is positioned in front of your desired setting, press the M+ pushbutton. Note that the word SAVED appears in the lower right margin of the screen. Also, this will cause the asterisk (*) to be deleted from in front of the prior default setting e.g., Reflex HL + curve and to be repositioned in front of the new setting.

3.7.2 Print Header Format

Three different approaches are available with respect to a print header:

print header = GSI;
print header = off;
print header = custom.

Print header = GSI is the default setting for this feature which means that each time the print screen or print all tests in memory pushbuttons are chosen, the printout will begin with the label "GSI 38." It is possible to deselect this default header and have no header printed out. This is accomplished by selecting the feature called print header off. If this option is selected, no header will appear before any test results and thus; will save some printout space and save some printout time. The third choice is to design a custom header which might be the name of your own facility, department or company name.

lse a similar procedure to that described above to deselect the GSI header and select no head-
or a custom header. With the < or > Hz pushbutton, position the square cursor in front of the
sired new setting and press M+ to select it as the new default setting. The word SAVED appears
he lower right margin. If the custom header is selected, a line cursor will begin to flash at the
-hand margin below the words Prn Header Custom. To "type" in the desired header use the dB
knob. Rotating this knob clockwise will sequence you through the alphabet in the forward direc-
and rotating this knob counter-clockwise will sequence you through the characters in a reverse
ection. The available character set is : A -Z; 0 - 9; and a blank space. The blank space can be
ed to erase an unwanted letter or number. A total of 35 character spaces are available. Please
e that if you wish the header to be centered, it will be necessary to consider the length of the
me to be inserted and calculate from the left margin where you want the header to begin.
herwise, if you begin to enter the characters for the header from the left margin, the header will
printed from the left margin on the printout.

NOTE

If you had previously entered a custom header, position the square cursor next to the asterisk (*) in front of Prn 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 right margin indicating that the custom header is still selected.

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

7.3 Audiometric Format During Printing

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

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 corner 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.

3.7.4 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 1.5 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 will not appear on the tymp screen or printout.

3:7.5 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 includes 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.

3.7.6 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.

.8 Tympanometry/Reflex Test Sequence

This section describes the test sequences for all modes of operation. Since there are four versions of the GSI 38 Auto Tymp, all of the test sequences described may not apply to your particular unit. All four versions have tympanometry and ipsilateral reflex capabilities so Sections 3.8.1, 3.8.2 and 3.8.3 apply to all units. Sections 3.8.4 and 3.8.5 indicate which versions contain the described capabilities.

.8.1 Tympanometry only Mode

Select the Tymp only mode by pressing the pushbutton labeled Tymp on the front panel. The display will immediately show the format for the tympanogram along with the summary information headers ECV, cm^3, daPa, and GR. The default scale for compliance is 1.5 cm^3. If a compliance peak greater than 1.5 cm^3 is measured, the GSI 38 automatically scales the compliance axis to 3.0 cm^3 so that more of the tympanogram data can be seen. Determine which ear is to be tested and select the appropriate ear pushbutton (R or L) so that the test results will be properly labeled. Examine the ear canal of the ear to be tested to determine the appropriate size eartip for the test and position the eartip on the probe. Be certain that the eartip is pushed as far down the probe tip as possible so that the eartip is flush with the tip of the probe. Position yourself so that you are at eye level with the test ear. Note that the green lamp is blinking which indicates that the GSI 38 is ready to begin the test. Place the probe up against the entrance of the ear canal so that its opening is completely covered with the eartip and so that no visible leaks are apparent.

The test sequence begins once the GSI 38 determines that a volume between 0.2 cm^3 and 6.0 cm^3 is present. This is indicated by the green lamp changing from blinking to a steady state. From this point on, hold the probe securely in this same position without any hand motion. Keep your eyes on the probe and the individual's ear.

At the start of the test, the pressure system establishes a pressure of +200 daPa within the ear canal. When this pressure is achieved, the GSI 38 makes a measurement of ear canal volume. This information is valuable since it indicates whether a good seal has been established and since it helps differentiate between two similar tympanograms (i.e., a fluid-filled middle-ear system and a perforated tympanic membrane). After the ear canal volume (ECV) is obtained, this compliance value is subtracted from the remaining compliance measurements so that a direct reading of the tympanogram compliance peak is possible.

The pressure sweep begins at the starting pressure of +200 daPa and proceeds in the negative direction at a rate of 600 daPa/second. Measurements of compliance are made continuously as the pressure sweep continues in the negative direction. The slope of the tympanogram increases as the measurement approaches the compliance peak. This signals the GSI 38 to slow down the rate of pressure sweep to 200 daPa/second to ensure a more accurate reading of the compliance peak. After the peak compliance and pressure values are detected and stored, the tympanogram drops downward toward the baseline (i.e., 0 cm^3) and the pressure sweep rate increases back to 600 daPa/second. The tymp sweep ends automatically when the compliance value returns to baseline and the pressure is at least -100 daPa. Only when the middle-ear pressure is very negative is it necessary for the pressure sweep to continue all the way down to -400 daPa. This automatic stop when the tymp compliance returns to baseline eliminates unnecessary pressurization of the ear and shortens the test time.

When the tympanogram is completed and the test is finished, the solid green lamp is turned off and the display indicates the complete tympanogram results. It is now possible to remove the probe from the ear and to view the test results on the display. The test results are automatically

stored in a page of memory. The actual memory location number is determined by the number of tests which preceded this current test. For example, if this is the first test to be stored in memory, it will be assigned the number M1. If it is the third test to be stored in memory, it will be numbered M3 and so on.

In addition to the tympanogram tracing, the screen displays the test summary information. This data includes the ear canal volume (ECV), the compliance peak in cm^3, the pressure at the peak of the tympanogram in daPa, and the gradient (GR) as a pressure width value. This test result can be printed out immediately as a single test by selecting the pushbutton labeled print screen only or other tests can be run and saved before all tests in memory are printed via the print all pushbutton.

3.8.2 Tympanometry and Ipsilateral Reflex

The default parameters for this test are tympanometry followed by an ipsilateral acoustic reflex test at 1000 Hz. To change this default setting, select the desired frequencies for the test as described in Section 3.8.3.

Once a seal is obtained, the tympanometry sequence is initiated. (See Section 3.8.1 for details.) As long as no large leak is encountered during tympanometry (orange lamp is illuminated) and no occlusion is detected (yellow lamp is illuminated), the test automatically sequences on to the reflex portion of the test as follows. The pressure from the tympanogram peak compliance is re-established within the ear canal and is offset by -20 daPa so as to avoid any problems with extremely sharp tympanogram slopes. With the air pressure held constant throughout the reflex test sequence, the lowest intensity level for the starting frequency is presented and a measurement of compliance change is made. If the compliance decreases by at least 0.05 cm^3, this reflex intensity level is stored in memory. If no other frequencies were selected for the test, the Tymp Reflex sequence ends here. The display will indicate the reflex test result as a Yes, as an HL value, or as an HL value plus a tracing of the reflex response curve. The default setting established in the Program mode determines the manner in which the reflex result is displayed. See Section 3.7 Program Mode. Note that the green lamp is no longer illuminated indicating that it is time to remove the probe from the ear.

If no response is measured (i.e., a compliance decrease of at least 0.05 cm^3 was not detected) at this lowest intensity level, the intensity level of the stimulus is automatically increased by 10 dB. During this second presentation, a measurement of compliance change is also made. If a response is detected, the test sequence for this frequency ends and either the result is displayed on the screen or the test proceeds on to the next frequency selected. However, if once again no response is detectable, the intensity level is increased by 10 dB (e.g., 1000 Hz Ipsi = 105 dB HL) and the stimulus is presented. After the compliance measurement is made and a response is detected, the highest intensity level is stored as the reflex test result and displayed on the screen. If no response is detectable at this third and highest intensity level, either a No or an NR (depending upon Program mode setting) is indicated on the screen next to the frequency tested label. If during any of the three stimulus presentations a large pressure leak develops an NT will appear on the screen next to the frequency where it occurred and the test sequence is aborted.

