GSI AUDIOSTAR PRO™

USER MANUAL

Part Number D-0121703 Rev. B

Setting The Clinical Standard **www.grason-stadler.com**

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gsi Grason-Stadler

Title: GSI AudioStar Pro™ Clinical Audiometer User Manual

Compliance
The CE 0123 mark identifies compliance with the Medical Device Directive 93/42/EEC. Grason-Stadler is an ISO 13485 certified corporation.

EC REP

European Authority Representative
Grason-Stadler
c/o DGS Diagnostics A/S
Audiometer Alle 1
5500 Middelfart
Denmark

CE
0123

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Preface

This user manual provides information about the GSI AudioStar Pro™ audiometer. This manual is intended for technically qualified personnel.
Please note: This operating manual is not intended as a training manual for audiometry. The reader should consult standard audiology texts for the theory and application of the auditory tests provided by this device.

Manual Conventions

Throughout this manual the following meaning of warnings, cautions and notices are used.

WARNING
Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION
Used with the safety alert symbol, indicates a hazardous situation which, if not avoided, could result in damage to the equipment.

NOTICE

NOTICE
Used to address practices not related to personal injury or damage to the equipment.

NOTE: Notes help identify areas of possible confusion and avoid potential problems during system operation.

US Federal law restricts this device to sale by or on the order of a physician or licensed hearing care professional.

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 facility. If field service is requested, there will be no charge for labor or material; however, there will be a charge for travel expense at the service center's current rate.

NOTE: Changes in the product not approved in writing by Grason-Stadler shall void this warranty. Grason-Stadler shall not be responsible 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 OR FITNESS FOR A PARTICULAR PURPOSE.

Recycling / Disposal

Many local laws and regulations require special procedures to recycle or dispose of electrical equipment and related waste including batteries, printed circuit boards, electronic components, wiring and other elements of electronic devices. Follow all local laws and regulations for the proper disposal of batteries and any other parts of this system.

Below is the contact address for proper return or disposal of electronic wastes relating to Grason-Stadler products in Europe and other localities.

The contact information for the WEEE in Europe:

Grason-Stadler
c/o DGS Diagnostics A/S
Audiometer Alle 1
5500 Middelfart
Denmark

Within the European Union, it is illegal to dispose of electric and electronic items in unsorted municipal waste. Electric and electronic waste may contain hazardous substances and therefore has to be collected separately. Such products will be marked with the crossed-out wheeled bin symbol, shown below. The cooperation of the user is important in order to ensure a high level of reuse and recycling of electric and electronic waste. Failing to recycle such waste products in an appropriate way may endanger the environment and consequently the health of human beings.

Warnings and Safety Precautions

This product and its components will perform reliably only when operated and maintained in accordance with the instructions contained in this manual, accompanying labels, and/or inserts. The following safety precautions must always be observed.

Follow all safety standards set by each place of employment. The employer should instruct each employee in the recognition and avoidance of unsafe conditions and the regulations applicable to his or her work environment to control or eliminate any hazards or other exposure to illness or injury. It is understood that safety rules within individual organizations vary. If a conflict exists between the material contained in this manual and the rules of the organization using this instrument, the more stringent rules should take precedence.

Any program aimed at obtaining reliable records of hearing thresholds should be staffed and supervised by appropriately trained individuals. This device should only be used by hearing health care professional such as an audiologist, otolaryngologist, researcher or a technician under the direct supervision by the specialist. Users should use their professional skills when interpreting the results and this should be done in conjunction with other testing as deemed appropriate given their professional skills. Incorrect use could lead to wrong results.

This icon indicates that the GSI AudioStar Pro is in compliance with applied part, Type B requirements of IEC 60601-1.

The GSI AudioStar Pro is designed for compliance to IEC and ES 60601-1 when used in the patient vicinity.

Latex is not used anywhere in the manufacturing process. The base material for the earphone cushions is made from natural and synthetic rubber.

Electrical

General Safety precautions must be followed when operating electrical equipment. Failure to observe these precautions could result in damage to the equipment and injury to the operator or patient.

To avoid the risk of electric shock, this equipment must only be connected to supply mains with protective earth. In addition to electrical safety considerations, poorly earthed mains power outlets could cause inaccurate test results due to the introduction of electrical interference from the mains.

The GSI AudioStar Pro Clinical Audiometer 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 adaptor is connected between the GSI AudioStar Pro power plug and an AC outlet. Do not use extension cords with this instrument. If extension cords are used, they can cause ground integrity and impedance problems.

This device uses a three wire power cord with a hospital grade plug (for international applications, IEC 60601-1 approved plug). The chassis is earth grounded. For grounding reliability, connect the device to a hospital grade or hospital only receptacle (for non US applications, IEC 60601-1 approved receptacle). Inspect the power cord often for fraying or other damage. Do not operate the apparatus with a damaged power cord or plug. Improper grounding is a safety hazard. Periodically check the system ground integrity.

There are four (4) UV detectors in the digital domain, two (2) over current detectors in the analog domain, one for USB and four (4) OV/UV detectors on the main supply lines. If just ONE fails, all output to the transducers will be muted.

Do not block access to the power switch. Do not position the AudioStar Pro so that it is difficult to operate the power switch or access the power cord.

Periodically, have a service technician perform electrical safety checks on the unit to maintain continued compliance to IEC and ES 60601-1.

Explosion

This system is not explosion proof. Do NOT use in the presence of flammable gaseous mixtures. Users should consider the possibility of explosions or fire when using this device in close proximity to flammable anesthetic or other gases. Do NOT use the AudioStar Pro in a highly oxygen-enriched environment, such as a hyperbaric chamber, oxygen tent, etc.

Sound Levels

The maximum sound levels (over 100 dB HL) that can be generated by the system can cause serious injury to the ear. Before attaching the earphones to the patient, ensure that:

a. The system is running.
b. The hearing levels in the test set to be used are appropriate.
c. A biologic check of the stimulus has been performed by the operator.

In the presence of high intensities, a yellow light will appear per channel as a warning indictor (IEC 60645-1 and ANSI S3.6).

When testing with the High Frequency earphones, do not allow the presentation of the signal at the maximum dB HL to exceed 10 minutes. The buildup of increased temperature can cause harm to the earphones. This caution label refers the user to the accompanying literature and manuals.

Fluids

This product should not be used in the presence of fluid that can spill onto or come into contact with any of the electronic components or wiring. Should the user

suspect fluids or condensation have come in contact with the system components or accessories, the unit should not be used until deemed safe by a GSI certified service technician.

Connections

Audiometers should be interconnected with accessories that have the proper electrical compatibility. Connection of accessories not meeting these requirements may result in electrical leakage currents in excess of those allowed by the standard and present a potential electrical shock hazard to the person being tested.

Do not switch on any system power until all cables have been properly connected and verified. Switch off the system power before connecting or disconnecting any system component(s) or accessories.

Battery

This instrument contains a coin-type lithium battery for a real time clock. The life expectancy of the battery is 10 years. The battery is not intended to be changed by the user. Batteries may explode or cause burns, if disassembled, crushed or exposed to fire or high temperatures. Do not short-circuit.

Defects and Repairs

A defective product or a system that is not functioning properly should not be used. Parts which may be broken or missing or are visibly worn, distorted or contaminated should be replaced immediately with clean, genuine replacement parts manufactured by or available from GSI. Do not operate it until all necessary repairs are made and the unit is tested and calibrated for proper functioning in accordance with Grason-Stadler published specifications

The AudioStar Pro is not user repairable. Do not open the case of the GSI Instrument. Do not remove any GSI instrument covers. Refer servicing to qualified personnel. Repairs and battery replacement must be performed by a qualified service representative only. GSI will make available any instructions and diagrams to repair devices that it deems appropriate to be repaired in the field. No modifications of the equipment are allowed by anyone other than a qualified GSI representative

Connecting Additional Equipment

External equipment intended for connection to signal input, signal output or other connectors shall comply with the relevant product standard e.g. IEC 60950-1 for IT equipment and the IEC 60601-series for medical electrical equipment. In addition, all such combinations – Medical Electrical Systems – shall comply with the safety requirements stated in the collateral standard IEC 60601-1-1 or the general standard IEC 60601-1, edition 3, clause 16. Any equipment not complying with the leakage current requirements in IEC 60601-1 shall be kept outside the

patient environment i.e. at least 1.5 m from the patient support or shall be supplied via a separation transformer to reduce the leakage currents.

Any person who connects external equipment to signal input, signal output or other connectors has formed a Medical Electrical System and is therefore responsible for the system to comply with the requirements. If in doubt, contact qualified medical technician or your local representative.

A Separation Device (isolation device) is needed to isolate the equipment located outside the patient environment from the equipment located inside the patient environment. In particular such a Separation Device is required when a network connection is made. The requirement for the Separation Device is defined in IEC 60601-1-1 and in IEC 60601-1, edition 3, clause 16.

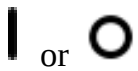
Any equipment connected to the GSI instrument and used in the patient vicinity must be powered by an isolated power supply to maintain the electrical safety of the overall system. The isolated power source can be purchased directly from GSI, or elsewhere when approved for use by GSI.

The AC power outlets on the isolated transformer/power box are intended for use with GSI approved components only. Use of any other equipment may result in damage to the power unit. Follow all safety standards set by each place of employment.

NOTE: If the instrument is connected to a PC, power to the monitor and computer must be controlled by the isolation transformer. Always leave the monitor and computer power switches in the ON position and control power from the isolation transformer. Always turn OFF system power before connecting or disconnecting system components to help guard against personal injury.

The operator should take care to not contact the computer or printer and the patient at the same time.

Regulatory Symbols

Symbol	Description
CE	Conforms to European Medical Device Directive 93/42/EEC. Classified under the Medical Device Directive (93/42/EEC) as a Class IIa device.
SN	Symbol for "SERIAL NUMBER."
REF	Symbol for “REFERENCE NUMBER.”
	Return to Authorized Representative, Special disposal required.
	Medical Equipment Classified by Intertek Testing Services NA Inc. with respect to electric shock, fire, and mechanical hazards only, in accordance with ES 60601-1.
EC REP	Symbol for “European Representative.”
	Symbol for “Manufacturer.”
	Symbol for “Date of Manufacture.”
	BF Patient Applied Part according to IEC 60601-1.
	Consult the operating instructions/directions for use. A copy of the operating manual is available on this website. A printed copy of the operating instructions can be ordered from Grason-Stadler for shipment within 7 days; or you can contact your local representative.
	On/Off - Next to power mains.
	This indicates that the power switch is in the ON position
	Keep Dry.
	This side up.

Symbol	Description
	Monitor.
	Patient response switch.
	Consult the operating instructions/directions for use. A copy of the operating manual is available on this website. A printed copy of the operating instructions can be ordered from Grason-Stadler for shipment within 7 days; or you can contact your local representative.

Audiometric Symbols

The AudioStar Pro can support different symbol sets to accommodate the conventions in different countries. The country symbol sets that are supported include:

- Australia
- China
- Hong Kong
- UK
- USA
- Israel

The AudioStar Pro Config App allows the selection of the desired symbol set. The symbol sets are shown in the following table. For symbols that are not specified in the reference documents for specific countries, the USA symbols are used.

Abbreviations used in the following symbol set table

AC: Air Conduction
NR: No Response
BC: Bone Conduction
SF: Sound Field
MCL: Most Comfortable Level
UCL: Uncomfortable Level

AudioStar Pro Symbol Sets

	USA			Australia			China			Hong Kong			UK			Israel		
	R	L	L/R	R	L	L/R	R	L	L/R	R	L	L/R	R	L	L/R	R	L	L/R
AC													or	or				
(NR)													or	or				
AC masked																		
(NR)																		
BC																		
(NR)																		
BC masked																		
(NR)																		
*BC Unspecified																		
**(NR)																		
BC Forehead																		
(NR)																		
BC Forehead masked																		
(NR)																		
SF																		
(NR)																		
SF masked																		
(NR)																		
SF Aided																		
(NR)																		
SF Cochlear																		
(NR)																		
MCL																		
(NR)																		
UCL																		
(NR)																		
Tinnitus																		
(NR)																		
TEN																		
(NR)																		

*Press the Clear/Pause button to store bone, unspecified symbol.
**Press Clear/Pause and Incorrect/Stop buttons simultaneously to store bone unspecified, NR symbol.

Elimination of Ambient Noise

The GSI AudioStar Pro may be installed in a single room environment or as part of a two-room suite.

Excessive noise in the test environment, such as that produced by conversation, office equipment, or printers, reduces test validity because it tends to mask the test signals. This is especially true at the lower frequencies where earphone cushions provide less effective attenuation. A room that attenuates sound may be required if ambient noise at the patient's ears reaches levels sufficient to cause apparent hearing loss at the lower frequencies.

The following table shows the maximum background levels that can be present inside the room while a valid hearing test is being conducted. These values apply for hearing threshold measurements to 0 dB HL.

Maximum Ambient Noise

Test Tone Freq. (Hz)	125	250	500	750	1000	1500	2000	3000	4000	6000	8000
Test Room level Max dB SPL,Ears covered	29.0	17.5	14.5	16.5	21.5	21.5	23.0	28.5	29.5	33.0	38.5
Max dB SPL, Ears not covered	23.0	13.5	9.5	7.5	9.0	5.5	3.5	3.5	4.0	9.0	5.5

Notes: Maximum permissible 1/3 octave band level. If the Hearing Level to be measured is -10 dB HL, then 10 dB should be subtracted from the levels listed in this table.

NOTE: A room providing sound isolation from ambient noise is highly recommended so that hearing threshold values may be obtained. If a separate examination (sound) room is used, it is considered sufficiently quiet for the purposes of these tests if a group of otologically "normal" listeners with their ears occluded is unable to detect any ambient noise during the test period. See ANSI S3.1 (R2003) Criteria for Permissible Ambient Noise during Audiometric Testing for maximum allowable outside octave band noise levels with three prefabricated sound room types.

NOTE: Live voice testing requires a separate sound attenuated room for the patient in order to avoid feedback and direct transmission of the test stimuli.

Sound Attenuation

Sound Attenuation for Earphones per ISO 4869-1				
Frequency (Hz)	**Attenuation**			
	TDH50/DD45 with MX41/AR or PH51 Cushion (dB)	**IP30 inserts (dB)**	**HDA 200/DD450 (dB)**	
125	3	33.5	14.5	
160	4			
200	5			
250	5	34.5	16	
315	5			
400	6			
500	7	34.5	22.5	
630	9			
750	-			
800	11			
1000	15	35.0	28.5	
1250	18			
1500	-			
1600	21			
2000	26	33.0	32	
2500	28			
3000	-			
3150	31			
4000	32	39.5	45.5	
5000	29			
6000	-			
6300	26			
8000	24	43.5	44	

Chapter 1: Introduction

The GSI AudioStar Pro™ continues the tradition of excellence in clinical audiometry by maintaining the Grason-Stadler legacy of fast, efficient, and familiar navigation. The one-button, one-function front panel of the AudioStar Pro is recognized worldwide as the Gold Standard of user-friendly design, allowing audiologists to test with confidence. From the extra-large display that reduces eye strain, to the ergonomic housing that maximizes hand and wrist comfort, and the light pipes around selected test buttons allowing concentrated focus on the patient, the AudioStar Pro has every desired feature.

Audiologists appreciate the flexibility of a stand-alone audiometer that offers seamless data transfer to a computer. In the event of a network failure or computer lock-up, the examiner will not lose patient data or the ability to test. The stand-alone configuration is optimized with direct connection to a wireless keyboard and mouse making it fast and easy to enter patient demographics, report comments, and expedite test administration. In addition, direct connection to a printer and the integrated print button make it possible to print a complete report for immediate review with the patient or physician. User login and password controls provide security for patient data in compliance with HIPAA. Complete audiometric results may be transferred to software such as GSI Suite and Noah, or integrated with your facility's EMR/EHR system.

The AudioStar Pro addresses the needs of a broad patient population. This revolutionary audiometer introduces complete flexibility in signal routing by enabling the user to select either Channel 1 or Channel 2 as the recorded stimulus channel. The active microphone during tone presentation ensures there are no delays in reinforcing or coaching. The built-in auxiliary intercom allows direct communication between operator and assistant which eliminates the need for an external intercom system. The built-in monitor speaker allows third parties to participate in the patient evaluation. The built-in VRA controls facilitate fast and simple activation of VRA systems eliminating the need for an external control box. The pediatric centered signal options including pediatric noise provide unique, frequency specific stimuli for pediatric testing. The built-in sound field amplifier provides testing to 90 dB HL without the expense or space required for an external amplifier. High performance speakers and a high-performance external amplifier are additional options for achieving 96 dB HL and 102 dB HL outputs in the sound field environment. The built-in selection of Special Tests including QuickSIN, BKB-SIN and TEN HL address special hearing evaluations. The direct calibration for all the transducers allows seamless transition between AC transducers without the need to plug and unplug saving time and eliminating the need for correction factors.

The AudioStar Pro comes standard with integrated word lists for repeatable and reliable recorded speech testing. Auto-advance, auto-play, auto-scoring and mouse control allows the examiner to present, pause, repeat, skip, and score with ultimate ease, removing the main objection for recorded speech testing. Other speech-in-noise tests and word lists can be loaded directly from a flash drive. Three Test Type buttons allow access to protocols that are customized to facility preferences. Tests are pre-programmed to optimize efficiency and workflow.

Indication for Use

The AudioStar Pro is intended to be used for the identification and etiology of hearing loss in patients of any age. It is intended to be used by an audiologist, ENT, hearing healthcare professional, or trained technician in a hospital, clinic, healthcare facility or other suitable quiet environment as defined in ANSI S3.1 or equivalent.

Intended Use

The GSI AudioStar Pro is intended to be used for the purposes of determining patient hearing sensitivity. It is intended to quantify the patient's level of hearing by presenting pure tones stimuli through specific transducers at different frequencies and at different sound pressure levels.

Description

This instrument is a two-channel clinical audiometer. This instrument has advanced functionality that makes it ideal for testing in every clinical setting, including Ear, Nose and Throat (ENT) physicians' offices, hospitals, clinics and audiology private practices. The tests are administered via headphones – supra-aural, circum-aural, or insert phones – or through a bone vibrator or sound field speakers. User defined test protocols allow for basic audiometric testing as well as detailed evaluations to assist in diagnosis of audiologic pathologies. Careful handling of instrument transducers and testing performed by a properly trained instrument operator should be of high priority. The patient is to remain relaxed and still while testing is being performed for optimal accuracy.

Chapter 2: Installation

External Inspection

Although this GSI AudioStar Pro Clinical Audiometer was carefully tested, inspected, and packed for shipping, it is good practice after receiving the instrument to immediately examine the outside of the container for any signs of damage. Notify the carrier if any damage is observed.

Unpacking

Carefully remove the GSI AudioStar Pro from its shipping container. If the instrument appears to have suffered any 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 a Grason-Stadler representative.

If the instrument must be returned to the factory, repack it carefully in the original container, (if possible) and return it prepaid to the factory for the necessary adjustments.

Check that all accessories are received in good condition. If any accessories are missing, a Grason-Stadler representative should be notified immediately.

It is recommended that the AudioStar Pro be installed by an authorized GSI representative.

NOTE: Refer to the supplied accessories list below to ensure that all accessories and cables have been included in the shipment.