The same sequence is followed for each test stimulus selected. The first stimulus presentation occurs at the lowest level available for the stimulus selected. If a compliance change of 0.05 cm^3 or greater is detected, the test sequence for this particular test stimulus ends at this lowest level. If no compliance change of at least 0.05 cm^3 is detected, the test automatically increases the stimulus intensity by 10 dB and this same frequency is repeated at this next higher level. Once again if a

npliance change of 0.05 cm^3 is detected, this sequence ends at this level and the intensity level tored. Finally, if there is no detectable response at the second intensity level, the test automatiy increases the stimulus intensity by another 10 dB and the same stimulus is repeated for a d and final time. If a response is detected, this third level is stored in memory as the test result. o response is detectable at this third and highest intensity level, the test is considered a no ponse (NR) or as a No depending upon the program mode default setting. In other words, for h test stimulus selected, a maximum of three different stimulus intensity levels are availabe for test. The test sequences through each of the intensity levels only if required to obtain a meaable result. Thus, if the individual being tested responds to the lowest level, there is no additionstimulus presentation necessary for this particular stimulus. This test protocol aims to save test e and to limit the number of circumstances where the higher level stimulus presentations are de.

he three intensity levels available vary with the frequency selected ipsilaterally as follows:

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

NOTE

Although four frequencies are available during the tymp and ipsilateral reflex test mode, most situations require only one or two frequencies to be tested. The GSI 38 offers a selection from the most commonly used frequencies. However, it is strongly recommended that you select only one to two frequencies per test since holding the probe in the same position for the length of time it takes to test four frequencies sometimes becomes a problem for both the operator and the individual being tested.

3.3 Programming Ipsilateral Acoustic Reflex Test Frequencies

s mentioned above, the GSI 38 defaults to a 1000 Hz test stimulus when the TYMP REFLEX shbutton is first selected after receipt from the factory. However, any combination of the four ailable frequencies (500, 1000, 2000, 4000 Hz) can be selected either temporarily or as revised ault parameters. To temporarily modify the default condition, .select the desired frequencies by ecting or deselecting the appropriate frequency pushbuttons after the Tymp Reflex pushbutton s been selected. In this way, the actual test stimuli presented will be determined by the frequenpushbuttons selected prior to beginning a test i.e., sealing the ear canal. Each frequency selectwill be indicated on the display as it is chosen. For example, if 2000 Hz is selected along with 00 Hz, the label I 1000 will appear at the top of the first column of numbers for reflex and I 2000 appear directly below it. If 500 is also selected, the screen will be modified so that I 500 pears at the top of the first column of reflex numbers, I 1000 will appear directly below I 500 and 000 will appear at the top of the second column of reflex numbers and directly to the right of I 0 and so on. Please note that there is a very definite pattern to the way in which these frequens are positioned on the screen; namely, the lowest frequency will be placed at the top of the first

column for reflex results followed by the next lowest frequency. If more than two frequencies are selected, the third and fourth frequencies will be placed in the second column for reflex results in a low to higher frequency order.

To change the default frequencies for the Tymp Reflex mode, select the desired frequencies as described above. Once you have reviewed them and are certain that they are the desired parameters, press the M+ pushbutton. Note that the word SAVED appears on the display screen. Now every time that you re-enter the Tymp Reflex mode these revised default parameters will automatically be selected. As mentioned above, it will still be possible to temporarily alter the frequencies selected by choosing the desired frequencies. However, in this case each time that the Tymp and Reflex test mode is exited and re-entered, the default parameters will reappear. There is no limit to the number of times that the default frequencies can be modified. It is a good practice to keep a record of the reflex default frequencies.

3.8.4 Tympanometry and Contralateral Reflex (Version 2 and 3)

To select tympanometry and contralateral reflex testing, select the Tymp Reflex mode pushbutton. This initializes the GSI 38 to perform a tympanogram along with some reflex measurements. Next, deselect ipsilateral acoustic reflex testing from the test sequence by pressing the IPSI pushbutton if the test mode had ipsi testing as part of its default setting. Note that the letter "I" disappears from the screen label but the frequency information does not. Select the CONTRA pushbutton. This causes the letter C to appear in front of the frequency labels. Determine which frequencies that you wish to test during the Tymp and Reflex test session. As described in Sections 3.8.2 and 3.8.3, it is possible to temporarily change from ipsilateral reflex testing by simply deselecting IPSI and selecting CONTRA or to change the default parameters for the Tymp Reflex mode by selecting the desired parameters (i.e., CONTRA instead of IPSI and the desired test frequencies) and then pressing the M+ pushbutton to save these parameters as the new default settings. In this way, contralateral only testing would be automatically selected upon entry to the Tymp and Reflex mode.

Before initiating this test sequence, select the appropriate size eartip from the color-coded eartip container. The size selected should be such that the insert phone can be tightly fitted into the ear canal. Push the selected eartip firmly onto the insert phone. Be sure to carefully position the insert phone within the ear canal as the calibration depends upon a proper seal of the ear canal. Select the ear under test by pressing R or L. According to general convention, the stimulus ear is the ear which contains the contralateral insert phone and the test ear is the ear where the probe is to be positioned. Thus, if the insert phone is placed within the ear canal of the left ear, the test ear is the right ear since this is the ear from which the reflex response is to be measured. In other words, select the pushbutton labeled R before starting this test sequence.

As with ipsilateral reflex testing, select the desired frequencies for the CONTRA test. If more than one frequency is selected, the stimulus presentation sequence will proceed from low frequency to high. Also, remember that it is highly recommended to select only one or two frequencies for the test. Failure to select at least one frequency causes the GSI 38 to default to the Tymp only mode. See Section 3.8.3 for programming procedure.

To initiate the test, position the probe up against the ear canal of the ear under test. Observe that the green lamp changes from a blinking to a steady state once the test begins. Keep your eye on the probe and the ear canal throughout the test sequence. The test begins with the tympanogram and is followed immediately by the contralateral acoustic reflex test. The pressure value used within the test ear throughout the contralateral stimulus presentations is the peak pressure obtained

ring the tympanogram offset by -20 daPa. As with ipsilateral reflex testing, a compliance change 0.05 cm^3 is the determinant as to whether a reflex response is detected or not. Up to three ensity levels per frequency selected are presented. Recall that it is only necessary to go beyond e first and lowest level if a change of 0.05 cm^3 cannot be detected during the stimulus presentan period. The format in which the test results are displayed on the screen is determined by the fault setting chosen in the Program mode (i.e., yes/no, dB HL, or dB HL and response curve).
The three intensity levels available per frequency are the same for all four (500, 1000, 2000, and 00 Hz) possible frequencies i.e., 90, 100, and 110 dB HL. Remember that the second and third ensity level presentations occur only if a response is not detected at the prior intensity level. The st is over once the green lamp on the probe is no longer illuminated.

8.5 Tympanometry and Ipsilateral/Contralateral Reflex (Versions 2 and 3 only)

As previously described, this test sequence can be selected either temporarily or can be set as e default sequence. If both ipsilateral and contralateral testing are only performed with certain tients, it is advisable to only temporarily change the test parameters on an as needed basis. wever, if your test protocol calls for ipsilateral and contralateral testing with all patients, it is visable to change the default settings. (Recall that the default settings are changed by selecting e M+ pushbutton after you have selected the desired test parameters. The word SAVED appears the screen to notify you that the new parameter settings are the new default settings.)
To select both ipsilateral and contralateral acoustic reflex testing, be certain that both the IPSI and ONTRA pushbuttons have been activated. This is confirmed by the presence of the letters "I" and " within the reflex section of the screen. Note that the letter "I" always appears at the top of the st reflex column and that the letter "C" appears at the top of the second reflex column when both silateral and contralateral testing is to be performed. Unlike the ipsilateral only and the contralateral ly reflex tests, it is not possible to select all four frequencies for this test. When testing both ipsi and ntra, you are limited to the selection of only two different frequencies or a total of four different stimus presentations. As a result, the freqencies tested during the ipsilateral test sequence are the me frequencies tested during the contralateral test sequence.
Before initiating the test, securely position the insert phone within the ear canal to receive the conlateral reflex stimulus. Next, position the hand-held probe up against the ear canal to receive the silateral stimulus. Once the green lamp changes from a blinking to a steady state, the test quence begins. First, a tympanogram is obtained and then the peak pressure from the compliance ak offset by -20 daPa is re-established within the ipsilateral ear canal (i.e., ear containing the obe). The reflex sequence begins automatically by starting with the lowest ipsilateral test frequency d is followed by a second ipsilateral test frequency if selected. After the ipsilateral reflex tests are mpleted, the GSI 38 automatically sequences on to the contralateral reflex test stimuli. Once ain, the lowest frequency is presented first and is then followed by the next frequency. Keep your e on the ear canal where the probe is positioned. Once the green probe lamp is no longer illumited, the test is complete and it is possible to remove the probe and the insert phone from their spective ear canals. The reflex test results can now be observed on the display screen. The format which the ipsi and contra reflex test results are displayed is dependent upon the setting chosen in e program mode.

3.8.6 Exit Tympanometry/Reflex

To exit Tymp Only Mode select Tymp Reflex or Audiometry Mode. Note that the appropriate screen appears on the display.

To exit Tymp/Reflex Mode select Tymp or Audiometry Mode. Note that the appropriate screen appears on the display.

3.9 Audiometry Test Sequence (Versions 3 and 4 only)

To enter the audiometry mode, select the pushbutton labeled AUD. Note that the display changes from a tymp or tymp and reflex format to an audiogram format. The default settings for the frequencies available during audiometry are set in the Program mode as 125 through 8000 Hz (normal) or 500 through 6000 Hz (narrow). The GSI default setting is the normal frequency range of 125 through 8000 Hz. Upon entering the audiometry mode, the starting frequency is automatically selected to be a steady signal of 1000 Hz at 0 dB HL. It is possible to temporarily change the signal format from steady (continuous) to a pulsed or frequency modulated tone. These alternative tone formats remain selected as long as you remain within that audiometric test. Once you leave that specific test by selecting either Tymp or Tymp Reflex, or by initiating the next test, the tone type returns to steady. In other words, the tone format is re-initialized to the steady tone format.The display indicates a continuous bar when steady is selected, a dashed bar when pulsed is selected, and the letters FM when frequency modulation is selected. Note that the audiometry test defaults to testing the right ear first. To start with the left ear, it is necessary to select the L pushbutton after entering the audiometry mode. Since the audiometry mode defaults to 1000 Hz at 0 dB HL, the cursor is positioned at the corresponding location on the audiogram. Please note that even though you may have selected the tabular format for the audiometric test results on the printout, the screen always appears in the audiogram format.

To change to a frequency above 1000 Hz, select the > Hz pushbutton. If the pushbutton is pressed once momentarily, the frequency increases to the next frequency in the range i.e., 1500 Hz. However, if the > Hz pushbutton is held down continuously, it is possible to quickly scroll through the available frequencies. Note that if the pushbutton is held down past the 8000 Hz (if the normal range is selected, otherwise 6000 Hz for the narrow range) position, the frequency scroll wraps around to the lowest frequencies (i.e., 125 Hz with the normal range and 500 Hz with the narrow frequency range). The reverse occurs if the < Hz pushbutton is pressed. In other words, the frequency changes from 1000 Hz to 750 Hz if the < Hz pushbutton is pressed a single time or the frequency scrolls in reverse direction if the pushbutton is held down continuously. Once again, the frequencies wrap around from the lowest frequency available in the range to the highest frequency available in the range. In addition to changing the cursor position on the audiogram, the < and > Hz pushbuttons cause the frequency value on the right-hand side of the display screen to change as well.

Use the dB HL knob to change the intensity level of the test tone. Rotating this knob in the clockwise direction causes the intensity level to increase in 5 dB steps and rotating this knob in the counter-clockwise direction causes the intensity level to decrease in 5 dB steps. Note that cursor moves up and down accordingly. Also, note that the dB level indicated above the frequency value on the right-hand side of the audiogram changes as well.

or each frequency, there is a fixed intensity range normally available while rotating the dB HL
bas follows:

125 Hz	-10 to 50 dB HL
250 Hz	-10 to 70 dB HL
500 to 6000 Hz	-10 to 90 dB HL
8000 HZ	-10 to 70 dB HL.

owever, in addition, it is possible to extend the intensity range per frequency by 10 dB simply selecting the +10 dB pushbutton. This +10 dB pushbutton may only be selected when the inten- level is set to the highest value in the normal range. For example, with the test tone of 1000 the normal intensity limit is 90 dB HL. Note that, when the intensity knob is rotated clockwise to ect beyond 90 dB HL, the intensity value above the 1000 Hz to the right of the audiogram flash- indicating that the normal intensity limit has been reached. To go beyond 90 dB HL, select the dB pushbutton. Note that a large + sign appears on the screen below the 1000 Hz value. Now, dB HL knob can be rotated through two additional positions, namely, 95 and 100 dB HL. If you te the dB HL knob to the next position beyond 100 dB, the intensity value 100 flashes on the een to the right of the audiogram; thereby, indicating that the maximum dB HL for the extended ge has been reached. If the dB HL is rotated one more position beyond the flashing 100 dB ition, the letters NR appear next to the letters dB above the 1000 Hz. This permits the selection ne no response symbol on the audiogram during testing. The extended range remains selected l either the intensity level for that particular frequency (e.g., 1000 Hz) is brought down 5 posi- s below the maximum dB HL value (e.g., 65 dB HL for 1000 Hz) or the frequency is changed.
save the threshold value per frequency, press the M+ pushbutton. Note that the appropriate bol (0 for right ear and X for left ear) for the ear under test is positioned at the correct location he audiogram. If no response (NR) was detectable over the intensity range available, an arrow ttached to the 0 or X symbol on the audiogram. It is possible to repeat a threshold check for frequency by returning to that frequency by way of the < and > Hz pushbuttons. In this ance, the last threshold obtained and saved with M+ pushbutton becomes the value saved in mory and is the value printed out on the audiometric test results.
present each test tone to the selected test ear, press the present bar. A speaker symbol with arrow pointing from it appears on the screen between the audiogram and the dB/ Hz values for ong as the present bar is depressed.

NOTE

Although the printout will combine the right and left ear test results on the same audiogram or table, the screen can display only the results from one ear at a time. Therefore, if an ear pushbutton (R or L) is selected while you are still testing a particular ear, the screen will change to a new audiogram. Once this happens, it is not possible to return to the incomplete audiogram to complete the test sequence.