Accessories

	Product Descriptions	Part Number
	AudioStar Pro™ Clinical Two-Channel Audiometer	
	Subject Response Hand switch*	8004365
	Monitor Headset with Boom Mic	8010870
	Headphones, Assistant (Aux Intercom)	8501251
	Wireless Mouse and Keyboard	8030554
	Talk Back Microphone with mounting bracket	8101853
	Gooseneck Microphone	8100682
	Ear Cushions 2 pack Sennheiser HZP 09	8104416
	Microphone Windscreen Sennheiser PS 01	8504476
	Dust Cover	8013226
	Cable, Stereo ext, m-f, 3.5mm	8100179
	Cable, USB A/B, 2 meters	8011241
	Mains cable B North America 2.5M	8011399
	AudioStar Pro Software and Manuals USB	8515177
	GSI Suite - Audiometric Data Management, USB	8109060
	Quick Guide, English, paper	8515176
	Remote Keyboard Shortcut	8106460

Part Number	DD45*	B81*	IP30*	DD450*	AMTAS*
8515319	√	√	√		
8518226	√	√	√	√	
8518227	√	√	√	√	√

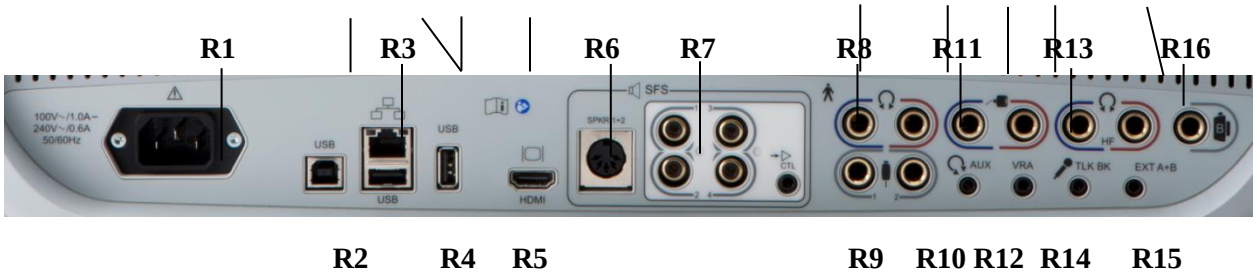
NOTE: Part numbers may change periodically. Please see the current GSI Price List/ Part List for current part numbers.

* Is considered applied part according to IEC/ES 60601-1

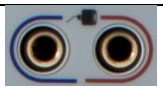
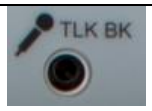
Chapter 3: Connectors, Controls and Indicators

Rear Panel

The connectors on the rear panel of the GSI AudioStar Pro are shown in the following diagram. The label and jacks are visible by turning the instrument around on a flat, stable surface.



	Connection	Description	Graphic
R1	**Mains Power Input**	IEC 14	
R2	**USB Computer Connection**	USB B style connector	
R3	**LAN Connections**	Ethernet Connection RJ45 Currently not supported	
R4	**USB Connectors**	USB A style plug	
R5	**External Monitor Output**	HDMI Video only signals, no audio, 1024 x 768 resolution	
R6	**FF Speaker DIN Connection Output** SFS - Sound Field Speaker	5 pin DIN connector Provides connection between the internal amplifier to left and right loudspeakers within a sound room **NOTE:** Free Field Speaker Outputs 1 and 2 are 25 Watts per channel into 8 ohm.	
R7	**FF Speaker RCA Connections Output**	4 RCA jacks Optionally connect to 4 speakers through an external amplifier using jacks 1 -4 (contact a GSI Representative for more information) **NOTE:** Free Field Line Outputs 1 and 2 are 5 VRMS into a 2000 ohm load.	

	Connection	Description	Graphic
R7	**FF Speaker RCA Connections Output, cont.**	**NOTE:** Cannot use internally amplified speaker connection and externally amplified speaker connections at the same time. **NOTE:** The CTL connection is for future use – not currently supported.	
R8	**Left and Right Headphone Outputs**	6.35 mm stereo jack Left (blue) and Right (red)	
R9	**Patient Response Inputs**	6.35 mm mono jack 1 or 2 hand switches may be used	
R10	**AUX Intercom Output**	3.5mm stereo jack Assistant monitor headset connector	
R11	**Left and Right Insert phone Outputs**	6.35 mm stereo jack Left (blue) and Right (red)	
R12	**VRA Connection Output**	3.5 mm TRRS jack to activate a left, center, or right VRA system. (Ref. Appendix 3 for pinouts) (contact a GSI service representative for details)	
R13	**Left and Right High Frequency Headset Output**	6.35 mm stereo jack Left (blue) and Right (red)	
R14	**Talkback Microphone Input**	3.5 mm stereo jack **NOTE:** Microphone inputs are between .25 mV and 5 mV for a 0 dB reading on a VU indicator; the input impedance is 3,200 ohm.	
R15	**Ext. A and B**	3.5 mm stereo jack Input jacks for optional digital music player or CD player input **NOTE:** External A and B inputs are between 15 mV and 500 mV for a 0 dB reading on a VU indicator; the input impedance is 50,000 ohm.	
R16	**Bone Vibrator**	6.35 mm phone stereo jack	

Right Side Panel

The power switch is located on the right side panel. To turn off the GSI AudioStar Pro, use the power switch.

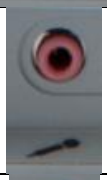
NOTE: Do not block access to the power switch.

Monitor Speaker

The monitor speaker is located on the right side panel. The monitor speaker may be activated by pressing the monitor speaker button. The level of the Channel 1 and Channel 2 stimuli may be adjusted using the monitor knob on the front panel of the instrument.

Left Side Panel

The following connectors will be visible on the left side panel of the GSI AudioStar Pro:

Connection	Description	Graphic
USB Ports	2 USB ports (A style)	
Monitor Headset	3.5 mm stereo jack Monitor microphone	
Headphones	3.5 mm stereo jack Monitor speaker	
Gooseneck Microphone	6.35 mm stereo jack (optional)	

USB Port

The AudioStar Pro is equipped with four (4) USB ports. It is possible to connect external devices such as mouse, keyboard, or external printer to be used with the audiometer. Additionally, a memory stick may be inserted into a USB port for updating software, adding additional sound files, license updates, printing to PDF or exporting diagnostic log files.

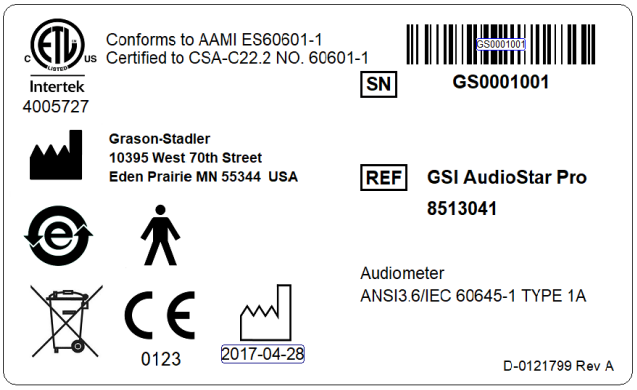
NOTE: Scan files on a USB drive for viruses prior to installing the drive into the instrument.

A/B Cable

Remote connection to an external computer is achieved through the use of a standard A/B USB cable.

NOTE: It is recommended to always have the USB ports enabled on the PC. Disable the “suspend USB” option on the PC.

Bottom Panel Label

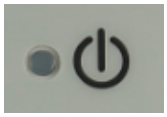


Description	Graphic
Medical Equipment Classified by Intertek Testing Services NA Inc. with respect to electric shock, fire, and mechanical hazards only, in accordance with ES 60601-1.	
Caution, consult accompanying documents.	
Conforms to European Medical Device Directive 93/42/EEC. Classified under the Medical Device Directive (93/42/EEC) as a Class IIa device.	
Manufacture Date (year and month will be inserted below).	
China RoHS symbol for products compliance.	
B Patient Applied Part according to IEC 60601-1.	
GSI Part number and model	REF
Serial Number.	SN
Return to authorized representative, special disposal required.	
Manufacturer.	

Chapter 4: Front Panel Controls

The controls on the front panel of the GSI AudioStar Pro are shown below.

Power



The green LED, located in the upper right portion of the front panel, is illuminated when mains power is supplied to the GSI AudioStar Pro. This indicates that the power switch is in the on position.

Stimulus Level(s)

Test Mic, Input A and Input B Level Controls — To calibrate the test signal for the test microphone or the external devices, use the Select button to activate the LED associated with the device. Then use the rotary knob to adjust the signal level until an indication of 0 dB on average is obtained on the selected channel VU meter.

Talk Forward

This rotary control allows the operator to adjust the microphone level in a continuous range of 45 to 90 dB HL when communicating through Talk Forward.

NOTE: The talk forward mic may be calibrated using the mic level select.

The Talk Forward Button allows the operator to speak directly to the patient using the Mic/Monitor headset or optional gooseneck microphone. Pressing and holding the Talk Forward button interrupts the stimulus that is being presented and activates the microphone in all selected transducers on Channel 1 and Channel 2. The GSI AudioStar Pro resumes the test status when the pushbutton is released. The light pipe around the Talk Forward button will be illuminated when enabled.

Left, Center, Right VRA

When an external Visual Reinforcement Audiometry (VRA) remote box is plugged into the VRA jack, and the Left, Center or Right VRA button is pressed and held, it will activate the VRA toy in the corresponding position.

The Interlock pushbutton locks the presentation function of the two channels together so that stimulating one channel will also stimulate the other, according to the status of the Interrupt button. When the Interlock is active, an icon is displayed on the LCD and the light pipe around the button is illuminated.

Tracking

The Tracking pushbutton allows the Channel 2 hearing level to track the Channel 1 hearing level. When in Tracking, any dB change to the Channel 1 HL causes the Channel 2 HL to change by the same amount, until the limit of the Channel 1 transducer is reached. If the dB HL limit is reached in Channel 2 before Channel 1, the Channel 2 dB HL display will temporarily flash and remain at this level. Tracking remains on. When the Channel 1 dB returns to a level at which the selected difference between the two channels can resume, Channel 2 again tracks Channel 1. When tracking is selected, an icon will appear on the screen and the light pipe will be illuminated. It is possible to manually change the level of Channel 2 to alter the dB difference between the two channels without deselecting Tracking.

Table / Audiogram Button

The Table / Audiogram button is used to select the format for the screen display. Pressing it will switch the screen between displaying the Table screen and the Audiogram screen for the Tone, TEN and Speech Test Types. In the Tone test type, this button allows access to the Fine Frequency Resolution option for detailed frequency testing.

Data Transfer

When the Data Transfer button is pressed, a data record containing the stored test data is transmitted to an external computer. Data is transferred as a complete battery of all saved test results. The data transfer format is configurable – see details regarding the data format options in the GSI Instrument Services manual.

Printing

If the appropriate printer is connected to the AudioStar Pro and the printer (HP or PDF) has been configured properly using the Configuration Application Software, the current stored test information is sent directly to the printer when the Print pushbutton is pressed.

An HP color printer may be attached to the GSI AudioStar Pro to allow printing of the audiometric test results directly from the AudioStar Pro. The HP Printer must be PCL 5E, PCL 3, or PCL 3 GUI compatible. If PDF is the selected printer, a memory stick or USB drive must be inserted into a USB port on the AudioStar Pro prior to printing test results.

Instrument Operation While Printing

The GSI AudioStar Pro does not remain operational while printing. Wait until the printer status indicates that the printing is complete before attempting to initiate any actions on the instrument.

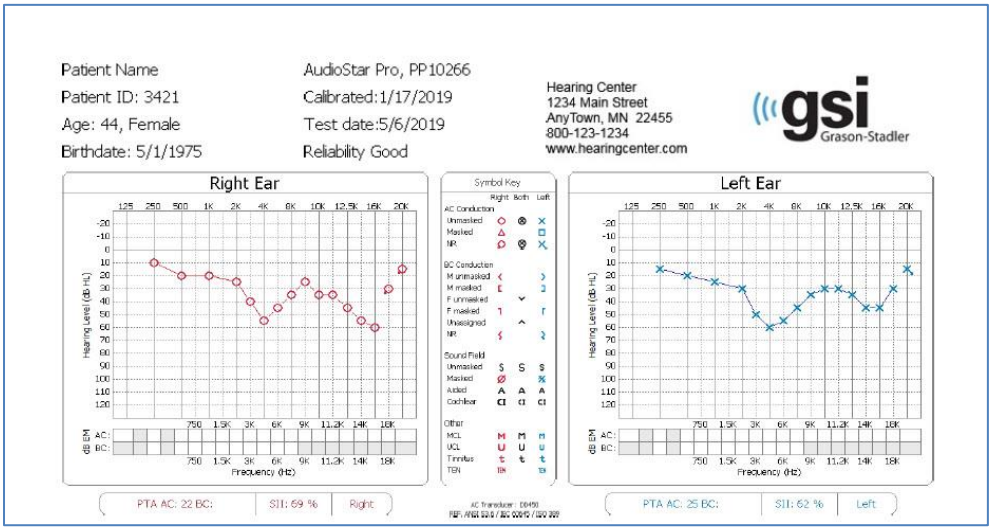
Print Messages

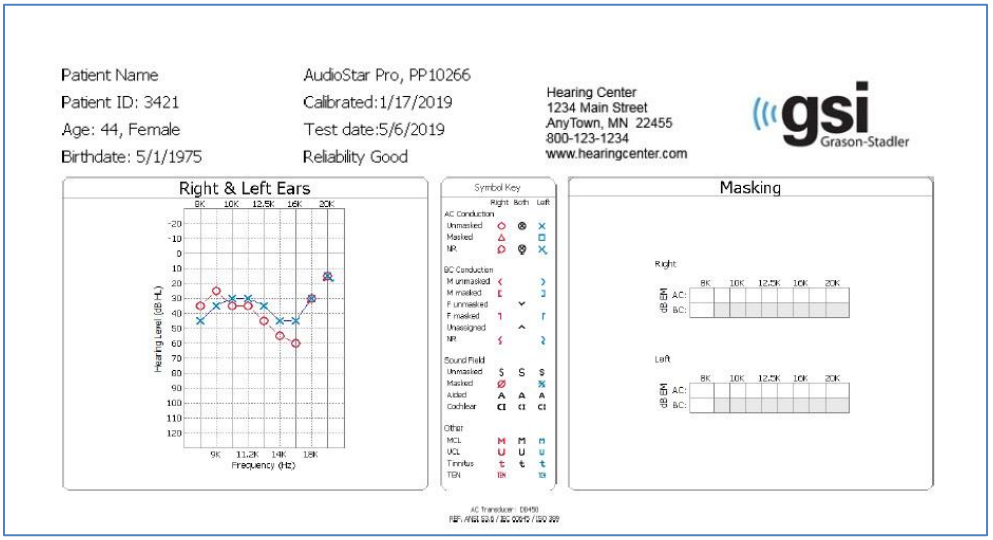
Printing A status bar will indicate the printing progress after the print button has been pressed.

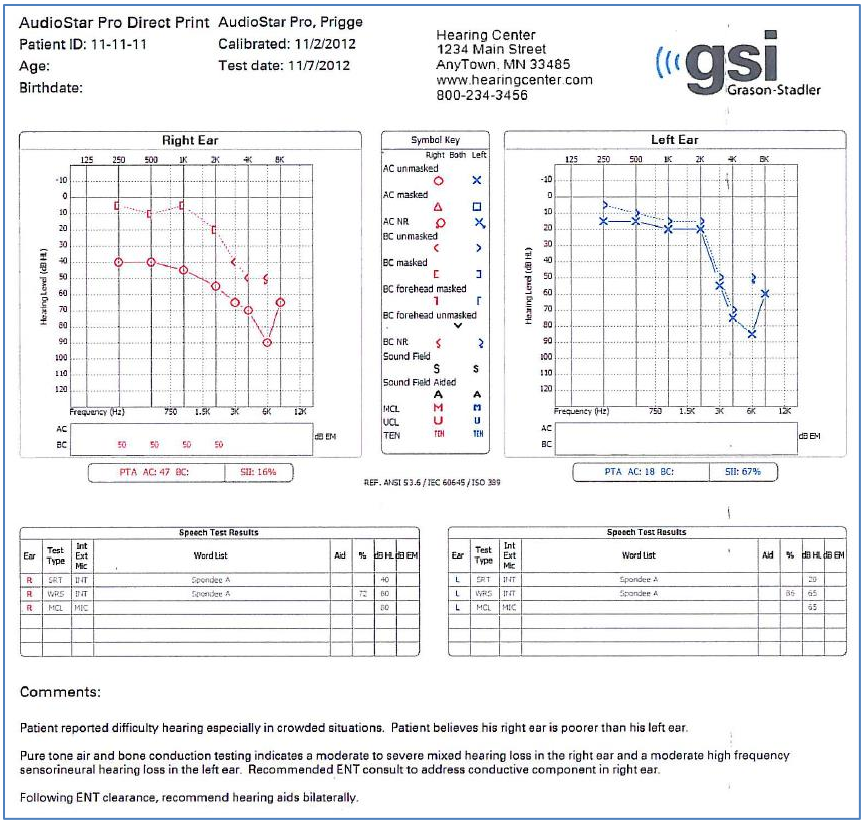
Check Printer Connection and Paper If there is an error detected during printing, it is recommended that the printer protocol in the configuration screen or Config App is verified.

Printer Output Format

The print out will match the current tone screen as displayed on the AudioStar Pro. Speech results will print as designated in Config App. Below are sample print outs that reflect the various audiometric displays.







AudioStar Pro Direct Print AudioStar Pro, Prigge
Patient ID: 11-11-11 Calibrated: 11/2/2012
Age: Test date: 11/7/2012
Birthdate:

Hearing Center
1234 Main Street
AnyTown, MN 33485
www.hearingcenter.com
800-234-3456

gsi Grason-Stadler

Right Ear

Symbol Key

Left Ear

PTA AC: 47 BC: SII: 16%

REF. ANSI S3.6 / IEC 60645 / ISO 389

PTA AC: 18 BC: SII: 67%

Speech Test Results

Ear	Test Type	Int Ext Mic	Word List	Aid	%	dB HL	dB EM
R	SRT	INT	Spondee A			40	
R	WRS	INT	Spondee A		72	80	
R	MCL	MIC				80	

Speech Test Results

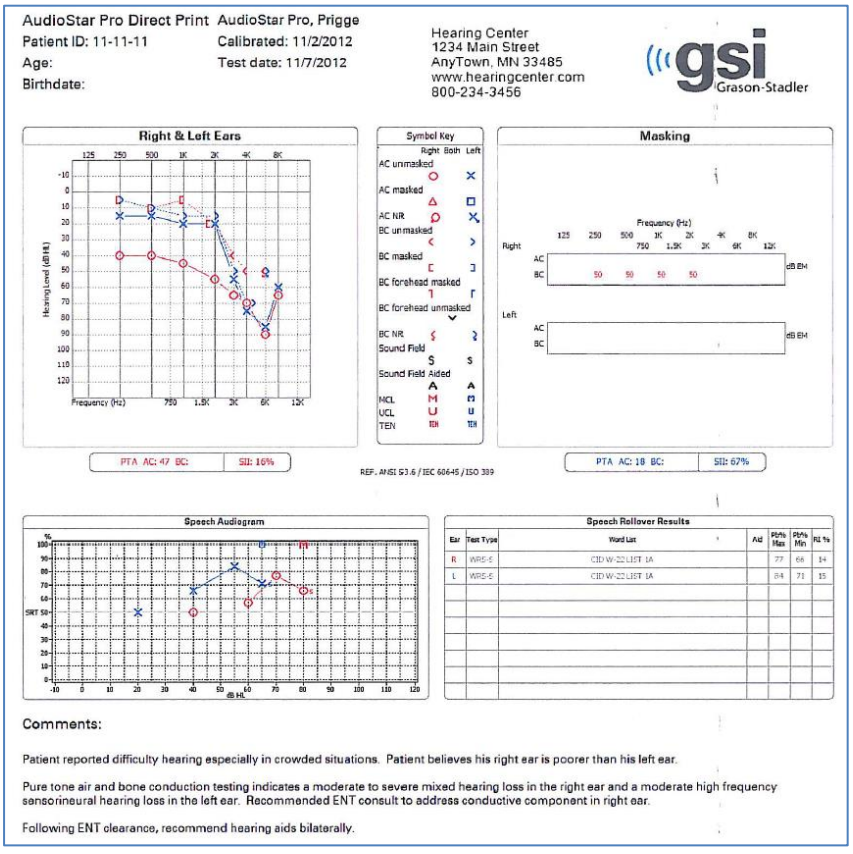
Ear	Test Type	Int Ext Mic	Word List	Aid	%	dB HL	dB EM
L	SRT	INT	Spondee A			20	
L	WRS	INT	Spondee A		86	65	
L	MCL	MIC				65	

Comments:

Patient reported difficulty hearing especially in crowded situations. Patient believes his right ear is poorer than his left ear.