.1 Screening Audiometry

refully position the earphones over the individuals ears so that the red phone covers the right and the blue phone covers the left ear. Be sure that nothing is obstructing each earphone such arrings, eye glasses or a hearing aid. Instruct the person being tested to raise a hand or a fin- (or press the optional handswitch) whenever a tone is heard. Encourage him/her to respond n if they are not sure whether they hear a tone.

Select the ear to be tested with the R (right) or L (left) pushbutton. Next,select the desired screening intensity by rotating the dB HL knob to the appropriate position. The American Speech Language and Hearing Association recommends 20 dB as the screening level for school-age children. Select the desired frequency at which to start the test by pressing the < or > Hz pushbuttons. Present the selected intensity via the present bar. If the individual fails to respond, increase the intensity by 10 dB and try again. Press the M+ pushbutton at the intensity level where the individual responded. Continue the procedure for all the desired frequencies.

These results can be printed in an audiogram or tabular format. Check the Program mode to determine which setting has been selected.

3.9.2 Threshold Audiometry

As described above, carefully position the earphones and select the ear to be tested first. Familiarize the individual with the test protocol by presenting a tone of 40 dB HL at 1000 Hz. Decrease the intensity in 10 dB steps until the person no longer responds or until you reach 0 dB HL. When you believe the individual understands the procedure, (i.e., raise your hand/finger when you hear a tone) proceed with the test protocol

The level of the first presentation generally is 10 dB below the level at which the individual responded during the familiarization procedure. Starting at the desired test frequency, present the tone for a period of one or two seconds. If a response is indicated, decrease the intensity of this same test frequency by 10 dB and present the tone again for one to two seconds. If no response is indicated, increase the intensity by 5 dB. Present the tone again. If no response is indicated, increase the intensity by another 5 dB. If a response is indicated, this is the second time that the individual responded to the same intensity level. Repeat the sequence of down 10 dB and up in 5 dB increments to determine if a correct response is again detected at the same intensity level. The threshold is considered to be the minimum level at which a response has occurred two out of three times. Press the M+ pushbutton when this intensity level is indicated on the screen above the test frequency to signify that the threshold level for that frequency has been reached. Note that the appropriate symbol (O = right, X = left) appears at the correct intensity level where the threshold was determined. Repeat this test sequence for each frequency to be tested.

Once the thresholds have been obtained for all the desired frequencies, select the other ear and repeat the sequence. Note that the display changes to a new screen for storing the second ear's results. The test protocol follows a down 10 dB and up 5 dB sequence to arrive at the threshold level.

3.9.3 Exit Audiometry

There are two ways to exit the audiometry mode: select the Tymp mode pushbutton or select the Tymp Reflex mode. Note that the appropriate screen appears on the display.

3.10 Tests 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 M1 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

e stored in memory, only five memory locations can be scanned. The memory can be scanned age at a time by pressing the PAGE pushbutton once and observing the result. The entire nory can be scrolled through by holding the PAGE pushbutton down continuously.

1 Memory Erase

there is a particular test result that you wish to delete before printing, PAGE to this test result press the M- pushbutton. This causes that particular test result to be erased from memory. erase mode is accessed when the operator selects a test to erase and presses the M- push-on. The LCD displays a blank screen for erased memories with the memory location number ted at the top right corner. Upon exit from the erase mode the stored memories reshuffle and ace the empty memory with the remaining tests in the order in which they were run. The erase le will be exited once the operator presses the PRINT ALL or ERASE ALL pushbuttons or any hbutton that would normally begin the setup of a new test. Please note that when the erase le 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.

you should wish to erase all tests from memory, press the M--(ERASE ALL) pushbutton. (For mple, 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!

2 Printing Test Results

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

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

print all tests in memory, simply select the PRINT ALL pushbutton. When PRINTALL is ssed and two audiogram tests are stored in memory, they will combine under the following con-ns. There must be one left test and one right test sequentially stored in memory. A left and t audiometric pair of tests will not be combined if they are separated in the memory by a tymp . Therefore, when tests are erased, the resorting could cause a change in left,right or right,left uence with audiometric tests. The result would be that the wrong audiometric tests would be bined when PRINT ALL is selected. Prior to selecting PRINT ALL the operator should scroll ugh the tests in memory to determine where the audiometric tests are located. This will help operator to avoid combining tests from different patients.

SECTION 4 - TEST RESULTS

4.1 Ear Canal Volume

NORMAL

As a general rule, values for ear canal volume should be between 0.2 and 2.0 cm^3. However, the normal values will vary with age and bone structure. With use , you will develop a feel for the appropriate values.

ABNORMAL

An ear canal value of less than 0.2 cm^3 indicates an abnormal condition. If the probe is partially plugged with cerumen or if the probe is positioned up against the ear canal wall, a smaller than expected value will be measured. Also, keep in mind that if an individual has a relatively large bone structure for his/her age group and a smaller than expected value is measured, the probe could also be partially occluded or up against the canal wall. It is also possible to collapse the canal if the probe is held too firmly against it. Examine the tympanogram and the reflex results to confirm your suspicions. If they are abnormal as well, it is good practice to repeat the test.

An ear canal volume greater than 2.0 cm^3 also may indicate an abnormal condition. An important application of the ear canal volume measurement is to determine if there is a perforation of the tympanic membrane. If there is a perforation due to trauma or due to the presence of a pressure-equalization (P-E) tube, the measured ear canal volume will be much larger than normal since the GSI 38 is measuring the combined volume of the ear canal and the middle-ear space.

4.2 Compliance Peak

NORMAL

The range of normals for compliance is 0.2 cm^3 to approximately 1.4 cm^3. Some groups use a larger range up to 1.8 cm^3. A measured compliance peak within this range indicates normal mobility within the middle-ear system.

ABNORMAL

A compliance value of less than 0.2 cm^3 indicates a pathological condition as the middle-ear system is stiffer than normal. To distinguish the probable cause of the stiffening, the pressure value where this stiffened compliance peak occurs needs to be considered. For example, normal pressure along with a stiff middle ear system is indicative of a "glue-ear", otosclerosis, a severely scarred tympanic membrane or a layer of plaque across the tympanic membrane. On the other hand, abnormal pressure along with a stiffened middle-ear system is consistent with a poorly functioning eustachian tube with possible effusion (serous otitis media).

NOTE

If the measured compliance value is less than 0.1 cm^3, the GSI 38 will print the letters NP next to the heading cm^3 on the screen and printout. The letters "NP" indicate a poorly defined or flat tympanogram. The tympanogram may depict a very shallow peak.

A compliance value greater than 1.4 cm^3 (or 1.8 cm^3) indicates a hyperflaccid tympanic membrane or a possible disarticulation depending upon how far above the normal range the value is. Generally speaking, a compliance value of greater than 3.0 cm^3 is indicative of a disarticulated ossicular chain. Further testing is necessary to confirm this suspicion.

NOTE

If a compliance value is measured to be greater than 1.5 cm^3, the GSI 38 automatically changes the range assigned to the graph and the tympanogram is traced to 3.0 cm^3.

The validity of tympanometry and acoustic reflex testing is dependent upon a healthy tympanic membrane. A pathological condition at this membrane can mask the true condition of the middle ear.

3 Pressure Peak

NORMAL

Strict rules for middle-ear pressure indicate a normal range of +/- 50 daPa. However, for most applications, a normal range of -150 daPa to +100 daPa is used.

ABNORMAL

Very rarely will you obtain an extreme positive pressure condition. Some researchers have reported high positive pressures at the onset of acute otitis media.

Pressure values more negative than -150 daPa are indicative of a poorly functioning eustachian tube. The severity of this condition is determined by how negative the pressure is and its impact on the compliance peak.