Pure tone air and bone conduction testing indicates a moderate to severe mixed hearing loss in the right ear and a moderate high frequency sensorineural hearing loss in the left ear. Recommended ENT consult to address conductive component in right ear.

Following ENT clearance, recommend hearing aids bilaterally.



AudioStar Pro Direct Print AudioStar Pro, Prigge
Patient ID: 11-11-11 Calibrated: 11/2/2012
Age: Test date: 11/7/2012
Birthdate:

Hearing Center
1234 Main Street
AnyTown, MN 33485
www.hearingcenter.com
800-234-3456

gsi Grason-Stadler

Right & Left Ears

Symbol Key

Masking

PTA AC: 47 BC: SII: 16%

REF. ANSI S3.6 / IEC 60645 / ISO 389

PTA AC: 18 BC: SII: 67%

Speech Audiogram

Speech Rollover Results

Ear	Test Type	Word List	Aid	Pt% Max	Pt% Min	RI %
R	WRS-S	CID W-22 LIST 1A		77	66	14
L	WRS-S	CID W-22 LIST 1A		84	71	15

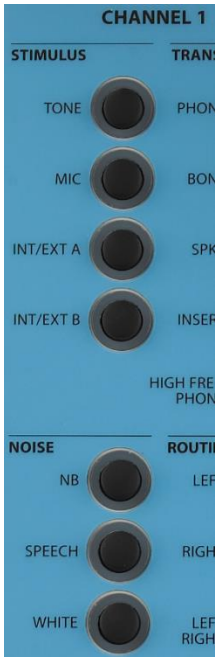
Comments:

Patient reported difficulty hearing especially in crowded situations. Patient believes his right ear is poorer than his left ear.

Pure tone air and bone conduction testing indicates a moderate to severe mixed hearing loss in the right ear and a moderate high frequency sensorineural hearing loss in the left ear. Recommended ENT consult to address conductive component in right ear.

Following ENT clearance, recommend hearing aids bilaterally.

Stimulus Channel 1 and Channel 2



Tone — The Tone pushbutton allows the selection of a pure tone stimulus for air/bone conduction testing with the choice of five transducer types.

NOTE: The selection of Tone on Channel 1 and Mic on Channel 2 is a valid combination. This setting allows the operator to have contact with the patient, especially a young child, without the need to select Talk Forward.

Mic — The Mic pushbutton provides input capability from the test microphone for monitored live-voice testing with the choice of five transducer types.

Int./Ext. A, Int./Ext. B — Internal A and Internal B provide access to internal .Wav files that may be used for recorded speech testing. External A and External B accept recorded audiometric material from an optional digital music player or compact disc player.

NOTE: When using a digital music player, select the level using the calibration track. First adjust the volume on the device until the VU meter reads nearly 0 dB, then fine tune the level using the level selection.

Narrow Band Noise — The NB Noise pushbutton selects a noise which is geometrically centered at the selected test frequency and contains a 3 dB down bandwidth of a 1/3 octave at a minimum and ½ octave at a maximum.

Speech Noise — The Speech Noise pushbutton selects speech noise that is calibrated in effective masking level and contains a spectrum of equal energy per frequency from 100 to 1,000 Hz with a 12 dB/octave roll-off from 1,000 to 6,000 Hz.

White Noise — The White pushbutton selects White Noise which is a broad band signal containing acoustic energy at all frequencies between 125 Hz and 12,000 Hz. White noise is calibrated for pure tone effective masking if a tone type signal is selected on the opposite channel and for speech effective masking if a speech type signal is selected on the opposite channel.

The selection of any stimulus will deselect a previously selected stimulus on the opposite channel if the stimuli are not compatible. Refer to the following table for the stimuli compatibilities listing:

Valid Stimuli Combinations

		Channel 1 Stimulus						
		Tone	Mic	Ext. A	Ext. B	NB Noise	S Noise	White Noise
Channel 2 Stimulus	Tone	Valid	Valid	Valid	Valid	Valid	Invalid	Valid
	Mic	Valid	Valid	Valid	Valid	Invalid	Valid	Valid
	Ext. A	Valid	Valid	Valid	Valid	Invalid	Valid	Valid
	Ext. B	Valid	Valid	Valid	Valid	Invalid	Valid	Valid
	NB Noise	Valid	Invalid	Invalid	Invalid	Valid	Invalid	Invalid
	S Noise	Invalid	Valid	Valid	Valid	Invalid	Valid	Invalid
	W Noise*	Valid	Valid	Valid	Valid	Invalid	Invalid	Valid

NOTE: If White Noise is selected on both channels, then calibration is set to speech effective masking levels. If White Noise is selected on one channel only, calibration will be set to mask the stimulus type on the opposite channel.

Transducer Output Selector

The Transducer pushbuttons allow the easy selection of the transducer for each stimulus available for Channel 1 and Channel 2. A transducer selection may be changed at any time.

Valid Transducer Combinations

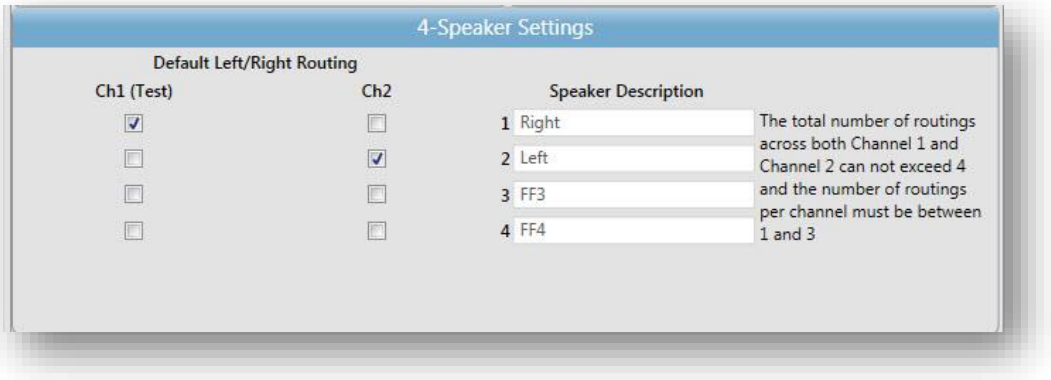
		Channel 1				
		Phone	Bone	Speaker	Insert	High Freq. Phones
Channel 2	Phone	Valid	Valid	Valid	Valid*	Invalid
	Bone	Valid	Valid	Valid	Valid	Valid
	Speaker	Valid	Valid	Valid	Valid	Valid
	Insert	Valid*	Valid	Valid	Valid	Valid*
	High Freq. Phones	Invalid	Valid	Valid	Valid*	Valid

*To use this transducer combination press and hold the desired transducer/channel button for 3 seconds**.**

Routing Output

The Routing pushbuttons determine the routing for the stimulus to the output transducer selected for Channel 1 and Channel 2. Left/Right delivers the stimuli from the selected channel to both the left and right transducers with the combined signal. Both the Channel 1 and Channel 2 maximum dB HL limits are appropriately decreased from the non-mixed maximum dB HL limits.

The AudioStar Pro can support four speakers. Using a four speaker configuration requires the instrument to be calibrated to accommodate all speakers. Additionally, the speaker defaults and descriptions must be defined in the Config App. When using four speakers a speaker routing dialog is displayed when the Left/Right routing is selected and the transducer is speaker.



NOTE: When using four speakers a single channel can have a maximum of three speakers. The total of all channels cannot exceed four

Attenuators (HL Controls)

Channel 1 and Channel 2

The GSI AudioStar Pro contains two independent HL rotary controls for test signal and masking level control with a range of -10 dB HL to 120 dB.
HL Maximum dB HL values apply to the mid-frequencies with earphones only. Refer to the specific transducer for dB HL limits in the Table in Appendix 1.

Present Bar / Interrupt

The function of the present bar in each channel is determined by the status of its Interrupt button. When the interrupt button is in the off position, pressing the present bar presents the stimulus to the selected transducer(s) for as long as the present bar is depressed. The channel turns off immediately when the bar is released. When the Interrupt button is in the on position, the corresponding channel is deactivated by pressing the present bar and activated by releasing the bar. Both the Interrupt buttons and present bars in each channel operate independently of the other. Note that in the ABLB test mode, the Interrupt pushbuttons do not operate independently of each other.

Frequency Up / Down

The Frequency pushbuttons allow the selection of eleven standard audiometric frequencies and nine high frequencies with the High Frequency option. When at the lower limit of the frequency selection, pressing the (<) pushbutton will cause the display to roll over to the highest frequency limit, and vice versa. If a transducer with a narrower range is selected, only the valid frequencies for that transducer are available. The frequency order is configurable by using the Configuration Application software.

Data Store

The Store pushbutton, when pressed, saves the current dB HL level representing the current data point including threshold level, MCL, UCL, tinnitus, aided sound field, cochlear implant and effective masking level if selected, as well as transducers and routing. Pressing Store in the Speech testing mode will save the current test type, word list, score and other applicable speech data. In the Display Audiogram format, the appropriate symbol appears each time the Store button is pressed.

NOTE: When a stimulus is present in both channels, the Channel 1 and 2 store buttons will function independently.

Navigation Controls

The four navigation buttons and the middle select button may be used to make selections from the on-screen menus as well as navigate through the internal .Wav files for speech testing.

Scorer / Timer

The Correct, Clear and Incorrect pushbuttons are used for scoring results in Speech, QuickSIN, BKB-SIN and SISI tests. The scorer is displayed in the test status area of the Status screen. When Speech, QuickSIN, BKB-SIN or SISI is selected, the scorer initializes to 0/0 = 0%. The operator presses the Correct or Incorrect pushbutton after each presentation to score the evaluation. The display clears with the pressing of the Clear pushbutton.

During Tone Decay tests, the Scorer/Timer pushbuttons may be used to start, pause, stop and clear the timer. The timer is displayed in the test status area of the Status screen. The timer may be set to stop at 1, 2, 3 or 4 minutes. The timer may be paused and resumed at any point by pressing the Pause pushbutton. Pressing Stop will stop the timer, but leave the current time displayed. Pressing Start will reset the timer to 0:00 and restart the timer.

NOTE: The timer may also be started by pressing the patient response button in the Tone Decay test. The timer will be active as long as the patient response button is depressed. When the patient response button is released, the timer will be paused and may be resumed by pressing and holding the patient response button again.

In Pure Tone testing, if the Incorrect/Stop button is pressed instead of the Store button the No Response (NR) symbol is stored and displayed on the current frequency and level on the audiogram. During unmasked bone conduction testing, if the Clear/Pause button is pressed the bone conduction, unspecified symbol (^) will store. When the Clear/Pause and Incorrect/Stop buttons are pressed simultaneously, the bone conduction unspecified NR symbol will store.

Aux Intercom

When the AUX Intercom button is pressed, there may be direct communication between the Operator and an Assistant. The assistant monitor headset allows the assistant to monitor signals being delivered to the patient with the same settings as the operator's Microphone / Monitor headset. The Aux Intercom can be configured as a toggle with the Configuration Application software. The button may also be disabled from the Configure button on the device.

Icon	Description	Front Panel	Configuration
	Examiner, Ch1 and Ch2 sounds can be heard by the assistant	On	Checked
	Ch1 and Ch2 sounds can be heard by the assistant	Off	Checked
	No sound goes the assistant monitor headphones	On/Off	Unchecked

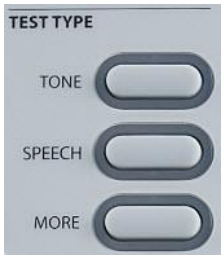
Monitoring

Channel 1 (CH 1), Channel 2 (CH 2), AUX Intercom, Talkback Controls —

The Monitor Headset or Internal Speaker allows the operator to listen to the stimuli as they are presented and to listen to the patient's comments through the talk-back system. The Assistant monitor headphones allow an assistant to listen to the stimuli as they are presented and to listen to operator via the AUX intercom. Adjust the Channel 1 (CH 1) and Channel 2 (CH 2) signals by using the select button to choose the appropriate signal to be adjusted and then rotating the knob to the desired level for the operator (and assistant). Select Talkback to adjust the level of the patient's voice for the operator. Select the AUX Intercom to adjust the level of the operator's voice for the Assistant

When Mic is selected, or when the Talk Forward is operated, that channel's input to the monitor speaker is disabled to reduce acoustic feedback.

Test Type Buttons



Test Type buttons allow the operator transition between audiometric evaluation components with a single button press. Pressing a test type button loads all stimuli, routing and transducer preferences from default settings or from customized protocols determined in the Config App. Transducer and routing are maintained between test types when allowed. Test types are pre-programmed to optimize efficiency and workflow.

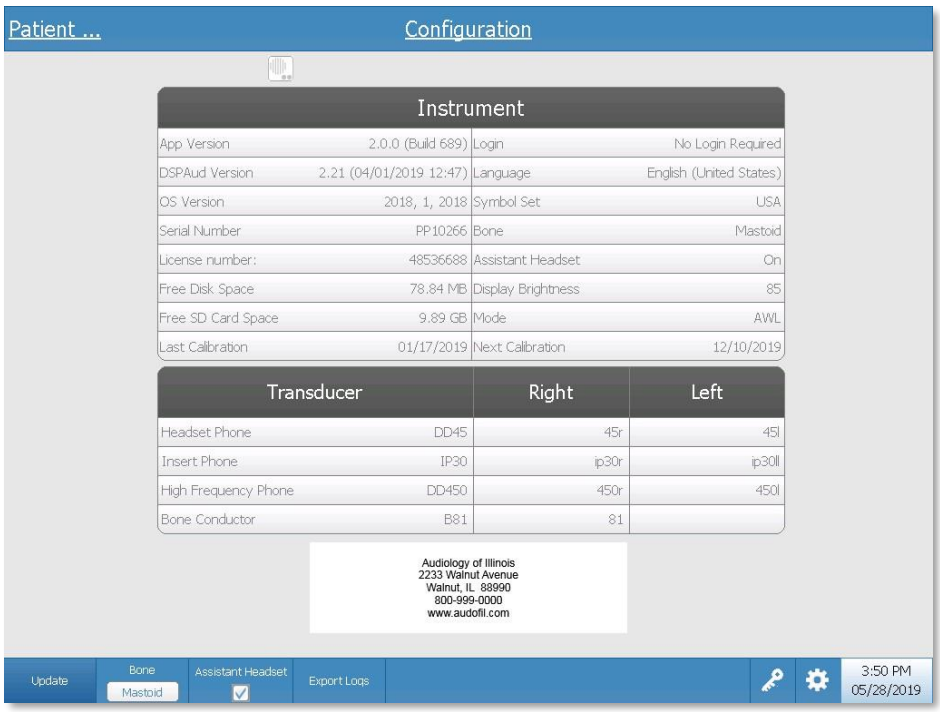
Function Buttons

Examiner - This button displays a list of examiners that may be assigned to each test session. Examiner names and security options are defined in the configuration application.

Patient - This button displays a screen that allows the examiner to create a new session, enter patient demographics, select a patient from the patient list, import a patient list and transfer, load, export or delete a session.

Data Erase – This button allows the user to Clear Session which clears all test type screens and saves the results in a single session. This button also erases user defined data from the internal memory. The user may select to erase a single data point, the last curve or all session data.

Configure - From this screen, it is possible to view the instrument information such as serial number, software version and last calibration date. This screen displays setup options to update the AudioStar Pro software, configure bone conduction symbol settings, enable/disable the Aux Intercom, export log files, set the date and time, and adjust the screen brightness.



- **Update -** Place a USB drive with the appropriate update loaded into one of the four USB ports. Select Update and then select from device, settings or sound files to update the instrument. Software and sound files updates must be obtained from GSI or an authorized GSI representative. Selecting Settings allows for installing an update from a config file generated from the Configuration Application.
- **Bone** - Select the symbol scheme for bone conduction testing. Choose between MAS (Mastoid) and FOR (Forehead.) This selection will be active throughout the current session. When a new session is started, the symbol scheme will revert to the configured preference.
- **Aux Intercom** - When the box is checked the Aux Intercom is enabled. If the box is not checked the Aux Intercom is disabled.
- **Export Logs** – Select to obtain and send the instrument logs to an attached USB drive. The instrument logs may be requested to help troubleshoot any problems.

- **License Icon –** Select to see the licensed options on the instrument. In the dialog that is presented, the current options are indicated and there are buttons to allow the update or export of the license key. An update to the license key may be made manually by typing the key code into the text box or the key may also be imported from an attached USB drive.

NOTE: One license key contains all the instrument options. When a successful update occurs, the option to add Another Key refers to licensed word lists, if applicable.

- **Settings Icon –** Select the settings icon to configure the items listed below.
  - **Graph Orientation –** Select from the dropdown to control how the audiogram is presented on the screen. Choose left-right, right-left or combined.
  - **Masked and Unmasked—**Select from the drop down menu to have masked thresholds replace unmasked thresholds at the same frequency OR store both masked/unmasked at each frequency.
  - **Printer Protocol -** Select from the dropdown the default printer or printer protocol to be used for the printouts from the instrument. Consult the printer documentation to determine the correct protocol.
  - **Date and Time** - Select to change the date and update the time displayed on the AudioStar Pro. Use the on board navigation buttons to tab to each field and the attenuator dials to change the date and time from the stand-alone instrument.
  - **Brightness** - Select to change the brightness of the screen.
  - **Save** – Select to save all settings changes.
  - **Cancel** – Select to cancel all changes to settings.

Keyboard

The AudioStar Pro works with a keyboard and many of the operations of the front panel keys on the instrument may be performed using the keyboard. The following table shows the mapping of the keyboard keys to the instrument.

Keyboard Key	Instrument Function
B	Routing - Left/Right
F	Transducer - Speaker
H	Transducer – High Frequency Phone
I	Transducer - Insert
K	Interlock
L	Routing – Ch 1 Left Ch 2 Right
M	Masking
N	Tone No Response
P	Transducer - Phone
R	Routing – Ch 1 Right Ch 2 Left
S	Store
T	Tracking
V	Transducer - Bone
Space Bar	Ch 1 Present
Up Arrow	Ch 1 Increase Level
Down Arrow	Ch 1 Decrease Level
Right Arrow	Ch 1 Increase Frequency
Left Arrow	Ch 1 Decrease Frequency
Page Up	Ch 2 Increase Level
Page Down	Ch 2 Decrease Level
+ or =	Correct/Start
-	Incorrect/Stop

NOTE: Channel 1 is always the stimulus and channel 2 is always masking when using remote functionality.

Chapter 5: Test Type Displays

Monitor

The AudioStar Pro comes standard with an LCD display. The LCD is hinged to the GSI AudioStar Pro and is used to display all of the testing information from the instrument. When the LCD is in the lowered position, easy access to the rear connector panel is provided. It is possible to order the AudioStar Pro without the LCD display and connect it to an external HDMI compatible monitor.

NOTE: Recommended specifications for external monitor are as follows: HDMI high definition monitor, 21.5inch screen that supports 1024 x 768 resolution in order to maintain the aspect ratio of the audiogram.

Test Type Screens

The information displayed on the AudioStar Pro LCD varies depending on the Test Type. There are common elements found on all screens such as the Channel 1 and 2 level settings, the Navigation menu and the Title Bar.

Title Bar

The title bar is located at the top of the display. The title bar displays the test type in the middle. The patient name will appear on the left side of the title bar if a patient name has been entered (or selected from an imported patient list). The right side of the title bar displays the examiner name if examiners have been entered. The examiners can be entered from the Configuration application.

Test Type Information

Under the title bar test specific information will be displayed. On the left and right side, the current output in dB HL for Channel 1 and Channel 2 will be displayed. The other information displayed will depend on the test type and is described as part of the individual test type displays.

Navigation Menu

This menu is located at the bottom of the display. It utilizes the on-board navigation buttons or an external mouse to access the menu options. The menu is specific to the test type selected.

Time and Date

The date and time are displayed in the bottom right corner of the screen. Using the Configuration Application, the Time may be configured in a 12 or 24 hour format and the Date may be configured in any order (dd/mm/yyyy, etc.). It is also possible to update the date and time in the configuration screen of the instrument. Use the navigation buttons and the attenuator dials to set the appropriate time and date. The date and time will update when a new session is started.

NOTE: The time does not change automatically for daylight savings time. The operator must manually change the time using the configure button on the front panel of the instrument or the configuration application.

Common Icons

These icons are found in the test information area and common to the different test types

Talk Forward – When pressed, a head with a headset icon will appear. This icon will remain active as long as the talk forward button is depressed.

Store – When either of the store buttons is pressed, a floppy disc icon flashes and the result is then displayed.

Interlock – When interlock is active, a padlock icon will appear.

Tracking – When tracking is selected, a railroad track icon will appear.

Aux Intercom – When pressed, the Aux intercom icon indicates direct communication between the operator and the Aux headset.

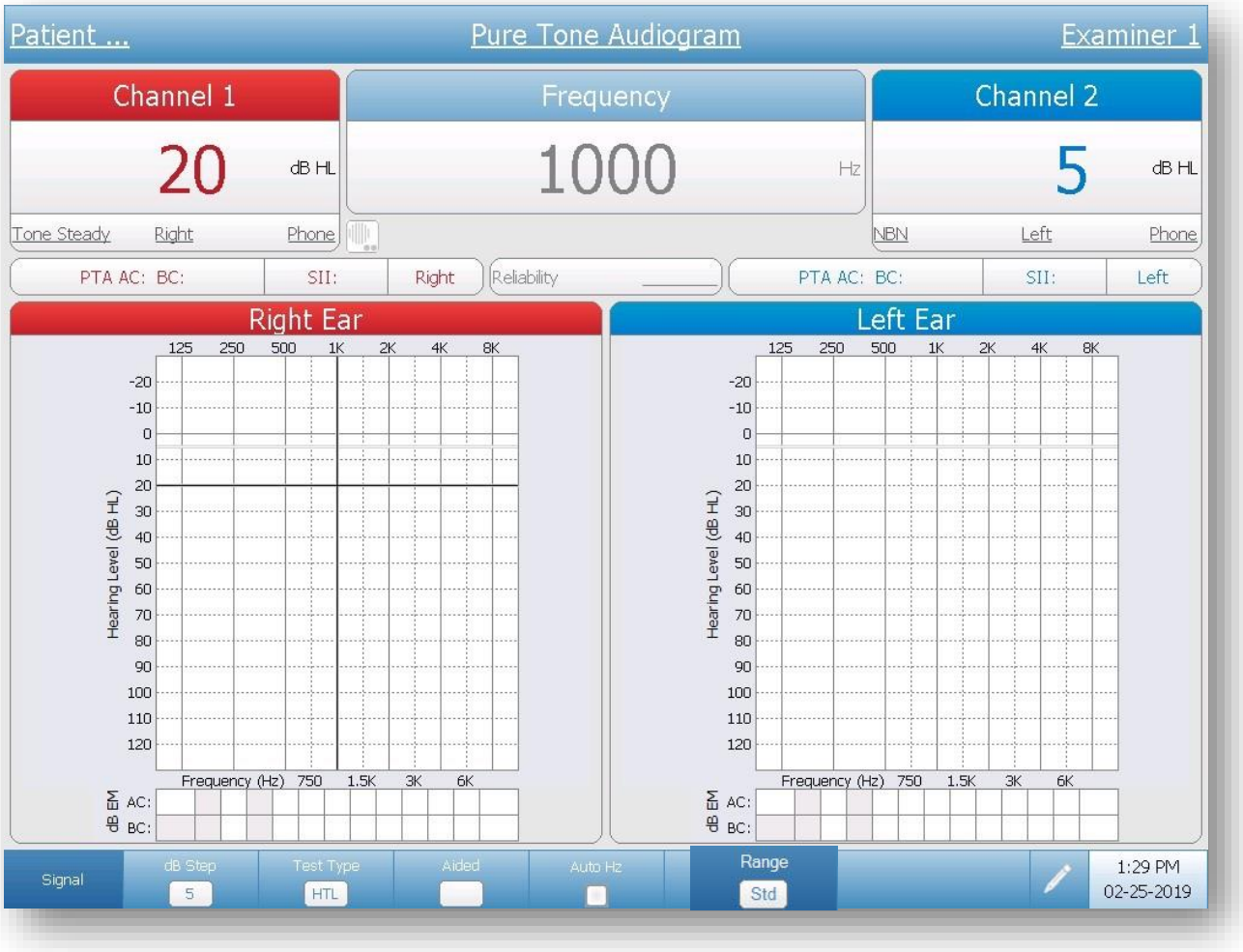
Data Transfer – When there is an active connection between the AudioStar Pro and an external computer, communication will be indicated by the blue arrows.

Left, Center and Right VRA – A VRA system with a right, left and centering toy may be connected to the AudioStar Pro. The VRA-L, VRA-R and VRA-C icons will appear on the display when the front panel buttons have been pressed to activate the VRA system.

Pencil Icon

This icon opens a comments window (must use external keyboard to utilize comment section). Comments may be entered from any test screen and it is possible to review and edit comments from any test screen.

Tone Test Type - Audiogram



Tone Test - Audiogram Display

Title Bar

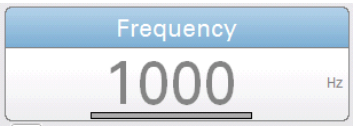
On the left side of the title bar, the patient name, if entered, will be displayed. In the center of the title bar, the test type (Pure Tone) will be displayed. On the right side of the title bar, the examiner name will be displayed. An underline on any item on the display indicates that a choice may be made using the mouse. In the title bar it is possible to select a patient, test type or examiner using the mouse to display a drop down menu of the selection choices.

Channel 1 and Channel 2 Windows

The Channel 1 and 2 windows display the current output for each channel. The sound wave symbol indicates that a stimulus is being presented. This sound wave will be present as long as the present bar is depressed, will flash to indicate a pulsed stimulus, and will be steady if “interrupt” is in the on position. The level of the stimulus will be displayed in the color of the ear that has been selected for each

channel. If Left/Right routing is selected, the Channel color will be black. At extreme levels, the value will be highlighted in yellow. When the attenuator has reached its upper limit (per transducer and frequency), an NR label will be displayed (and highlighted in yellow if the level is 100 dB or more), indicating No Response. The signal type (pulsed, FM, pulsed/FM, steady), ear and transducer selected are displayed at the bottom of the channel windows. The signal type, ear and transducer may be selected with the mouse to display a drop down list of options for selection.

Frequency Window



This window will display the test frequency. When a patient response switch is used, a bar will flash below the frequency when the patient depresses the button. This bar will be gray if only one response switch is used. If two response switches are used, then the bar will be blue for a left response and red for a right response.

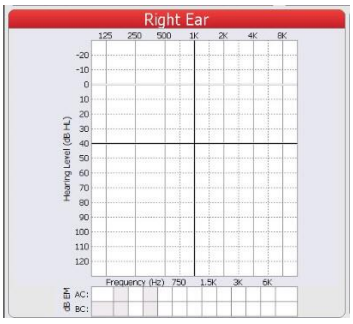
On Screen Data Logging

The Pure Tone Average (PTA) for air and bone conduction is automatically calculated as the threshold data is collected. The frequencies used for the PTA may be defined in the Configuration application.

The Speech Intelligibility Index (SII) is automatically calculated as the threshold data is collected. The SII is the portion of speech information that is audible and usable for each patient and is calculated using pure tone thresholds.[1] There is a high correlation between SII and word recognition scores.

Reliability may be reported as good, fair, or poor at any time throughout the evaluation to indicate the validity of the results of the tests. A empty field indicates that the reliability was not labeled. Additional labels may be defined in the configuration application. The reliability may be assigned by using the navigation buttons in the comments window of the instrument. By clicking on the reliability underline with the mouse a menu of reliability items defined by the Configuration application will be displayed.

Audiogram View



Selecting the Audiogram viewing mode displays the audiometric data in graphic format. The user may determine the layout of the audiogram graphs (Right/Left, Left/Right, or combined into a single graph). Press and hold the Test Type Tone button for two seconds to change the graph view.

Black crosshairs on the graph indicate position of the attenuator and oscillator. The masking level in the opposite channel will be indicated by two light gray horizontal lines. The appropriate symbols will be displayed on the audiogram after the Store button has been pressed. The effective masking levels for air conduction and bone conduction will be displayed below the audiogram graphs.

Navigation Menu

The navigation menu contains the options for the Tone test type. The options may be selected by using the navigation keys on the instrument or by using a mouse. The right side of the menu displays the current date and time.

Signal Menu

The signal menu displays a sub menu with the choices of signal type.

- Steady – Indicates a steady pure tone or noise signal.
- FM – Applies a frequency modulation (warble) to a pure tone stimulus.
- Pulsed – Any signal or masking signal may be pulsed including narrow band noise for a pediatric-focused stimulus.
- FM/Pulsed – Applies both a warble and a pulse to the test signal
- Ped Noise – Pediatric noise – a steeply filtered noise providing a frequency specific signal and presented in HL
- PN/Pulsed – Pulsed pediatric noise
- Lock Menu – Locks the signal dialog box - the dialog box will remain on the screen for efficient changing of signal types.

Decibel (dB) Step

The dB Step button toggles the choices for the decibel steps when adjusting the attenuator dial. Each time this option is selected with the navigation button or a mouse, the step size moves to the next option. The options for dB step size are

- 1 dB
- 2 dB
- 5 dB

Threshold Test Type

The Test Type button display a sub menu with the choices for the test type level.

- HTL – Hearing Threshold Level. The appropriate threshold symbols will be stored on the audiogram when HTL is selected.
- MCL – Most Comfortable Level. An “M” symbol will be displayed.
- UCL – Uncomfortable Level. A “U” symbol will be displayed.
- Tinn – Tinnitus level. A “t” symbol will be displayed.
- TEN –Threshold Equalization Noise (TEN Test)

NOTE: When the TEN test type is selected, TEN noise is automatically loaded in Channel 2 at an intensity level of 70 dB, transducers routed to the same ear and a 2 dB step size selected. To exit the TEN Test, press the Tone Test Type button to return to Audiometry (HTL.)

Aided

The Aided menu has 3 options that toggle each time the button is selected.

- Blank
- Aided (HA)
- Cochlear Implant (CI)

When the box is HA or CI, the aided or cochlear implant symbol will appear on the audiogram when a result is stored.

NOTE: When HA or CI is selected the transducer will automatically change to speakers as the selected transducer and FM as the signal type.

Auto Hz

The Auto Hz button controls whether or not the frequency automatically advances to the next frequency to be tested when the store button is pressed. The frequency presentation order is defined in the Configuration application. When the Auto Hz option is checked, each time a threshold is stored (pressing Store) the frequency will advance to the next test frequency automatically. If the option is not checked, the frequency must be changed using the frequency buttons on the front panel of the instrument.

NOTE: Only the frequencies appropriate for the test range are presented. If a frequency above 8000 Hz is included in the frequency list and the test range is standard, only the standard frequencies are presented.

Range

The Range selection determines the displayed audiogram frequency range and available test frequencies. The three audiogram options are Standard, High and Full range. The frequencies available for testing will vary depending on the selected transducer.

- Standard audiogram range: 125 Hz-8 kHz.
- High audiogram range: 8 kHz-20 kHz. (The High Frequency Range display does not have the data calculations for the PTA or SII.)
- Full audiogram range: 125 Hz-20 kHz.

Comments

The pencil icon opens a comments window (must use external keyboard to utilize comment section). Comments may be entered, reviewed and edited from any test screen.

Stenger Test Results

In addition to entering comments, the comments dialog has the options for recording Stenger test results (both pure tone and speech). The Stenger buttons on the comments dialog may be toggled to indicate a positive or negative test result. Off indicates that the test was not performed.

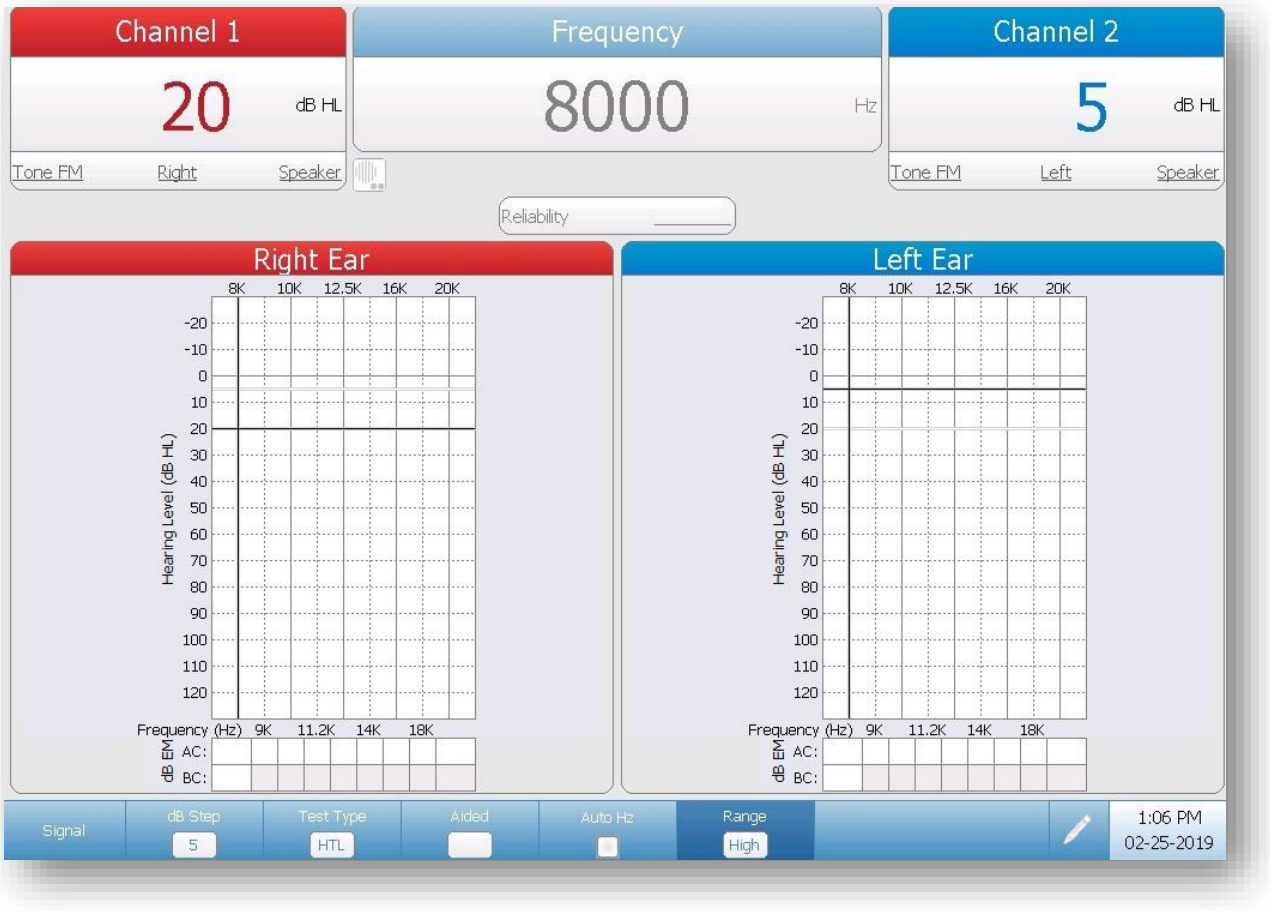
Reliability

The comments dialog also contains the option to record the patient test reliability. Selecting the Reliability button from the comments dialog displays the options for reliability. The options for the reliability label are defined in the Configuration application.