If no pressure peak is measured over the pressure range of +200 daPa to -400 daPa, then the GSI 38 will print the letters NP on the screen and the printout. This indicates that no pressure peak was detected over this pressure range.

4 Gradient

NORMAL

When testing a child, the normal range for the gradient is between 60 and 150 daPa. (Infants may show higher gradient values due to the mobility of their ear canals.) The range of normal is somewhat narrower for adults i.e., 50 to 110 daPa.

ABNORMAL

A high gradient value (greater than the high end of the normal range per age group) is indicative of middle-ear effusion. The reduced compliance values and negative middle-ear pressure characteristic of developing or resolving otitis media with effusion (OME) will be manifested in a broad tympanogram with a large gradient value. However, abnormal gradient values may also be found in the absence of abnormal parameters. This could indicate a transient OME, so a retest after several weeks may be recommended.

When the middle ear's mobility is reduced to near 0 cm^3, due to viscous effusion or a "glue-ear" condition, no gradient value can be measured. In this case, the GSI 38 will display dashes (---) next to the letters GR.

Very low gradient values are associated with a flaccid middle ear system. These low values should be taken into consideration with the ear canal volume and compliance peak values to determine the probable cause of the flaccid condition.

4.5 Acoustic Reflex

NORMAL

For screening purposes, an ipsilateral or contralateral reflex measured at any one of the three levels available per frequency can be considered normal. Obviously, the lowest values are desired. However, without knowing the hearing threshold level of the individual per frequency, it is difficult to make a more definite statement. Generally speaking, the reflex is reported to occur at between 70 and 90 dB HL above the hearing threshold in normals. Remember that these values apply to reflex threshold measurements and that the GSI 38 does not permit reflex threshold measurements due to the use of a hand-held probe.

The presence of a reflex in the absence of a compliance peak suggests that the tympanometric results should be considered invalid and the test repeated. This is true because if there is no compliance measured during tympanometry, it is not possible to measure any stiffening affect during the reflex stimulus presentation.

ABNORMAL

If a pressure leak occurs during the reflex testing and the pressure system is unable to correct for this leak, the reflex test sequence is aborted. When this occurs, the test results are assigned the letters NT (not tested).

If no response is obtained at the third and final stimulus level, the GSI 38 will indicate this with the letters NR or No. More detailed testing at the frequency where this occurred is required to determine the reason for the no response.

4.6 Audiometry

NORMAL

A normal response from a child should be at or below 20 dB HL. A normal response from an adult will be somewhat higher at or below 25 dB HL. Remember that these normal values assume a quiet environment during testing.

ABNORMAL

In children, a failure to respond to a 20 dB HL (or lower) stimulus presentation during a retest performed four to six weeks after the initial test would indicate the need for more extensive diagnostic testing to determine the cause.

In adults, a failure to respond at or below 25 dB HL when the room noise levels are low indicates the need for more evaluation. However, the age and employment history of the individual must also be considered.

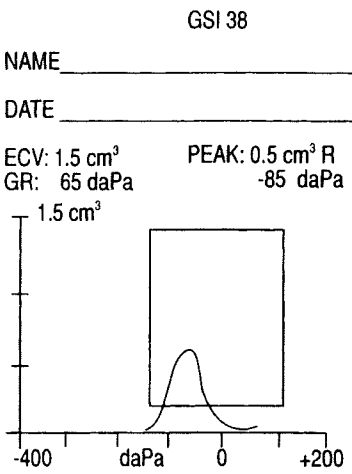
' Special Messages and Error Codes

rror code numbers and other "special" messages may be displayed on the screen or on the ıtout. These messages appear whenever an instrument error occurs or, in some instances, to ırise the operator of certain situations. For example, if there is no test result on the screen and print screen pushbutton is pressed, the printer will indicate "No Test To Print"

rror codes will appear as a two-digit number prefixed by the letter "E". If an error code appears, ase repeat the operation that caused the error code to appear. If the error code appears for the ond time, make a note of it and contact your GSI Service Representative, giving him/her the ct error code number.

Sample Test Results

gures 4-1 through 4-10 illustrate test results from sample GSI 38 Auto Tymp printouts. The oothness of the tympanogram tracing is determined by the amount of movement during the ing. Little or no movement during the testing provides a smoother tracing. Moving, talking or ng during testing leads to a more erratic looking tracing but does not dramatically affect the results.



Range of Normals

Ear Canal Volume 0.2 - 2.0

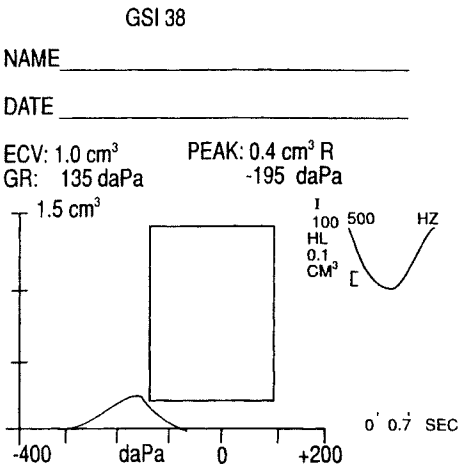
Compliance Peak 0.2 - 1.4

Pressure Peak -150 - +100

Gradient 60 - 150 Child
50 - 110 Adult

Acoustic Relex Yes or No

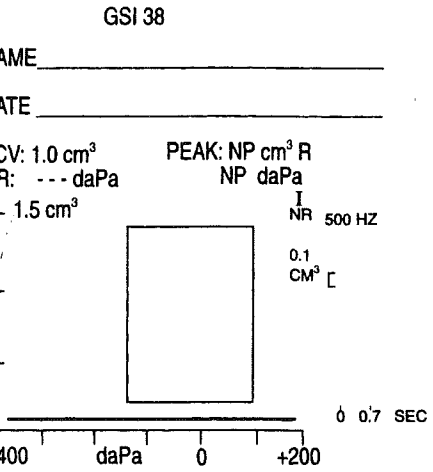
Figure 4-1: Range of Normals



Normal Ear Canal Volume
Restricted Mobility
Abnormal Middle-Ear Pressure
Borderline Wide Gradient
Slightly Elevated Reflex (Ipsi)

POSSIBLE CAUSE
Poorly Functioning Eustachian Tube

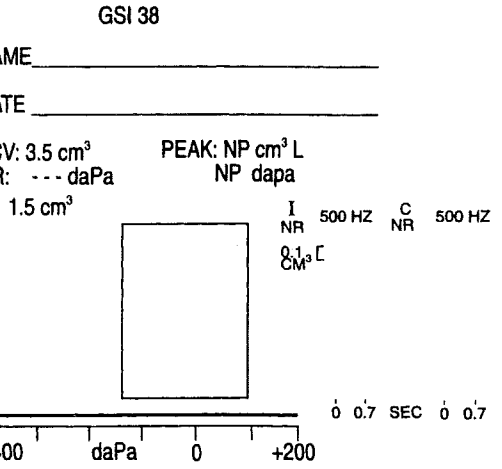
Figure 4-2: Abnormal Tymp



Normal Ear Canal Volume
No Mobility
No Middle-Ear Pressure
No Gradient
No Reflex (Ipsi)

POSSIBLE CAUSE
Fluid-filled Middle-Ear (Serous Otitis Media)
Compliance Peak May be Present at a More Negative Pressure than -400 daPa

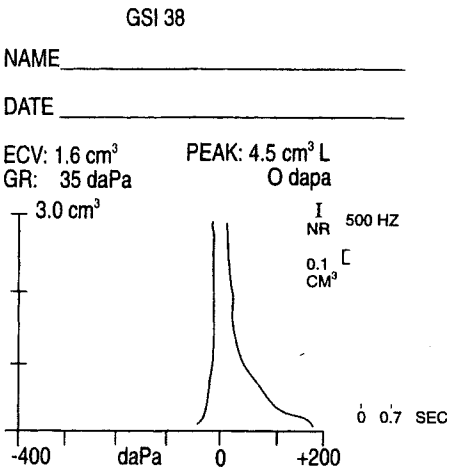
Figure 4-3: Abnormal Tymp



Abnormal Ear Canal Volume
No Mobility
No Middle-Ear Pressure
No Gradient
No Reflex Ipsi and Contra

POSSIBLE CAUSE
Open Perforation
Patent Pressure Equalization (P-E) Tube

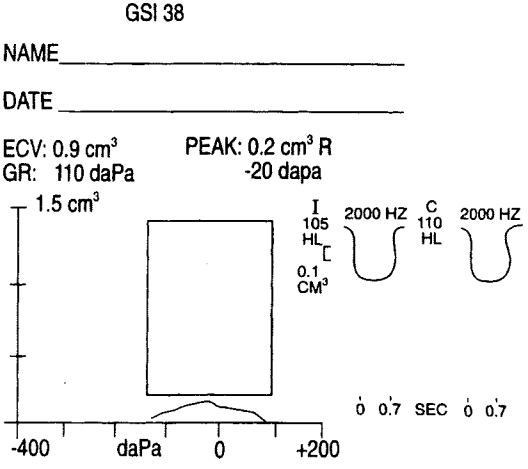
Figure 4-4: Abnormal Tymp



Normal Ear Canal Volume
Extremely Hyperflaccid Middle-Ear
Normal Middle-Ear Pressure
Narrow Gradient
No Reflex

POSSIBLE CAUSE
Ossicular Disarticulation
More Detailed Testing Indicated

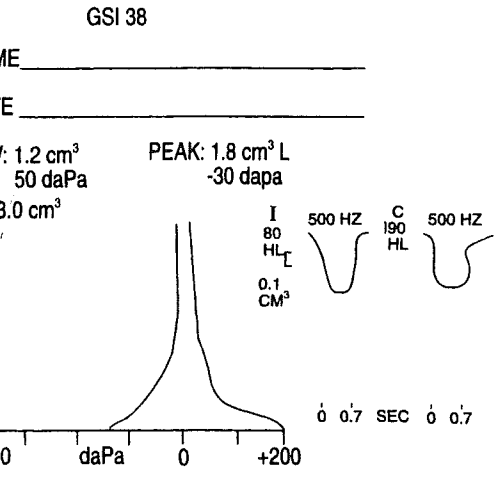
Figure 4-5: Abnormal Tymp



Normal Ear Canal Volume
Normal Middle-Ear Mobility
Normal Middle-Ear Pressure
Borderline-or-Wide Gradient
Slightly Elevated Reflex, Ipsi & Contra

POSSIBLE CAUSE
Glue-Ear
Otosclerosis
Severly Scarred Tympanic Membrane
Plaque Over Tympanic Membrane

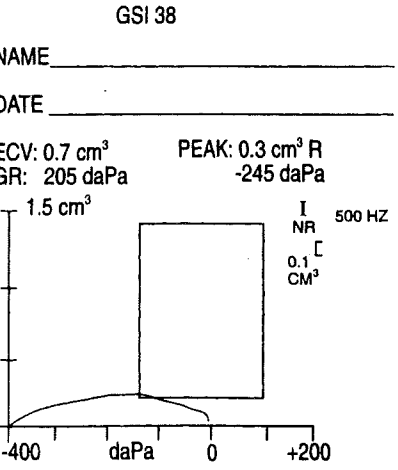
Figure 4-6: Abnormal Tymp



Normal Ear Canal Volume
Hyperflaccid Middle-Ear System
Normal Middle-Ear Pressure
Normal-or-Borderline Narrow Gradient
Normal Reflex, Ipsi & Contra

POSSIBLE CAUSE
Minor Scar Tissue in Tympanic Membrane

Figure 4-7: Abnormal Tymp



Normal Ear Canal Volume
Restricted Mobility
Negative Middle-Ear Pressure
Abnormally Wide Gradient
Elevated or No Reflex

POSSIBLE CAUSE
Serous Otitis Media
Small Air Pockets Present

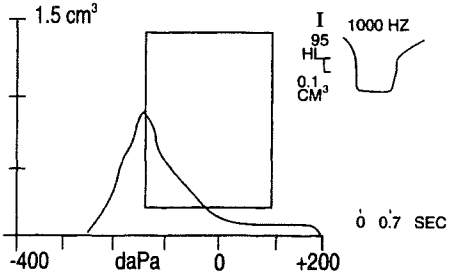
Figure 4-8: Abnormal Tymp

GSI 38

NAME_____

DATE _____

ECV: 0.8 cm^3 PEAK: 0.8 cm^3 R
GR: 105 dapa -145 dapa



Normal Ear Canal Volume
Normal Middle-Ear Mobility
Slightly Negative Middle-Ear Pressure
Normal Gradient
Normal to Slightly Elevated Reflex

POSSIBLE CAUSE
Partially Blocked Eustachian Tube

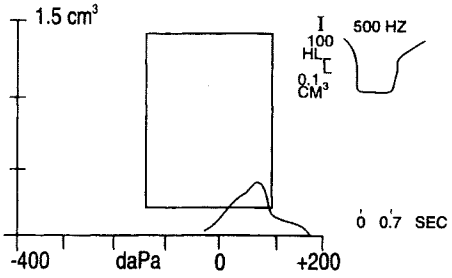
Figure 4-9: Abnormal Tymp

GSI 38

NAME_____

DATE _____

ECV: 1.1 cm^3 PEAK: 0.4 cm^3 L
GR: 95 dapa 85 daPa



Normal Ear Canal Volume
Normal Middle-Ear Pressure
Positive Middle-Ear Pressure
Normal Gradient
Elevated Reflex

POSSIBLE CAUSE
Patient has a cold

Figure 4-10: Abnormal Tymp

SECTION 5 - RS-232 INTERFACE

5.1 Introduction

The GSI 28 RS-232 Interface option provides the capability of transferring stored test results form the GSI 38 to an external computer or data collection device via an optically isolated serial interface.

5.2 Operation

Press the DATA TRANSFER button, located on the front panel of the instrument, to transfer test results stored in memory. During data transfer the message "DATA TRANSFER" will appear on the LCD screen.

Transferring During Normal Operation

During normal testing operation, the DATA TRANSFER button will sequentially transfer all stored test results. The test results are transferred with one record for each memory location in the order in which they are stored. Any test results which have been erased will not be transferred.

Transferring from Memory Pages

If the PAGE button is used to review individual test results stored in any of the eight memory locations, the DATA TRANSFER button will transfer only the currently displayed stored test results. There is one exception to this rule: If the last (most recent) test result is displayed, the instrument assumes normal testing operation, and transfers all test results.

Other LCD Screen Messages

"INVALID SELECTION"

This message appears if the DATA TRANSFER button is pushed during any of the following circumstances:

- During presentation of an audiometric tone
- During a tympanometry test
- During a reflex test
- During Printing

"NO DATA AVAILABLE"

This message appears if the DATA TRANSFER button is pushed and no results are stored.

"NOT AVAILABLE"

This message appears if the DATA TRANSFER button is pushed and the RS-232 interface is not installed.

5.3 Record Formats

5.3.1 General Record Format

All output records are transmitted in a predefined, fixed length format. The generic format for all records is:

"." •	Record Type	Record Sequence Number	Record Index Number	Total Record Number	Data Fields	Checksum	"CR" "LF"

Each record contains only printable ASCII characters, other than the terminating "CR" "LF" characters. Each record consists of fixed length data fields with any unused data fields filled with a value of 0.