Comments:
Stenger Speech
Off
Stenger Tone
Off
Reliability
Cancel
Save

High Frequency Audiogram

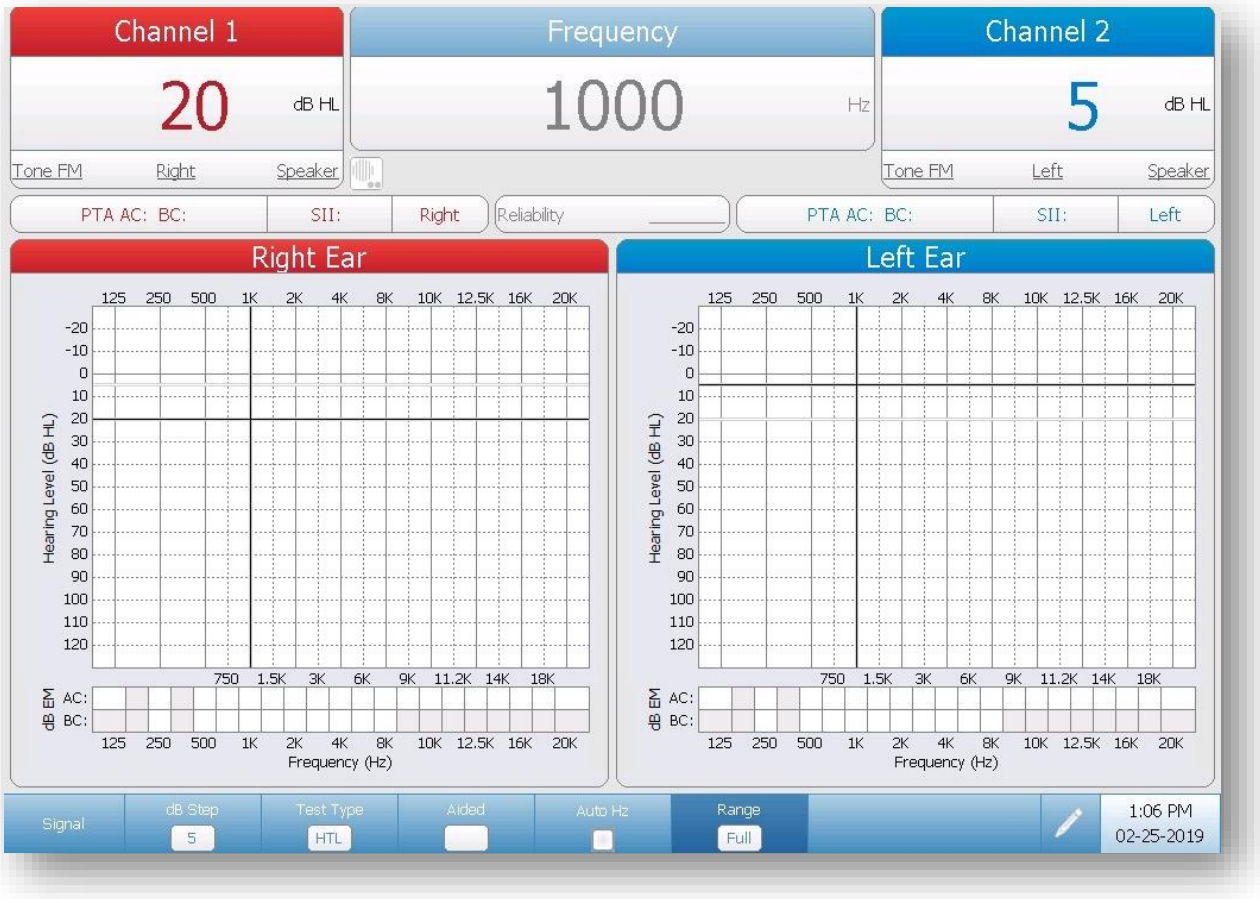
When High Frequency range is selected, the audiogram will display test frequencies from 8-20kHz. Data calculations for the PTA or SII will not appear. The high frequency headphones (RadioEar DD450) must be calibrated to test these frequencies.



High Frequency - Audiogram Display

Full Frequency Audiogram

When Full Frequency range is selected, the audiogram will display test frequencies from 125-20kHz. The high frequency headphones (RadioEar DD450) must be calibrated to test these frequencies.



Full Frequency Audiogram Display

Tone Test Type - Table

Tone Test Table Display

The Table display for the Tone Test Type presents the data in a tabular format. The columns indicate the stored results for the frequencies tested, dB HL level for air conduction (AC), bone conduction-mastoid (BC-M), bone conduction forehead (BC-F), sound field speaker results (SPKR) and second speaker (SPKR-B). The effective masking level (dB EM) will display if applicable. The display contains the same elements as the audiogram graph display. Only the frequencies tested will be displayed. If more than 10 frequencies are tested, multiple pages of test data will store. This is indicated in the top right area of the Test Results title bar. The up/down arrows allow movement between pages using the mouse, the frequency buttons or the on board navigation buttons.

Fine Frequency Resolution

The Fine Hz button allows the user to select from a sub menu of different octave band frequency resolutions and single hertz resolution. If more than 10 frequencies are tested, multiple pages of test data will store. You may navigate

to the additional pages by using a mouse, the frequency buttons or the on board navigation buttons.

High Frequency and Full Frequency – Table

The display for the High Frequency and Full Frequency Table and the Tone Test Table are identical. Use the Range Selection button on the Navigation Menu that corresponds to the frequencies to be tested.

Speech Test Type - Table

Speech Test Status Display

Title Bar

On the left side of the title bar, the patient name, if entered, will be displayed. In the center of the title bar, the test type (Speech) will be displayed. On the right side of the title bar, the examiner name will be displayed. An underline on any item on the display indicates that a choice may be made using the mouse. In the title bar, it is possible to select a patient, test type or examiner using the mouse to display a drop down menu of the selection choices.

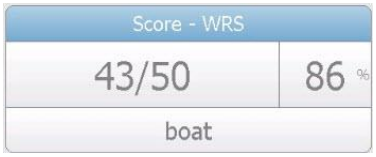
Channel 1 and Channel 2 Windows

The sound wave icon and the VU meter indicate when a stimulus is being presented. The sound wave icon and VU meter will remain active through the duration of the stimulus.

The level of the stimulus will be displayed in the color of the ear that has been selected for each channel (red for right, blue for left and black for binaural). At extreme levels, the value will be highlighted in yellow. When the attenuator has reached its upper limit (per transducer) the level will flash and the NR symbol will appear.

The stimulus source (Microphone, INT/EXT A or INT/EXT B), ear selected, and transducer selected are displayed at the bottom of the channel windows. The signal type, ear and transducer may be selected with the mouse to display a drop down list of choices for selection.

Scoring Window



This scoring window displays the speech scores in a percentage value. The scores are populated using the Correct/Incorrect buttons on the front panel of the instrument. The left side indicates the number of correct responses over the total presented. The right side converts this into a percentage. The lower part indicates the current word being presented.

NOTE: When using internal Wav files, the Correct, Incorrect and Clear buttons are inactive while the stimulus is being presented.

On Screen Data Logging

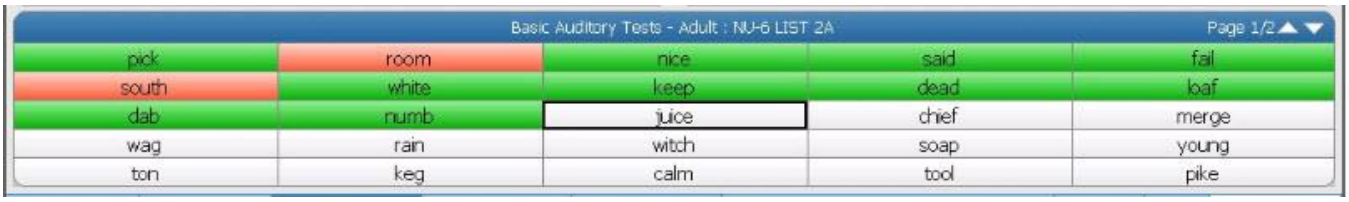
Pure Tone Average (PTA) for air and bone conduction is automatically populated from the tone test screen if the data is available. The audiologist may quickly compare the results of the PTA with the results of the Speech Reception Threshold (SRT) or Speech Detection Threshold (SDT) to rule out the possibility of pseudohypoacusis.

Speech Intelligibility Index (SII) is automatically populated from the tone test screen if the data is available. The audiologist may quickly quantify the speech information that is audible to the patient and compare to the word recognition score (WRS). There is a high correlation between SII and WRS.

Speech Test Results

The Speech Test Results Table displays the speech information for the tests that have been stored. To store a speech test result, press the Store button on the instrument. The results table stores the ear, test type speech source, the word list presented, if an aid (hearing aid or cochlear implant) was used by the patient, the percentage correct, the HL level and the masking level. There are tables for right and left ear results and each table holds up to 8 test results. If more than 8 results are stored, test data is stored on additional pages. (An unlimited number of tests may be stored.) This is indicated in the top right area of the Speech Test Results title bar. The up/down arrows allow movement between pages using the mouse or the on board navigation buttons.

Words/Sentences for Presentation



The lower part of the Speech display shows the first 25 words from the selected word list. The words on the list may be presented by selecting the word with the mouse or by using the navigation buttons on the device (and the manual Word Nav option from the Navigation Menu) to highlight the word and pressing the present button. When a word is being presented, the background of the selected word will be highlighted in yellow. As the words are scored by pressing the correct or incorrect button, the correct word cells are colored green and the incorrect word cells are colored red. If more words are on the list than can be displayed, additional pages are used. This is indicated in the top right area of the word list title bar. There are up/down arrows that allow movement between pages using the mouse. When the last word on the list is presented the next page will be displayed. Using the navigation buttons on the instrument you can move to the next page by pressing the down or right navigation key on the last word in the list. You may also select additional word lists without resetting the score. Pressing the Store button, resets the percent score and stores all relevant speech data in the table.

Navigation Menu

Test Type

Select SRT (Speech Reception Threshold), SDT (Speech Detection Threshold), WRS (Word Recognition Score), SRS (Speech/Sentence Recognition Score), MCL (Most Comfortable Level) or UCL (Uncomfortable Level); this will determine how the record is scored and labeled.

Word Lists

Using the on-board navigation keys or an external mouse, selecting this button will pull up a menu of available word list options. The operator may select the source (internal or external), the CD name (protocol of assorted word list groups such as Adult Basic Evaluation or Child Basic Evaluation) and the word lists. When the word list has been selected by pressing Save, the dialog box will disappear, and the words will appear in the bottom half of the display screen.
There is a favorite list at the top of the word list dialog. This favorite list is specific to the test type and is set up in the Configuration application. The first word list in the favorite's list will automatically appear in the test screen when the test type is selected.

Word Nav

When selected, this option presents a sub menu of options appear:

- The Manual option moves the cursor control to the word lists and allows the operator to use the navigation buttons to scroll to specific words in the

internal word lists. To return to the Navigation Menu, deselect Word Nav (by pressing the select key of the navigation controls).

- The Auto Advance check box determines the word movement behavior that is set up in the Configuration application. The Auto Advance moves to the next word in the list after a score key (Correct/Incorrect) is pressed.
- The Auto Advance Word List functions are used in conjunction with Word List Favorites as designated using the Config App. For each Test Type, when multiple favorite word lists are designated, storing a test result will automatically advance to the next word list in favorites.
- The Auto Play option has a box indicating the time (in seconds) and up/down arrows to adjust the time. The Auto Play option will automatically present the word and the time is how long between the word presentations. Auto Play is activated by pressing the interrupt button. The Configuration application defines the behavior of the Auto Play option. The auto play option may be defined to do one of the following; wait for a score, score as correct, incorrect or no score when the time expires.
- Close closes the Word Nav sub menu.

NOTE: In Manual mode, highlight the desired word and press the presentation bar to present the word. When the word is presented, it will be highlighted yellow. When the yellow highlight disappears, score the word and move to the next test word using the navigation keys. If a score is indicated before the highlight disappears it might not be accepted as a score.

NOTE: When scoring phonemes (CVC, etc), it is necessary to deselect the Auto Advance option to ensure that multiple "scores" may be entered per word

Aided

Select this box to indicate if the word list was presented in an aided condition. The Aided menu has 3 options that toggle each time the button is selected.

- Blank
- Aided (HA)
- Cochlear Implant (CI)

NOTE: When HA or CI is selected the transducer will automatically change to speakers as the selected transducer.

Decibel (dB) Step

The dB Step button toggles the choices for the decibel steps when adjusting the attenuator dial. Each time this option is selected with the navigation button or a mouse, the step size moves to the next option. The options for dB step size are

- 1 dB
- 2 dB
- 5 dB

Display Pure Tone Audiogram

The audiogram checkbox displays the pure tone air conduction audiogram of the test ear in place of half of the Speech test Results table. This button acts as a toggle to display the audiogram or speech results table.

Speech Test Table Display – Pure Tone AC Audiogram

Comments

This pencil icon opens a comments window (must use external keyboard to utilize comment section). Comments may be entered from any test screen and it is possible to review and edit comments from any test screen.

Stenger Test Results

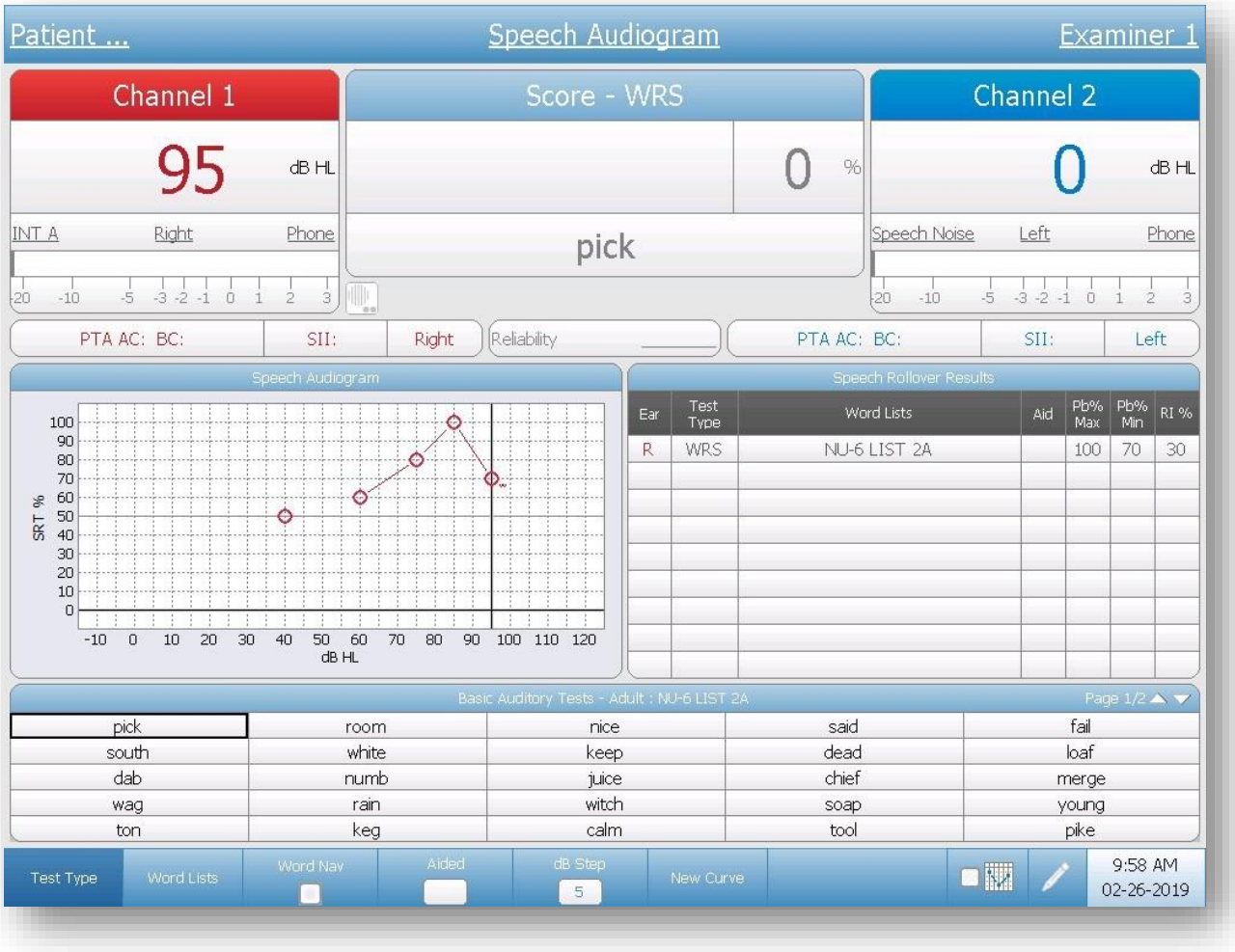
In addition to entering comments, the dialog has the options for recording Stenger test results (both pure tone and speech). The Stenger buttons on the comments

dialog may be toggled to indicate a positive or negative test result. Off indicates that the test was not performed.

Reliability

The comments dialog also contains the option to record the patient test reliability. Selecting the Reliability button from the comments dialog displays the options for reliability. The options for the reliability label are defined in the Configuration application.

Speech Test Type - Audiogram



Speech Test Audiogram Display

This Speech Test Audiogram displays speech results in a graphic format and has the Rollover Index Table. The display for the Speech Test Audiogram is identical to the Speech Test Table display except the tables are replaced with the Speech Audiogram and Speech Rollover Results Table. An additional menu option, New Curve, is added to the Navigation Menu.

The SRT score will be plotted on the Speech Audiogram at 50% at the corresponding level. Word recognition scores will be plotted on the Speech Audiogram based on the level at which the test was performed and the score that was achieved. As additional WRS are plotted, the AudioStar Pro will determine PIPB (Performance Intensity Function for Phonetically Balanced Words) function. PIPB function is tested by comparing two (2) or more WRS results performed at different intensities. It will automatically calculate and display in the table the Rollover index when enough data is available.

NOTE: If the SRT was tested using Left/Right routing, the symbol plotted on the Speech Audiogram will be  which indicates the stimulus was presented to both ears.

Navigation Menu

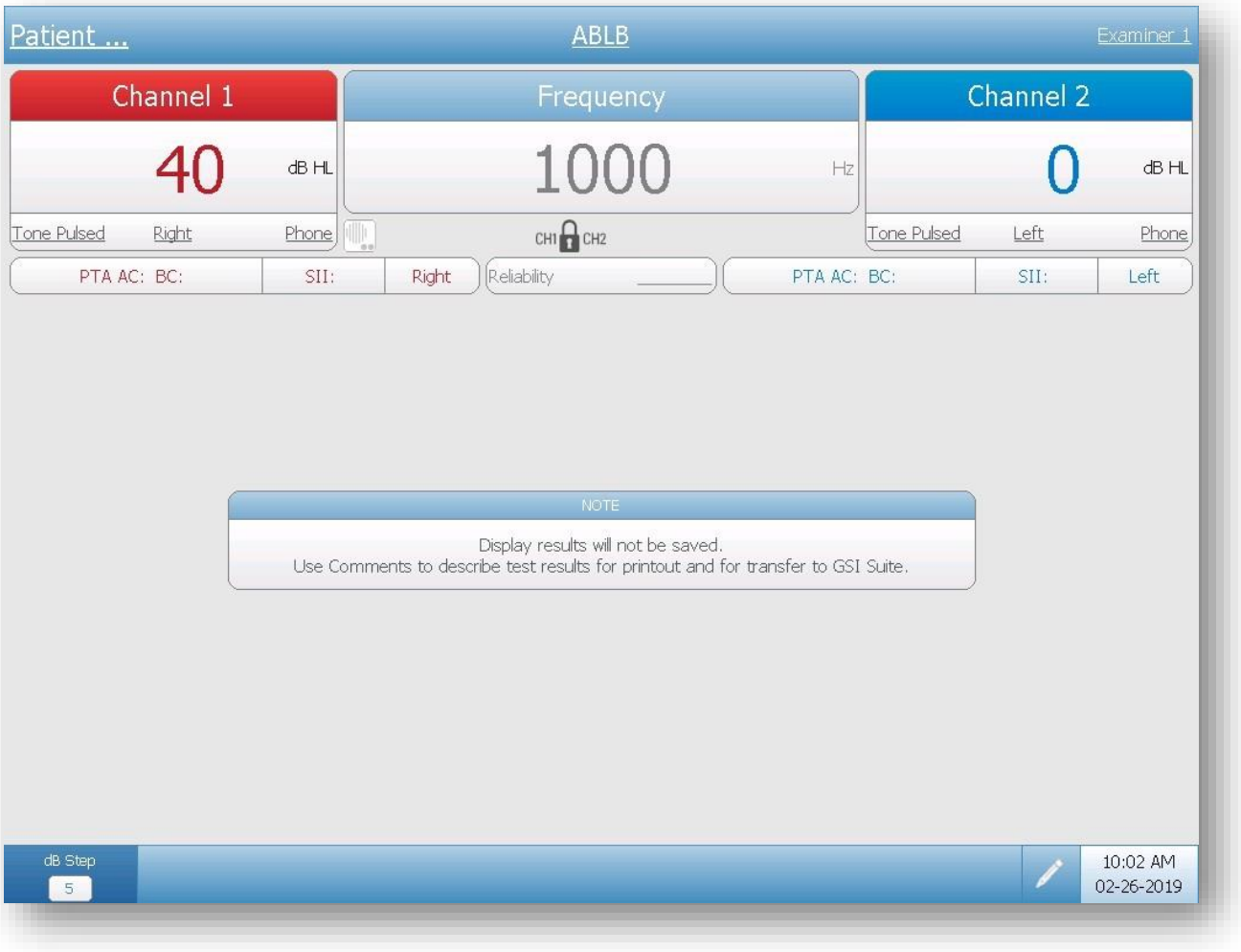
The Navigation menu has the same functionality and selections as the Speech Status display and the addition of the New Curve menu item.

New Curve

The new curve button on the Navigation Menu starts a new curve on the speech audiogram. The current data is maintained and you may start a new test collecting SRT and WRS data that will be plotted on the graph and results displayed in the Speech Rollover Results table.

NOTE: Only curves with PIPB Rollover will be displayed in the rollover results table.

More Test Type
ABLB



In ABLB (Alternate Binaural Loudness Balance) test, the tone is presented alternately between the two ears. The level of the tone stays the same in one ear (i.e. fixed ear) and is varied up / down in the other ear (i.e. variable ear).

The top section ABLB test display has common elements found on the previously described screens. The Navigation Menu has a single option for the dB Step in addition to the comment icon. The results should be stored as a comment.

BKB-SIN

The BKB-SIN is a speech-in-noise test that uses BKB (Bamford-Kowal-Bench) sentences, recorded in four-talker babble. The BKB-SIN can be used to estimate SNR loss in children and adults for whom the QuickSIN test is too difficult.

The BKB-SIN display has the Title bar and the Channel 1 and 2 Output sections that are similar to what has been described for the speech displays.

Scoring Window

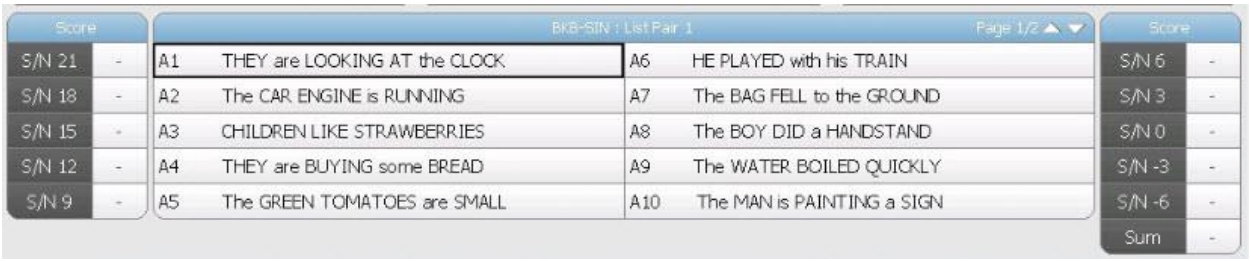
There are two scoring windows in the middle of the top section of the display. The scoring windows show the calculated average of the individual list test scores. The scores are separated for the ear and group and reported as the SNR loss. There can be two groups for comparison.

NOTE: In order to obtain a SNR loss the age range must be indicated in the Age box of the Navigation Menu.

BKB-SIN Test Results

The BKB-SIN Test Results Table displays the information for the tests that have been stored. The data is separated by ear and group. The results include the SNR 50 and the SNR Loss. For details on the scoring see the BKB-SIN manual. The SNR Loss can only be calculated if the age range is indicated in the Age button on the Navigation menu.

BKB-SIN Sentences and Score



The lower section of the display contains the BKB-SIN sentences. The capitalized words indicate the target words to be scored. Next to the sentence is the score box for the sentence with an indication of the Signal to Noise (S/N) ratio for the sentence.

The sentence on the list may be chosen for presentation by selecting with the mouse or by using the navigation buttons on the device (and the Word Nav option from the Navigation Menu) to highlight the sentence and pressing the present button. When a sentence is being presented the background will be highlighted yellow. The sentences are scored by pressing the correct or incorrect button, the appropriate number of times. If more sentences are on the list than can be displayed, additional pages are used. This is indicated in the top right area of the sentence list title bar. There are up/down arrows that allow movement between pages using the mouse. When the last sentence on the list is presented the next page will be displayed. Using the navigation buttons on the instrument, move to the next page by pressing the down or right navigation key on the last sentence in the list.

Navigation Menu

The Navigation Menu contains options that are the same as those previously described for the speech displays. The Word List, Word Nav, Aided, dB Step and the comment icon items function the same as in the Speech display. The Navigation Menu also contains items unique to the BKB-SIN test.

Age

The age menu item is a toggle that provides a choice of age ranges for the patient. This information is necessary to score the results and provide an SNR loss calculation. The age range is automatically set if the patient date of birth has been entered in the demographic information. If the date of birth has not been entered, toggle the age button to choose the appropriate age range. The selections correspond to the BKB-SIN test norms.

Group

The Group menu item acts as a toggle to indicate the 'group' for the testing. In the BKB-SIN test, up to 2 groups may be used to compare different conditions. Such comparisons might be used to demonstrate the benefits of amplification (unaided vs. aided) or assess directional microphone performance (no directional mic vs. directional mic). The BKB-SIN Test is a flexible tool that may be applied clinically in a variety of ways by adjusting the presentation level or the presentation mode.

Research

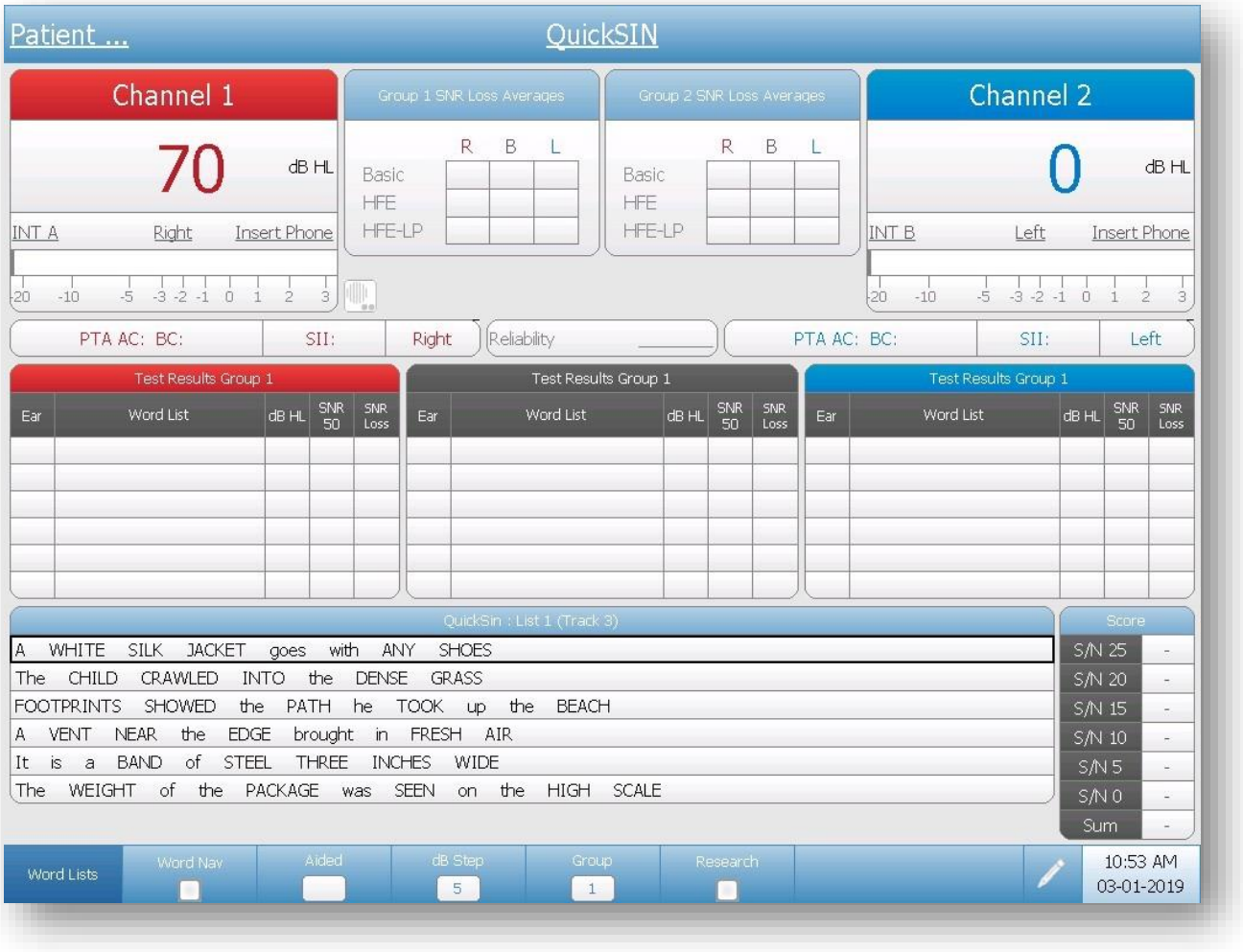
The Research menu item is a check box to indicate that the system is in Research mode. Research mode is designed for research and special applications. In the Research mode the Output for Channel 1 and 2 may be controlled independently. In the 'Standard' mode the Output for Channel 2 cannot be adjusted. The Split Track lists should be used for Research mode. The standard BKB-SIN sentences have the target talker and background babble recorded on the same channel and the S/N ratio integrated into the recording. The Split Track lists provide the ability to control the signal and noise in ways not available in the standard sentences.

Split Track I
In these recordings the target talker and background babble are recorded on separate channels (Channel 1 = target talker, Channel 2 = background babble) so the speech and babble may be presented through separate loudspeakers in the sound field. When the audiometer attenuators are set correctly (both attenuators set to identical presentation levels) these tracks maintain the same signal-to-noise ratios as on the standard recording; that is, the signal-to-noise ratio automatically changes by 3 dB for each sentence.

NOTE: When using Split Track I both Channel 1 and 2 outputs should be set to the same HL level. If the output HL is different for the channels then the S/N ratio will not be correctly maintained.

Split Track II
Both channels of these tracks (Channel 1 = target talker, Channel 2 = background babble) were recorded at a constant overall level. The signal-to-noise ratios do not change automatically after each sentence; the tester must manually adjust the level of the target talker and/or the background babble to change the signal-to-noise ratio.

QuickSIN



The QuickSIN is a speech-in-noise test that quickly measures ability to understand speech in noise. The QuickSIN is comprised of sentences recorded in four-talker babble.

The QuickSIN display has the Title bar and the Channel 1 and 2 Output sections that are similar to what has been described for the speech displays.

Scoring Window

There are two scoring windows in the middle of the top section of the display. The scoring windows display the calculated average of the individual list test scores. The scores are separated for the ear, group, QuickSIN sentence type and are reported as the SNR loss. There can be two groups so that comparisons may be made.

QuickSIN Test Results

The QuickSIN Test Results Table displays the information for the tests that have been stored. The data is separated by ear and group. The results include the SNR 50 and the SNR Loss. For details on the scoring see the QuickSIN manual.

QuickSIN Sentences and Score

The lower section of the display contains the QuickSIN sentences. The capitalized words indicate the target words to be scored. Next to the sentence is the score box for the sentence with an indication of the Signal to Noise (S/N) ratio for the sentence.

The sentence on the list may be chosen for presentation by selecting with the mouse or by using the navigation buttons on the device (and the Word Nav option from the Navigation Menu) to highlight the sentence and pressing the present button. When a sentence is being presented the background will be highlighted yellow. The sentences are scored by pressing the correct or incorrect button, the appropriate number of times. If more sentences are on the list than can be displayed, additional pages are used. This is indicated in the top right area of the sentence list title bar. There are up/down arrows that allow movement between pages using the mouse. When the last sentence on the list is presented the next page will be displayed. Using the navigation buttons on the instrument, move to the next page by pressing the down or right navigation key on the last sentence in the list.

Navigation Menu

The Navigation Menu contains options that are the same as those previously described for the speech displays. The Word List, Word Nav, Aided, dB Step and the comment icon items function the same as in the Speech display. The Navigation Menu also contains items unique to the QuickSIN test.

Group

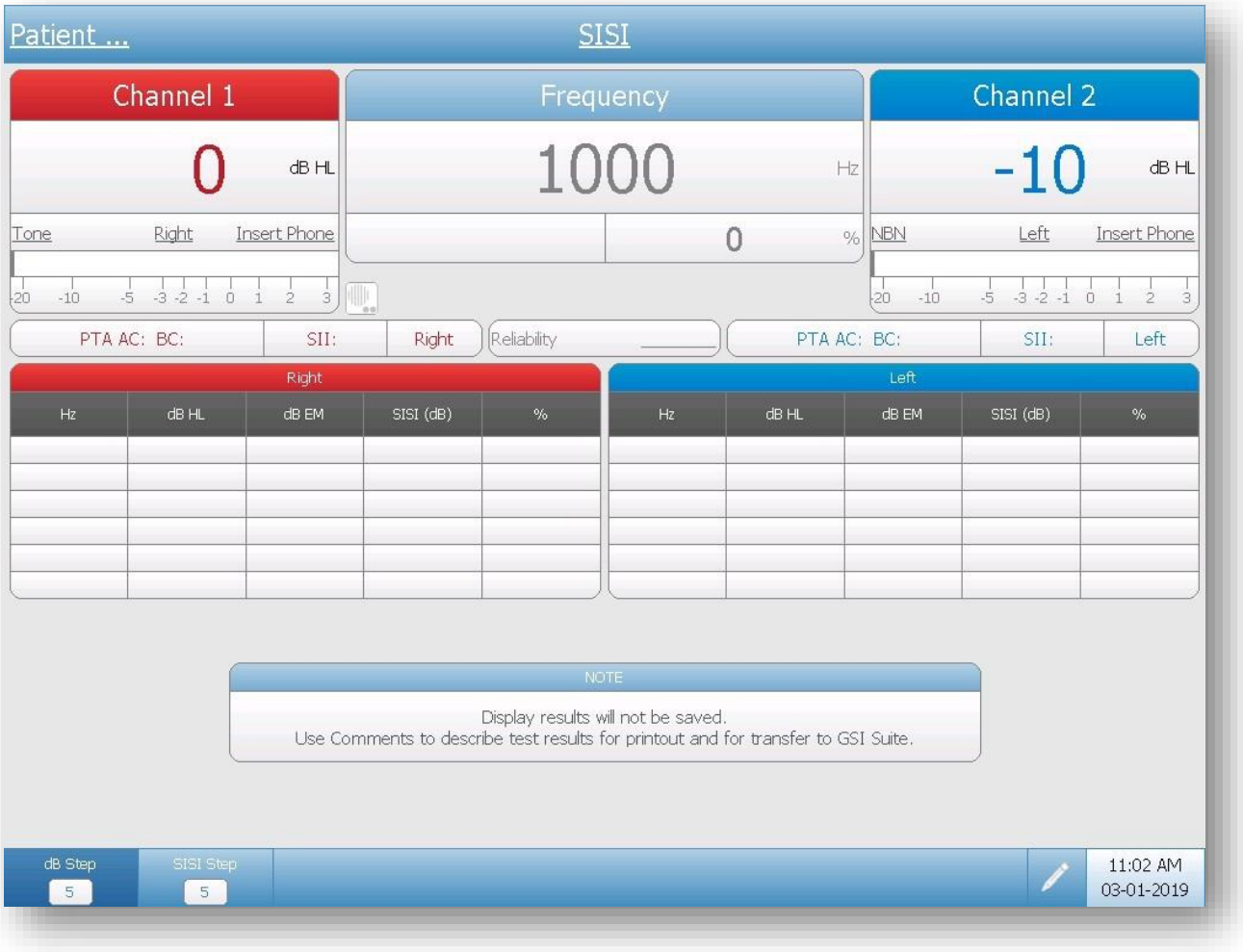
The Group menu item acts as a toggle to indicate the 'group' for the testing. In the QuickSIN test, up to 2 groups may be used to compare different conditions. Such comparisons might be used to demonstrate the benefits of amplification (unaided vs. aided) or assess directional microphone performance (no directional mic vs. directional mic). The QuickSIN Test is a flexible tool that may be applied clinically in a variety of ways by adjusting the presentation level or the presentation mode.

Research

The Research menu item is a check box to indicate that the system is in Research mode. Research mode is designed for research and special applications. In the Research mode the Output for Channel 1 and 2 may be controlled independently. In the 'Standard' mode the Output for Channel 2 cannot be adjusted. The Separated Track lists should be used for Research mode. The standard QuickSIN sentences have the target talker and background babble recorded on the same channel and the S/N ratio integrated into the recording. The Separated Track lists provide the ability to control the signal and noise in ways not available in the standard sentences.

Separated Tracks
Both channels of these tracks (Channel 1 = target talker, Channel 2 = background babble) were recorded at a constant overall level. The signal-to-noise ratios do not change automatically after each sentence; the tester must manually adjust the level of the target talker and/or the background babble to change the signal-to-noise ratio.

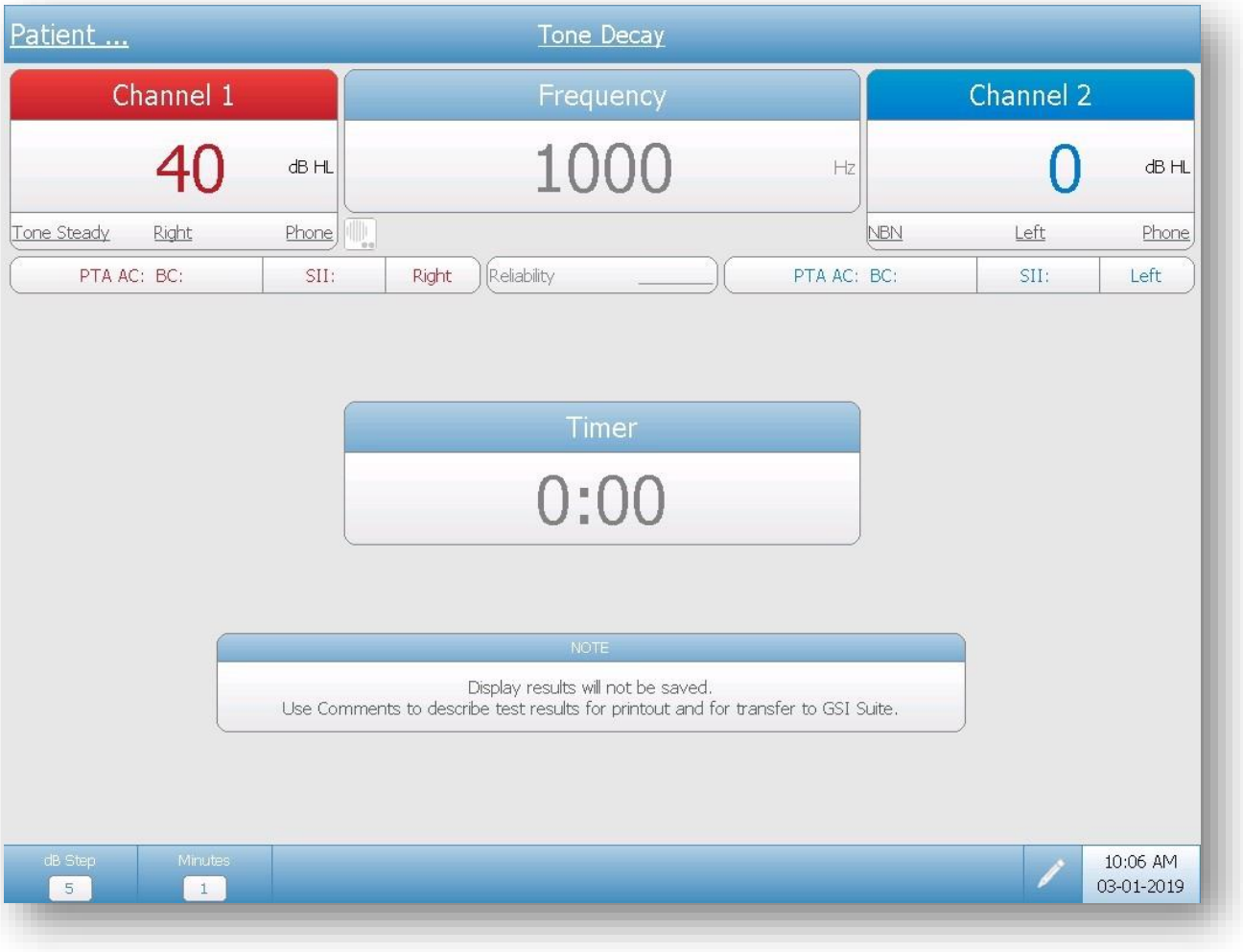
SISI



The SISI (Short Increment Sensitivity Index) test requires the generation of a continuous tone that increases in level a selected amount at a selected point in time. The SISI has level increments of 5 dB, 2 dB and 1 dB. An increment is added to a tone in the selected channel for 200 msec, every 5 seconds.