The Record Sequence Number is a value from 0 to 9 which is incremented by 1 for each new record which is transmitted. This value will wrap around from 9 to 0. A record will be retransmitted with the same sequence number if retransmission is necessary due to a communications error.

he Record Index Number is a value from 0 to 8 which indicates the record number within a up of records when all test results are transmitted. For example this value will identify a record Record 1 of 5 or Record 7 of 8 when used in conjunction with the Total Record Number. If only currently displayed record is being transferred, this value will be 1.

he Total Record Number is a value from 1 to 8 which indicates the total number of records to be nsmitted in a group when all tests results are transmitted.

he Checksum is calculated as the mod 256 sum of all preceding characters in the record, uding the ":" prefix, with the most significant bit = 0 and stored as two Hex ASCII characters.

3.2 Tympanometry and Reflex Test Results Record

Character Number	Number of Characters	Data Type	Field Name	Field Description
1	1	ASCII	Start of record	":"
2	1	ASCII	Record Type	"x"
3	1	ASCII	Record Sequence Number	"0" to "9"
4	1	ASCII	Record Index Number	"1" to "8"
5	1	ASCII	Total Record Number	"1" to "8"
6	5	ASCII	Reserved	Reserved for future use. Defaulted to "-------"
11	2	uChar	Ear	Ear under test Bit 0 = 1 = Left ear under test = 0 = Left ear not under test Bit 1 = 1 = Right ear under test = 0 = Right ear not under test Bits 2-7 = Not used Either the RIGHT ear is selected OR the LEFT ear is selected. Both ears selected or no ear selected is invalid.
13	4	uint	ECV	Ear canal colume in cm3 measured at +200 daPa, stored as ECV x 64. Range = 0.00 to 6.00 cm3
17	4	uint	Peak Compliance	Peak compliance in cm3, stored as compliance x 64. Range = 0.00 to 6.00 cm3
21	4	sint	Peak Pressure	The pressure where the peak compliance occurred, stored in daPa. Range = 399 to 200 daPa
25	4	sint	Gradient	Gradient value calculated as the pressure difference at the compliance half-peak popints stored in daPa. Range = -1 to 500 daPa -1 = No gradient has been calculated yet 0 = No gradient could be calculated.
29	2	sChar	End Index	The data index where the last compliance data point is stored. Range = -1 to 87 -1 = No data was stored.
31	2	sChar	Slow Index	The data index where th last compliance data point measured at 600 daPa/sec before the rate changes to 200 daPa/sec is stored. -1 = No rate change occured

33	2	sChar	Fast Index	The data index where the first compliance data point measured at 600 daPa/sec after changing back to 600 daPa/sec from the 200 daPa/sec rate is stored. -1 = No rate change back occurred
35	2	uChar	Tymp Data [0]	Tympanometry compliance data point #0 in cm3, stored as: compliance X 64. Range = 0.00 to 3.98 cm3. A maximum of 88 data points are stored per Tympanometry test.
:	:	:	:	:
209	2	uChar	Tymp Data [87]	Tympanometry compliance data point #87 in cm3, stored as: compliance X 64
211	2	uChar	Tymp Scale	Tympanometry compliance axis scale. 15 = 1.5 cm 3 30 = 3.0 cm3
213	2	uChar	Number of Reflex Tests	The number of reflex tests performed Range = 0 to 4
215	2	uChar	Reflex Test Parameters	Reflex test selection parameters. Bit 0 = Ispi status: 0 = Not selected 1 = Selected Bit 1 = Contra status: 0 = Not selected 1 = Selected Bit 2 = 500 Hz status: 0 = Not selected 1 = Selected Bit 3 = 1000 Hz status: 0 = Not selected 1 = Selected Bit 4 = 2000 Hz status: 0 = Not selected 1 = Selected Bit 5 = 4000 Hz status: 0 = Not selected 1 = Selected Bits 6 & 7 = Not used
217	2	uChar	Reflex #1 Result	Results of Reflex test #1.. Bits 1 & 0 = dB level tested 00 = Low dB level 01 = Middle dB level 10 = High dB level 11 = Invalid Bits 3 & 2 = Reflex tests status: 00 = NT = Not tested 01 = YES = Yes, a reflex was detected 10 = NR = No reflex detected 11 = NT_CAL = Not tested, due to a calibration data error Bits 5 & 4 = Test frequency: 00 = 500 Hz 01 = 1000 Hz 10 = 2000 Hz 11 = 4000 Hz Bit 6 = Test type: 0 = IPSI 1 = CONTRA Bit 7 = Not used
219	4	uint	Reflex #1 Baseline Average	Average baseline compliance, in cm3 X 256

223	4	uint	Reflex #1 Reflex Average	Average reflex compliance, in cm3 X 256
227	4	uint	Reflex #1 Reflex [0]	Reflex compliance data point #1 of 4, in cm3 X 256. Bit 15 = Noise indicator 0 = Quiet data measurement 1 = Noisy data measurement, potentially unreliable
:	:	:	:	:
239	4	uint	Reflex #1 Reflex [3]	Reflex compliance data point #4 of 4, in cm 3 X 256. Bit 15 = Noise indicator 0 = Quiet data measurement 1 = Noisy data measurement, potentially unreliable
243	4	uint	Reflex #1 Recovery [0]	Reflex recovery compliance data point #1 of 6 measured after the stimulus is turned off, in cm3 X 256, Bit 15 = Noise indicator 0 = Quiet data measurement 1 = Noisy data measurement, potentially unreliable
:	:	:	:	:
263	4	uint	Reflex #1 Recovery [5]	Reflex recovery compliance data point #5 of 6 measured after the stimulus is turned off, in cc X 256, Bit 15 = Noise indicator 0 = Quiet data measurement 1 = Noisy data measurement, potentially unreliable The recovery points #5 and #6 are only included when the recovery is slow and there was no recovery according to the first four recovery data points. If not included, their values will be 0.
267		asst	Reflex #2	See Reflex #1 format.
317		asst	Reflex #3	See Reflex #1 format.
367		asst	Reflex #4	See Reflex #1 format.
417	2	uChar	Checksum	The hexadecimal sum of characters 1 to 416
419	2	ASCII	Package Terminator	"CR, "LF"

3.3 Audiometry Test Results Record

Character Number	Number of Characters	Data Type	Field Name	Field Description
1	1	ASCII	Start of record	":"
2	1	ASCII	Record Type	"y"
3	1	ASCII	Record Sequence Number	"0" to "9"
4	1	ASCII	Record Index Number	"1" to "8"

5	1	ASCII	Total Record Number	"1" to "8"
6	5	ASCII	Reserved	Reserved for future use. Defaulted to "-------"
11	2	uChar	Ear	Ear under test Bit 0 = 1 = Left ear under test = 0 = Left ear not under test Bit 1 = 1 = Right ear under test = 0 = Right ear not under test Bits 2-7 = Not used Either the RIGHT ear is selected OR the LEFT ear is selected. Both ears selected or no ear selected is invalid.
13	4	sint	HL Threshold 125 Hz	-10 to +100 dB HL x 2 NR = Any value in the range of 231 to 450 NT = 32,768 (0x8000 Hexadecimal)
:	:	:	:	:
53	4	sint	HL Threshold 8000 Hz	-10 to +100 dB HL x 2 NR = Any value in the range of 231 to 450 NT = 32,768 (0x8000 Hexadecimal)
57	2	uChar	Checksum	The hexadecimal sum of characters 1 to 56
59	2	ASCII	Package Terminator	"CR", "LF"

5.3.4 Notes

1. "uChar" & "sChar" designate unsigned and signed characters respectively, single bytes represented in Hexadecimal by two ASCII characters.
   Example: 0xE9 is sent as: "E", "9"
2. "uInt: and sInt" designate unsigned and signed 16-bit integers respectively, expressed in HiByte/LowByte sequence by four Hex ASCII characters.
   Example: 0xE196 is sent as: "E", "1', "9", "6"
3. Tympanometry compliance values are stored in the record scaled by 64. To convert to cm3, divide by 64.
   Example: Tymp Data[0] = "4", "2" = 0x42=66 decimal scales X64 = 66/64 = 1.0-3 cm3
4. Reflex compliance values are stored in the record scaled by 256: To convert to cm3, divide by 256.
   Example: Reflex #1 Reflex [0] = "0", "3", "0", "D" = 0x30D = 781 decimal scaled X 256 = 781/256 = 3.051 cm3
5. Audiometry Threshold values are stored scaled by 2 in the sequence of 125 Hz, 250, 500, 750, 1000, 1500, 2000, 3000, 4000, 6000 and 8000 Hz.
   Example: HL Threshold 125 Hz = "0", "0", "9", "6" = 0x96 = 150 decimal scaled x 2 = 150/2 = 75 dB
6. The pressure at which a Tympanometry compliance value was measured at is not contained in the data record but may be calculated.
   At the start of each pressure sweep, the pressure sweep rate is 600 daPa/sec. If the compliance begins to rapidly increase, the pressure sweep rate changes to 200 daPa/sec and remains at that rate until the compliance rate of change has sufficiently slowed down to allow the pressure sweep rate to return to 600 daPa/sec.
   While the pressure sweep rate is 600 daPa/sec, a compliance data point is stored at every 12 daPa drop in pressure and at 200 daPa/sec a compliance data point is stored at every 3 daPa drop in pressure. The Slow Index and Fast Index values in the data record indicate where the pressure sweep rate changes, if any occurred.

Reflex compliance values are stored in three groups: 1 Reflex Baseline Average value which is he reference measurement performed before the stimulus is presented, 4 Reflex compliance lata points which are measured while the stimulus is presented and stored as the relative com-liance change form the Baseline Average value, and 4 to 6 Reflex recovery compliance data oints which are measured after the stimulus is turned off and stored as the relative compliance hange form the Baseline Average value.

4 Data Transmission Protocol

he GSI 38 RS-232 Interface uses a Auto Repeat Request (ARQ) communications protocol to ure the reliable transfer of data. With this protocol. the GSI 38 will transmit a data record and n wait for a response from the external device. If the external device receives the record cor-tly, is should respond with an acknowledge "ACK" character (ASCII control character ACK). If record is not received correctly, the external device should respond with a not acknowledge AK" character (ASCII control character NAK.)

an ACK is received by the GSI 38 within 3 seconds of the completion of the transmission, the nsmission has been successfully completed. The "DATA TRANSFER" message is erased and mal operation resumes.

after the transmission of a record there is no response within three seconds, the record is ansmitted with the same Record Sequence Number. If such a timeout occurs after the second empt then the message "NO RESPONSE" is displayed, any pending transmissions are aborted, l normal operation resumes

a NAK response is received during a transmission or within three seconds after the transmis-n is completed, the record is retransmitted with the same Record Sequence Number. If the nsmission is not acknowledged within three attempts the message "TRANSFER NOT COM-ETE" is displayed for about three seconds, any pending transmissions are aborted, and normal eration resumes.

he NAK responses and timeouts are treated independently. Thus, when a combination of errors appening, the NAKs and timeouts are being counted separately. If the transfer is not success-the error message displayed corresponds to the failure condition which occurs first.

he only expected response from the external device to the GSI 38 is an ACK or a NAK character. hen a series of records are transmitted, the external device must ACK or NAK after each record.

5 Data Transfer Program Mode

he Data Transfer Program mode is used to modify the RS-232 interface configuration parame-s to match the computer's RS-232 parameters. To enter the Data Transfer program mode, first er the User Selections Program Mode by selecting the PROGram pushbutton. Then select the TA TRANSFER pushbutton. The following screen appears the first time the Data Transfer gram mode is entered showing the default settings set at the factory.

PROGRAM MODE - DATA TRANSFER

19.2 kBAUD	* NO PARITY + 8-BIT DATA
* 9600 BAUD	ODD PARITY + 7-BIT DATA
4800 BAUD	EVEN PARITY + 7-BIT DATA
2400 BAUD	SPACE PARITY + 7-BIT DATA
1200 BAUD	* XON/XOFF FLOW DISABLED
600 BAUD	XON/XOFF FLOW ENABLED

These selections fall into three difference groups of control:

Baud rate
Parity and data bits
Flow control

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

Selecting difference default settings for any of the groups is done in the same manner as the Program mode. Use the <Hz or >Hz pushbuttons to move the solid square cursor down or up to the setting that you wish to select and press the M+ pushbutton. The word SAVED will appear in the lower right margin of the screen and the asterisk (*) will be repositioned in front of the new setting.

Exit the Data Transfer Program mode by selecting either the DATA TRANSFER or PROGram pushbuttons. This will return to the User Selections Program mode which can be exited by selecting PROGram a second time.

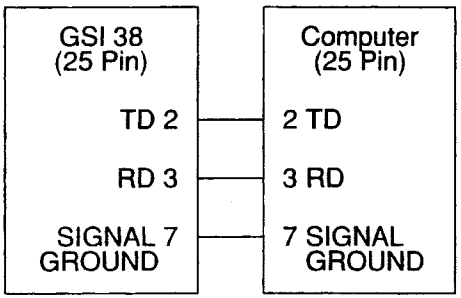
5.6 RS-232 Interface

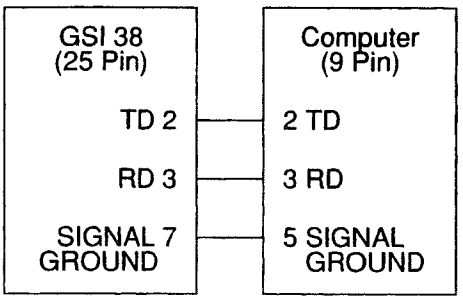
5.6.1 Interface Configuration

The configuration of the GSI 38 RS-232 interface must be set to match the interface configuration of the computer. The GSI 38 defaults to 9600 baud, no parity, 8 data bits, 2 stop bits and no communications flow control. The default settings for the baud rate, parity, number of data bits and flow control may be modified using the Data Transfer Program mode explained in Section 5.5.

5.6.2 Cable Connections

The GSI 38 RS-232 interface provides a serial interface consisting of RxD (Received Data) and TxD (Transmitted Data) using a standard DB-25 female connector. A straight through cable can be used to connect to either a 25 pin or 9 pin (using an appropriate adapter) connector on the external device.





5.6.3 Communications Flow Control

Software XON/XOFF flow control is available to allow software commands from the external computer to start and stop the flow of data from the GSI 38. No hardware flow control is provided.

Sending XOFF (ASCII control character [DC3]) to the GSI 38 pauses its transmission.

ending XON (ASCII control character [DC1]) to the GSI 38 resumes the transmission.
nce XOFF is received by the GSI 38, XON must be received within six seconds. If not received in this time then the message "NO RESPONSE" is displayed for about three seconds, transsion is aborted, and normal operation resumes.
ter an XOFF timeout, the next transmission waits for XON to be received within six seconds as cribed above.
ese commands are valid only during data transmission and when enabled in the Data Transfer gram Mode.

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