The top section of the display has the common elements found on all the previously described screens. The center section displays the results of the testing. Using the Correct/Incorrect score buttons, obtain a percentage correct of the patient responses. The results are added to the table when the test is Stored. The Navigation Menu has an option for the dB Step (continuous HL level) and an option for the SISI step (level increment). The results are not transferred to GSI Suite via the data transfer and therefore should be entered as a comment.

Tone Decay



The Tone Decay test evaluates auditory fatigue. The general procedure is to measure the ability to perceive and maintain a pure tone presented continuously (usually for 1 minute).

The top section of the display has the common elements found on the previously described screens. The center section displays the timer. The timer is started when the patient presses the response button or may be started manually from the Correct/Start button on front panel. When the patient response button is released it pauses the timer and when pressed again resumes. The Navigation Menu has an option for the dB Step and an option to set the time in minutes (1-4). The time setting in the Navigation Menu will stop the timer after the defined number of minutes is reached on the timer. The results are not transferred to GSI Suite via the data transfer and therefore should be entered as a comment.

Chapter 6: Operation
Preliminary Checks

Before starting any procedures using the GSI AudioStar Pro Clinical Audiometer, ensure that the power cord is plugged into a properly grounded receptacle.

WARNING! Check also that all cords from the transducers, patient response hand switch (if used), and printer fit securely in their connectors on the rear and side panels.

Inspect all cords for fraying and damage. If there is any damage to any cord, do not use the AudioStar Pro. If speech testing with recorded voice from an external source is to be performed, check that the CD or digital music player device is connected and operating properly.

1. Turn on the instrument and allow it to come to operating temperature (approximately 10 minutes).
2. Check that the transducers and other system components are operating properly.
3. Seat the patient comfortably in the test area.
4. Place the selected transducers on the patient.

CAUTION! Handle earphones, bone vibrator, and insert earphones with care. Do not drop them nor allow them to be banged together. Severe mechanical shock can alter their operating characteristics or change the output levels, which may require that the transducers be replaced.

CAUTION! It is recommended that all parts that come into direct contact with the patient (e.g. earphone cushions) are subjected to standard disinfecting procedures between patients. This includes physically cleaning and using a recognized disinfectant. Individual manufacturer's instructions should be followed for use of any disinfecting agent to provide an appropriate level of sterilization.

Placement of the Earphones

Prior to positioning the earphones on the patient's head, inspect the ear canals for any blockage due to cerumen or foreign objects. Recognize that soft-walled ear canals may collapse under the earphones and this may lead to incorrect threshold levels. Insert phones might be used in these cases. Eliminate all obstructions, such as glasses, hair, or hearing aid, between the earphone and the patient.

Center the earphone over both ears and adjust the headband so that it rests solidly on the crown of the head and exerts pressure on both ears. Place the earphone with the red connector over the patient's right ear and the earphone with the blue connector over the left ear.

Placement of the Insert Phone

WARNING! Push the correctly sized eartip onto the earphone and then place the insert phone securely into the patient's ear. Be sure there is an eartip attached to the insert phone before inserting into the patient's ear. Inserting the insert phone without an eartip could cause harm to the patient. When using the paired insert

phones, follow the manufacturer's recommended procedure for eartip preparation, placement, and insertion.

WARNING! Insert eartips are single use only. Using disposable eartips ensures sanitary conditions for each patient.

Placement of the Bone Vibrator

The bone vibrator may be placed on the promontory of the mastoid process or on the forehead, whichever has been selected in the configuration application or modified in the Configure screen.

Placement of the High Frequency Transducer

Remove eyeglasses and earrings if possible and position the transducer directly on the head of the patient. Place the rubber cushions so that the earphone diaphragm is aimed directly at the opening into the ear canal. Adjust the headband for a tight fit. If the cushions are not tight to the ears, the test result will be false, especially at lower frequencies.

WARNING! Do not connect or disconnect Earphones, Insert Phones, Bone Vibrator, High Frequency Transducers or any other accessories while in contact with the patient.

Typical Evaluations

Test Type Buttons

Test Type buttons allow the operator to access protocols that are customized to facility preference with a single button press. Tests are pre-programmed to optimize efficiency and workflow. The options for the defaults for each test type are set up in the Configuration application.

Tone Test Type Button

Pressing the Tone Test Type button prepares the AudioStar Pro for pure tone air and bone conduction testing from 125 to 20,000 Hz. Each selection on the blue Navigation Menu is specific to Pure Tone Testing. It is possible to utilize headphones (DD45) insert earphones (IP30) high frequency/circumaural headphones (DD450) bone vibrator (B81) and Sound Field speakers from this test type. Pressing this button will set the defaults from the configuration application to start the test.

- Press the Tone Test Type Button.
- Verify that the transducers and signals are correct.
- Verify the correct audiogram range is selected (standard, high, full)
- Perform air conduction threshold testing.

NOTE: Press "Store" after each threshold is obtained

- When the pure tone evaluation is complete, move to the next test type in the typical testing sequence.

Speech Test Type Button

Pressing the Speech Test type button prepares the AudioStar Pro for Speech testing. The internal .Wav files may be presented by using the auto play options, the present button or by a single click of a mouse. The correct/incorrect/clear buttons may be used to score. It is critical that the test type be carefully selected as the reporting/storing is dependent upon test type. To perform a PIPB rollover evaluation, select the speech audiogram view.

Integrated Word Files

When Speech Test Type is selected, the AudioStar defaults to internal .Wav files. These may be presented for consistent recorded speech testing. For manual presentation:

- Utilize the navigation menu or external mouse to select the test type and the word list.
- Select Word Nav and use the navigation buttons to highlight word stimulus. Press the present bar to present the word.

- OR -

- Utilize an external mouse to present the words (single click to present).
- When the speech stimulus is being presented, the word will be highlighted yellow.
- When the patient responds (and the yellow highlight disappears), the stimulus word/sentence may be scored correct or incorrect.
- The stimulus word/sentence will turn green for correct or amber for incorrect. The center area of the display will indicate the % correct/#words presented.
- After the completion of each speech test type, press store to save the results in the speech results table.
- When the speech evaluation is complete, move to the next test type in the typical test sequence.

NOTE: An unlimited number of speech test results may be stored. A total of eight (8) individual speech test results are displayed in the Speech Test Results table for each ear. If more than 8 results are stored, test data is stored on additional pages. This is indicated in the top right area of the Speech Test Results title bar. There are up/down arrows that allow movement between pages using the mouse or you may use the on board navigation buttons.

Using the Configuration application and the Auto Advance and Auto Play options, it is possible to configure the AudioStar to automatically move and present the internal word lists.

More Test Type button

Pressing the “More” test type button calls up a menu of the following special tests: ABLB, BKB-SIN, QuickSIN, SISI and Tone Decay. Use the on-board navigation buttons or an external mouse to select the special test.

Routine Test Procedures

The following procedures are in compliance with the current ANSI and ISO recommendations for Manual Pure Tone Threshold Audiometry.

Patient Instructions

Preparing the subject for test:

1. Put the subject at ease.
2. Make sure the subject understands the task.
3. Use the following instructions:

"I am going to place these earphones over your ears. You will hear tones or beeping sounds which may be loud or soft. Whenever you hear, or think you hear, one of these tones, raise your hand. Lower your hand when you no longer hear the sound. Remember, raise your hand when you hear the tone and lower your hand when you do not."

Patient Familiarization

- Familiarize the subject with the test and determine the start point.
- Start with the "better" or **RIGHT** ear.
- Demonstrate a tone for the subject using 1,000 Hz at 50 dB HL.
- If the subject responds, repeat at 40 dB.
- If the subject responds again, this is the "**start**" point.

NOTE: Discomfort of the patient could lead to inaccurate results. The operator is to evaluate the environment and physical conditions to determine whether these factors may affect the examination and give discomfort to the patient.

Threshold Determination (Pure Tone): Modified Hughson-Westlake

- Present the tone at 50 dB.
- Present the tone for 1 or 2 seconds. The time between the tones should vary, but should not be shorter than the test tone.
- With each response, decrease the tone 10 dB until the first "No Response" occurs.
- When the subject does not respond to a tone, increase the level by 5 dB until a response occurs.
- Continue with **DOWN** 10 dB, **UP** 5 dB until the threshold is reached.

NOTE: Threshold = minimum dial setting at which a response has occurred 2 times out of 3 on an ascending scale**.**

- The threshold is considered to be the minimum level setting at which a response has occurred two out of three times at lowest db HL. Record this setting by pressing Store.
- Repeat the sections on Patient Familiarization and Threshold Determination for each tone setting in the following order: 1,000 Hz, 2,000 Hz, 4,000 Hz, 8,000 Hz. Retest 1,000 Hz followed by 500 Hz and 250 Hz. If there is a difference of 20 dB or greater between octaves, test the inter-octave frequencies, i.e. 750 Hz, 1,500 Hz, 3,000 Hz, and 6,000 Hz. Record these settings by pressing the Store pushbutton with each threshold level.
- Repeat this procedure with the other ear.
- Determine if masking should be used. If necessary, repeat the testing with masking and again record the testing process.

Spondaic Speech Testing, Speech Reception Threshold (SRT)

Speech Reception Thresholds (SRT) refer to the level at which a patient can repeat 50% of the presented words correctly. Use the following instructions to prepare the patient:

"You will now hear some two syllable words such as hotdog, ice-cream, baseball, mushroom or toothbrush. Some of the words will be loud enough to hear easily but others will be softer and more difficult to understand. Repeat the words until you can no longer hearing them. It is okay to guess."

NOTE: It is appropriate to familiarize the patient with the entire spondee word list.

- Using live voice or recorded speech (internal .Wav files or external file played through a digital device), present the standardized spondee word lists, testing the better ear first. Start 20 dB above the 1,000 Hz pure tone threshold level. Present one word on the list and, if the response is correct, lower the level by 10 dB. Continue to decrease the level until the patient can no longer repeat the word. Increase the level 5 dB and present another word. Continue in the down 10 dB, up 5 dB method until the patient responds correctly to 50 % of the words presented.

Word Recognition (PB Words)

- Instruct the patient that he or she is to repeat the words presented.
- Using live voice or recorded speech (internal .Wav files or external file played through a digital device), present the selected standardized PB word list. Present the words at a level comfortable to the patient; at least 30 dB and generally 35 to 50 dB above the 1,000 Hz pure tone threshold. Using the scorer buttons on the front panel, press the "Correct" button each time the right response is given and the "Incorrect" button each time a wrong response is given.

The Word Recognition Score is the percentage of words repeated correctly: Recognition % at HL = 100 x Number of Correct Responses/Number of Trials.

Special Test Procedures - More Test Type button

The AudioStar Pro may be configured to perform many audiologic evaluations for further diagnosis, to rule out the presence of malingering and for research purposes. This section describes special test procedures that have been optimized for use with the GSI AudioStar Pro audiometer.

Pressing the “More” test type button calls up a menu of special tests. Use the on-board navigation buttons or an external mouse to select the desired special test.

Alternate Binaural Loudness Balance (ABLB) or Fowler Test

The perceived growth of loudness of a supra-threshold tone in an impaired ear may differ from the compared growth of loudness of a tone of identical frequency in the normal ear. Recruitment, if present, may be found.

- Determine the threshold level for each ear at all frequencies being tested.
- Select the ear to serve as the reference ear, typically the ear with the better hearing sensitivity. This ear will receive the tone at a fixed level.
- Select ABLB from the More Test Menu.
- Set the level of the tone for each channel to 20 dB above the threshold of each corresponding ear.
- The tone will automatically alternate from Channel 1 when the interrupt function in channel 1 is in the on position or manually, by pressing and holding the presentation bar in channel 1.
- The tone alternates at the rate of 400 msec on, 400 msec off followed by Channel 2 at 400 msec on, 400 msec off.
- Keeping the level fixed in the reference ear, vary the level of the tone presented to the test ear. Record the level at which the patient judges both of the signals to be of equal loudness.
- Repeat the above procedure increasing the level of the reference ear by 20 dB each time until a level of 80 or 90 dB is reached. Identify the dB HL of the tone necessary to “balance” in loudness the tone in the reference ear at each level. This procedure is followed for the each frequency to be balance tested.
- To increase the test reliability, the patient should be given several trials to judge whether a variable tone is “softer,” “equal to,” or “louder” than the tone in the reference ear.

BKB-SIN

For a detailed description of the BKB-SIN test the user is referred to the BKB-SIN manual provided on the AudioStar Pro CD. The BKB-SIN Test uses the Bamford-Kowal-Bench sentences (Bench and Bamford, 1979; Bench, Kowal and Bamford, 1979) spoken by a male talker in four-talker babble (Auditec of St. Louis, 1971). The QuickSIN™ Test (Etymotic Research, 2001; Killion et al., 2004) was designed to provide a quick estimate of SNR Loss and is appropriate for use with most adults. The sentences used in the QuickSIN are at approximately a high school language level, making the test too difficult for use with young children. The BKB-SIN test was developed as speech-in-noise test that could be used as part of the test protocol for a binaural cochlear implant study on adults and children. The BKB-SIN Test is a flexible tool that can be applied clinically in a variety of ways.

BKB-SIN Methodology

The BKB-SIN contains 18 List Pairs. Each List Pair consists of two lists of eight to ten sentences each. The first sentence in each list has four key words, and the remaining sentences each have three. A verbal "ready" cue precedes each sentence. The key words in each sentence are scored as correct or incorrect. The sentences are presented at prerecorded signal-to-noise ratios that decrease in 3-dB steps.

Presentation Level

The choice of presentation level depends on the purpose of testing. For standard SNR Loss testing the BKB-SIN Test should be presented at a relatively high level (loud, but below discomfort). Normative data on normal-hearing adults and normal-hearing children were collected using binaural presentation via insert earphones, at a presentation level of 70 dB HL (83 dB SPL). Normative data on adult cochlear implant users were collected using a 65 dB SPL presentation level in sound field (equivalent to 50 dB HL at 0 degrees azimuth).

Test Instructions

Child

"You will hear a man talking to you through the earphones (or loudspeaker). He is going to say "Ready" and then he'll say a sentence. Repeat the sentence the man says. You will hear other talkers in the background. Don't pay any attention to them; just repeat what the man says. The background talkers will get louder, and then it will be hard for you to hear the man's voice. When that happens, it is OK to guess; repeat anything you think you heard the man say."

Adult

"Imagine that you are at a party. There will be a woman talking and several other talkers in the background. The woman's voice is easy to hear at first, because her voice is louder than the others. Repeat each sentence the woman says. The background talkers will gradually become louder, making it difficult to understand the woman's voice, but please guess and repeat as much of each sentence as possible."

Test Procedure

- Select BKB-SIN from the More Tests Menu**.**
- Select the proper transducer and levels for each channel.
- Select the appropriate age from the Navigation Menu
- Using the Word Nav and front panel navigation buttons or an external mouse, select the first sentence.
- Press the present bar or click the first sentence.
- Score the four/three key words highlighted in each sentence by pressing the **CORRECT or INCORRECT** button for each word repeated by the patient.

NOTE: Scoring preference options may be setup as defaults from the Config App.

- The **SNR** Loss score will appear in the SCORE/WORD window.
- Select additional list pairs for testing if necessary
- Interpreting test results for children should be done on a case-by-case basis. For adults the table presented in the QuickSIN section that follows can be used.

QuickSIN

The primary complaint of hearing-impaired persons is difficulty in background noise. The measurement of SNR loss (signal-to-noise ratio loss) is important because speech understanding in noise cannot be reliably predicted from the pure tone audiogram (Killion & Niquette, 2000). For detailed information on the QuickSIN, please see the QuickSIN manual.

QuickSIN Methodology

A list of six (6) sentences with five (5) key words per sentence is presented in four-talker babble noise. The sentences are presented at pre-recorded signal-to-noise ratios which decrease in 5 dB steps from 25 (very easy) to 0 (extremely difficult). The SNR's used are 25, 20, 15, 10, 5, and 0, encompassing normal to severely impaired performance in noise.

Presentation Level

For pure-tone average (PTA) less than or equal to 45 dB HL, set the attenuators in Channel 1 and Channel 2 to 70 dB HL. For PTA of 50 dB HL or greater, set the attenuators to a level that is judged to be "loud, but okay." The sound should be perceived as loud, but not uncomfortably loud.

Test Instructions

"Imagine that you are at a party. There will be a woman talking and several other talkers in the background. The woman's voice is easy to hear at first, because her voice is louder than the others. Repeat each sentence the woman says. The background talkers will gradually become louder, making it difficult to understand the woman's voice, but please guess and repeat as much of each sentence as possible."

Test Procedure

- Select QuickSIN from the More Tests Menu**.**
- Select the proper transducer and levels for each channel.
- Using the Word Nav and front panel navigation buttons or an external mouse, select the first sentence.
- Press the present bar or click the first sentence.
- Score the five key words highlighted in each sentence by pressing the **CORRECT or INCORRECT** button for each word repeated by the patient.

NOTE: Scoring preference options may be setup as defaults from the Config App.

- The **SNR** Loss score will appear in the SCORE/WORD window.
- Select additional lists for testing if necessary
- To interpret the **SNR** loss score see table below.

SNR LOSS	DEGREE OF SNR LOSS	EXPECTED IMPROVEMENT WITH DIRECTIONAL MIC
0-3 dB	Normal / near normal	May hear better than normals hear in noise
3-7 dB	Mild SNR loss	May hear almost as well as normals hear in noise
7-15 dB	Moderate SNR loss	Directional microphones help; consider array mic
>15 dB	Severe SNR loss	Maximum SNR improvement is needed; consider FM system

SISI (Short Increment Sensitivity Index) Test

The SISI test is used to detect small level changes in a steady-state signal in patients with disorders of the cochlea. The SISI tests a patient's ability to detect 1 dB change of level in a pure tone stimulus at 20 dB SL. A SISI consists of 20 target level increments (200 msec at 1, 2, or 5 dB) presented every 5 seconds and can be completed for a number of frequencies. The SISI test is scored in terms of the percentage of correctly identified 1 dB increments out of a possible 20. Scores of higher than 70% indicate cochlear involvement equals Positive SISI. Scores of less than 70% indicate auditory disorders not in the cochlea or normal hearing equals Negative SISI.

Presentation Level

- Increase the attenuator to **20 dB SL.**

Test Instructions

"You will hear a steady tone in your left or right ear. There may be an increase in loudness. Each time you hear the increase in loudness, press the patient response button."

Test Procedure

- Familiarize patient by presenting an easily heard (5 dB) SISI step. To do this, press the presentation bar one time per presentation of the SISI increment.
- Select **dB Step** (1 dB) for the test.
- To begin, press the "**Interrupt**" button to automatically present the level increment change every 5 seconds.
- Observe the patient responses – Record them using the "**correct/incorrect**" counter.
- Press Store to record the SISI score for each frequency. Results are displayed on the results table.

Tone Decay Test

Carhart Tone Decay Test (1957)

Patients with retrocochlear pathology of the eighth nerve exhibit a rapid "abnormal auditory adaption" or "temporary threshold drift" in response to a continuous pure tone presentation.

Presentation Level

- Establish the patient's hearing threshold for the test ear using earphones or insert phones using a pulsed tone.
- Set the level for the selected channel to 0 dB SL (or 20 dB SL to present an easier listening task). The Interrupt pushbutton may be selected or the Tone bar may be manually depressed for the duration of the test.

Test Instructions

- Instruct the patient to depress the hand switch as soon as a tone is heard, and to release the hand switch only when the tone becomes inaudible.

Test Procedure

- Select Tone Decay from the More Tests Menu.
- Present the continuous tone at the selected level.
- When the patient responds by pressing the patient response button, the timer will start. The timer may be manually started by pressing the Start pushbutton of the scorer/timer.
- When the patient releases the patient response button, the timer will pause. If the patient pushes the response button again, the timer will resume.
- Record the number of seconds the tone sustains audibility.
- If the tone becomes inaudible before the minute criteria is met, without interrupting the tone presentation, raise the level in 5 dB steps until the tone is heard for a full minute.
- Reset the time at each increase in level. Continue this procedure until the tone is heard for a full minute, or until a level of 40 dB SL is reached.

TEN Test

Purpose of the TEN Test is to identify cochlear dead regions. This is useful for several purposes including the following:

- Counseling about the benefit of hearing aids.
- Assisting in hearing aid selection or cochlear implant candidacy.
- Fitting hearing aids appropriately.

The accepted rule is that a dead region is present when the TEN-masked threshold is at least 10 dB above the absolute threshold.

- Select TEN from the Test Type menu in the Tone Test
- Channel 1 and Channel 2 will be routed to the same ear (default is the Right ear).

- Channel 1 stimulus will be tone.
- Channel 2 stimulus will be TEN Noise.
- The step size will default to 2 dB.
- To perform the test, use the following guide.
- To Exit the Ten Test press the Tone Test Type button

Presentation Level

- If the hearing loss is 60 dB or less, start the TEN noise level at 70 dB.
- If the hearing loss is 70 dB or greater, start the TEN level 10 dB higher than the threshold.
- If the TEN is reported to be too loud, start the TEN level at the same level as the threshold.

Test Instructions

When the starting level has been determined, instruct the patient in the same manner as when measuring pure tone thresholds with masking.

Test Procedure

The procedure for determining thresholds in the TEN is identical to the manual pure tone audiometry except that a 2 dB final step size should be used for maximum accuracy. The TEN will take approximately 4 minutes per ear (to complete all test frequencies).

NOTE: The available test frequencies are 500 to 4,000 Hz.

Press the Store button to store the TEN threshold and advance to the next frequency or ear.

NOTE: The TEN threshold symbol will be the word “TEN.”

Chapter 7: Application Software & Integration

The AudioStar Pro uses configuration application software to define the instrument and test settings defaults. These settings are downloaded from the application software on the PC to the AudioStar Pro. It is recommended that a copy of the custom configuration is saved as a back-up. This will allow the custom configuration to be loaded quickly onto multiple AudioStar Pros. A separate manual describes in detail the AudioStar Pro Config App program.

Config App

Installing the Configuration Software

NOTE: Administrator or Power User Rights on the computer are required to load the software.

NOTE: Close all other applications before attempting to up/download from the AudioStar Pro Config. App.

NOTE: The AudioStar Pro must be powered down and restarted after downloading Config. App. changes in order for them to take effect.

Insert the CD into the computer and ensure the computer is connected to the AudioStar Pro via USB cable. The AudioStar Pro should be powered on. Follow the on-screen installation prompts to load the configuration application to the computer.

The AudioStar Pro Config App will be listed in the Windows start menu.

Customizing the Configuration

The configuration application is separated into two sections. The first section, Instrument, determines global settings of the instrument. The second section, Audiometry, determines default settings for audiometric evaluations. Each section will be described briefly in the following section. For a more detailed explanation of the configuration application, review the AudioStar Pro Config App User Manual.

Menu

Download: Download default settings from the Configuration application to the AudioStar Pro (always restart the AudioStar Pro after download).

Upload: Upload current settings from an AudioStar Pro audiometer to the Configuration application on a connected computer.

New: Creates a new configuration file and sets the Config App to the factory defaults.

Revert: Ignores any changes and returns the settings to the configuration that was loaded.

Load: Allows the operator to select a specific protocol from a list of saved configurations. This may include back-up configurations or site-specific configurations.

Save: Saves selections and settings from the configuration application to a specific location. This saved configuration may be downloaded at a different time or to multiple AudioStar Pro audiometers.

Instrument

Setup

Facility Date and Time, regional settings (language), AUX intercom, patient response button and 4-speaker settings may be configured in general settings.

Facility

Facility name, address and logo as well as report view may be configured in this section.

Printing

The printer options including protocol, color and page size are customizable items. Speech print mode is also configurable.

Security

A list of examiner names and examiner passwords may be entered in the Security section of the Config App software. Examiner Passwords are user defined and may contain any combination of lower or upper case letters and numbers.

Audiometry

General

The default start-up test mode, audiogram orientation, channel routing/level/transducer, and bone conduction preferences (mastoid or forehead) may be customized in this section. The reliability labels, routing behavior and the frequencies used for PTA calculations may also be customized.

Tone

Pure Tone Channel 1 and Channel 2 stimulus defaults, audiometric display, starting frequency and step size are defined in this section. It is also possible to assign signal format, masking behavior and Auto Hz Advance behavior.

Speech

Allows the user to select the default Speech display screen, filter settings, stimulus settings, and automatic speech functionality. The default speech test type and dB step size may also be defined. Additionally, configure the Auto advance, Auto Advance Wordlist and Auto play settings and scoring methods for the BKB-SIN and QuickSIN tests.

Word Lists

When uploaded from the AudioStar Pro, this window displays the existing word lists that are stored on the device. External CD names may be added. Word lists may be deleted from the instrument and favorites for the word lists are defined in this tab.

Norm Values

The GSI factory does not include sample norm values to be used on the Speech Audiogram screen. Each facility should enter its own values, if desired.

If Display on the AudioStar Pro box is checked, the normative curves will appear on the Speech Audiogram screen based on the transducer being used.

GSI Instrument Services

Description

The GSI Instrument Services allows electronic transmission of test parameter information from the AudioStar Pro to an external computer with a single push of the Data Transfer button. See the GSI Instrument Services user manual for detail on how to utilize its functionality.

Operation

Data capture occurs when the Store pushbutton is pressed. When there are test results, comments or patient demographics saved in the AudioStar Pro, data may be electronically transferred to a software solution on an external computer using the Data Transfer button.

Public Interface (Direct)

The Public Interface option, provided through GSI Instrument Service, transfers the audiometric data from the AudioStar Pro in an XML format which may be directly incorporated into an Electronic Medical Record. The GSI Suite utilizes this format. Alternatively, independent software programming engineers may implement the XML schema provided by GSI into their proprietary software in order to manage patient data directly. The direct transfer of data gives the physician immediate access to the audiometric data in the electronic record. More information may be found on the Software and Manuals USB flash drive in the Instrument Services folder that was included in the original shipment of the AudioStar Pro or contact your GSI representative.

GSI Suite

GSI Suite Audiometric Data Management software (Rev. 2.0 and higher) is compatible with the GSI AudioStar Pro as well as legacy products. GSI Suite imports, saves, and stores audiometric data from the AudioStar Pro and allows the addition of comments into a report. The report data is saved in a PDF or other format that may be saved to the local PC, a remote location or attached with

electronic medical data records (EMR). GSI Suite may be used as a stand-alone software solution or in combination with Noah 4 or OtoAccess.

OtoAccess™

OtoAccess is a SQL database that is used to network multiple audiometric systems, creating one master database. The robust database provides security and detailed patient search function for intuitive patient review. When combined, GSI Suite and OtoAccess increase the efficiency of the contemporary audiology practice.

Noah 4

GSI Suite may be installed in Noah 4 as a measurement module providing seamless integration between the audiometric evaluation and the hearing instrument fitting. Noah 4 may be installed as standalone software or on a network. Data transfer and storage utilizes the Noah database for data management.

AudBase

AudBase software saves audiometric data from the AudioStar Pro and other legacy GSI products into multiple report formats (single page, tabular and graphic, as well as sequential test results and custom options). Multiple data formats – PDF, TIF, GIF, JPEG, etc. – are available for compatibility with EMR/EHR systems. Patient data is maintained via a 4D database.

NOTE: It may be necessary to also install GSI Instrument Services.

Chapter 8: Routine Maintenance

Biological Calibration Check

The design of the GSI AudioStar Pro audiometer should provide trouble-free service for a long time period. It is recommended to routinely record and file the audiogram of one person for the purpose of biologic calibration. This person (or group of persons) should have a known stable audiometric curve that does not exceed 25 dB HL at any frequency. This procedure should start when the GSI AudioStar Pro is first installed and then be continued. Remember that individual thresholds can shift by as much as 5 dB from day to day; however, variations that exceed this range may point to difficulties which require attention.

Periodic Checks

The routine maintenance checks described below may point to the source of some instrument problems. If they do not, the instrument should receive technical service before further use. The checks should be made at periodic intervals, even if biologic checks reveal no problems.

Earphone and Bone Vibrator Cords

With extended use, all transducer cords tend to fray internally at the connectors. To evaluate the cord status, turn on the GSI AudioStar Pro. Set the HL to a comfortably audible level. Place the transducer on your head. Activate both Interrupt buttons. Bend the cord next to the plug at both ends of each earphone. Listen for an intermittent signal, abrupt changes in the signal level, or a scratchy sound that coincides with the flexing of the cord. The presence of any of these conditions signifies that the cord should be replaced. Repeat this check for all transducers.

Hum and Noise

Set the GSI AudioStar Pro to Tone test type with the standard earphones selected and the Channel 1 Interrupt button in the ON mode. Turn the Channel 1 Hearing Level control from 0 to 60 dB HL. Listen for low frequency hum (60 or 120 Hz) and any other noise (hiss or low rushing sound) at all attenuator levels through the earphone. Some audible noise at levels above 70 dB is permissible. If these noises are detected below 70 dB, the audiometer should be scheduled for maintenance. Repeat for Channel 2.

Distortion and Frequency Shift

Check for distortion and frequency shift by listening to the GSI AudioStar Pro's output through the earphones at each frequency (in the 125 Hz to 12,000 Hz range) at a loud, but not uncomfortable level (70 to 80 dB HL for normal ears). Listen also to ensure that the signal frequencies change appropriately when the Frequency up arrow (>) and down arrow (<) pushbuttons are operated. If distortion is heard in one earphone but not the other, the chances are high that the earphones are at

fault and should be replaced. In any case, the audiometer should be scheduled for immediate maintenance.

Speech Level Check

To check the speech level with recorded speech, select the Speech test type button. Place the earphones on a person with normal hearing and present a word list at 40 dB. If intelligible speech is not heard, with the Channel 1 Hearing Level control set at 40 dB or less, the audiometer should be scheduled for technical service.

Internal Controls Check

Should the front panel controls lock into one state and it is not possible to change any of the parameters, turn off the power. Wait one minute and then power on.

Bone Vibrator Check

This check must be performed in a quiet environment or in a sound room. With the frequency set to 2,000 Hz, the Channel 1 level set at 40 dB HL and the bone vibrator positioned properly, the tone should be clearly audible to a person with normal hearing – less than 25 dB. When a bone vibrator fails this test, the calibration should be verified.

Masking Level Check

Select the Tone test type. Ensure the stimulus is narrow band noise on Channel 2. Activate the Channel 2 Interrupt button and listen for a smooth, even hiss.

Talk Forward Check

Speech should be clearly audible (in the earphones) when spoken in a normal tone with the Talk Forward dB HL control set at 45 dB HL.

Cleaning the System

Turn **OFF** the system and disconnect power before cleaning the instrument. Use a soft cloth lightly dampened with cleaning solution to clean all exposed surfaces. Take care to not allow liquid to come in contact with the metal parts inside the transducers (e.g., earphones / headphone). Do not permit solutions or disinfecting agents to seep into the electronic portions of the system. Take special care around controls, connectors and panel edges. Remove any dust from the exterior of the system with a soft brush or cloth. Use a brush to dislodge any dirt on or around the connectors and panel edges. Remove stubborn dirt with a soft cloth slightly dampened with mild detergent and water. Wipe surfaces dry afterward. Do not use instrument or transducers until they are completely dry.

Cleaning and Disinfecting Agents

According to the recommendations from the CDC, audiometric equipment is considered to be non-critical medical equipment and typically requires cleansing followed by low to intermediate level disinfecting, depending on the nature of the contamination. Cleaning should be done with a mild soapy detergent (such as dishwashing liquid) and a damp cloth or an Endozime Sponge followed by an application of EPA-registered hospital disinfectant. Do not use any abrasive cleaners.

Use of a non-alcohol based disinfectant is recommended for larger areas and headphones. Non-alcohol based products contain the active ingredient referred to as quaternary ammonia compound or hydrogen peroxide based cleaner such as Oxivir Disinfectant Wipes to clean the ear cushions, headset, and to wipe down the machine. The quaternary ammonia compound and hydrogen peroxide are specifically designed to disinfect rubber, plastic, silicone and acrylic products which are commonly used in hearing evaluation instruments.

Status/Error Messages

Please try another selection: Indicates an incorrect selection. This could include actions such as incompatible transducers, incompatible routing, or no calibration data stored for the selected transducers.

No test data stored: Indicates that there is no test data available to be erased, printed or transferred.

Printer communication error: If communications problems occur during the course of printing, this error message will be displayed.

Error: If there are general system errors, a dialog box with "Error" in the title will be shown with the given error.

Record test result in comments: Test results of the ABLB and Tone Decay are not recorded directly on the report. This message indicates that the results should be documented in the comments.

The startup configuration for this test type is not fully calibrated; a search for a different configuration that is calibrated has found the currently displayed configuration: This message indicates that the selected transducers have not been calibrated.

Not supported in speech: The selected action is not supported in the speech test type.

Appendix 1: Specifications

Dimensions and Weight	W x D x H:	20.1 inches x 14.6 inches x 13.2 inches (LCD raised) 51.0 cm x 37.0 cm x 33.5 cm	
	Height with LCD lowered:	5.5 inches	14.0 cm
	Weight:	17 pounds	7.7 kg
	Shipping Weight:	27 pounds	12.25 kg
Power Specifications	Power Consumption:	90 Watts	
	Voltage & Amperage:	100 Vac 1.0 A and 240 Vac 0.6 A	
	Frequency:	50 Hz and 60 Hz	
Channels	Two independent Channels		
Pure Tone - Channel 1 and Channel 2	**Frequency Range**		
	Standard Air Conduction:	125 Hz to 8,000 Hz	
	High Frequency:*	8,000 Hz to 20,000 Hz (8 kHz, 9 kHz, 10 kHz, 11.2 kHz, 12.5 kHz, 14 kHz, 16 kHz, 18 kHz and 20 kHz)	
	Full Frequency Range:*	125 Hz to 20,000 Hz	
	Bone Conduction:	250 Hz to 8,000 Hz	
	Sound Field:*	125 Hz to 8000 Hz	
	Paired Inserts:	125 Hz to 8,000 Hz	
	Frequency Accuracy:	± 1 %	
	Total Harmonic Distortion:	< 2% (earphones and paired insert phones*) < 5.5% (B81)	
	Level Range **		
	Air Conduction:	-10 dB HL to 120 dB HL (DD45)	
	High Frequency:*	-20 dB HL to 100 dB HL (RadioEar DD450)	
	Bone Conduction B81	-10 dB HL to 90 dB HL (mastoid) -10 dB HL to 80 dB HL (forehead)	
	Sound Field:*	-10 dB HL to 90 dB HL (basic speakers) -10 dB HL to 96 dB HL (high performance speakers) -10 dB HL to 102 dB HL (high performance speakers and external booster amplifier)	
	Paired Inserts:	-10 dB HL to 120 dB HL	
	Masking Level Range (Calibrated in effective masking)		
	Narrow Band Noise:	Maximum dB HL is 15 dB below tone	
	Signal Format		
	Steady:	Tone continuously present.	
	Pulsed:	Tone pulsed 200 msec ON, 200 msec OFF.	
	FM:	Modulation Rate: 5 Hz Modulation depth +/- 5%	
	Pediatric Noise	Continuously presented or pulsed	
Speech - Channel 1 and Channel 2	Microphone:	For live voice testing and communications. Microphone must be used as specified/recommended by the manufacturer (Sennheiser).	
	INT/EXT A & INT/EXT B:	Can be utilized for internal wave files or recorded speech material from an external digital device	
	Level Range:		
	Air Conduction:	-10 dB HL to 100 dB HL (DD45 Linear)	
Speech - Channel 1 and Channel 2	Bone Conduction (B81):	-10 dB HL to 60 dB HL (mastoid) -10 dB HL to 50 dB HL (forehead)	

	Sound Field:*	-10 dB HL to 90 dB HL (basic speakers)
	Paired Inserts:	-10 dB HL to 95 dB HL
	Masking Level Range	
	Narrowband Noise (calibrated in effective masking)	
	Maximum dB HL is 15 dB below tone.	
	Speech Noise:	
	Air Conduction	-10 dB HL to 95 dB HL (DD45)
	Bone Conduction	-10 dB HL to 50 dB HL (mastoid B81)
		-10 dB HL to 40 dB HL (forehead B81)
	Sound Field:	-10 dB HL to 85 dB HL
	White Noise:	
	Air Conduction	-10 dB HL to 95 dB HL (DD45)
	Bone Conduction	-10 dB HL to 60 dB HL (mastoid B81)
		-10 dB HL to 50 dB HL (forehead B81)
	Sound Field	-10 dB HL to 80 dB HL
	Frequency Range	
	Narrowband Noise	3 dB down bandwidth, 1/3 octave minimum; ½ octave maximum of test signal
	Speech Noise	Equal energy per frequency 100 to 1,000 Hz with a 12 dB/octave roll-off from 1,000 to 6,000 Hz
	White Noise	125 Hz and 12,000 Hz with constant bandwidth
Input Specifications	Ext. CD	7mVrms at max. gain for 0dB reading; input impedance 47kOhm
	Talk Forward	100uVrms at max. gain for 0dB reading; input impedance 3.2kOhm
Output Specifications	Headphones	7Vrms at 10 Ohm load; 60-20,000Hz -3dB
	Insert Phones	7Vrms at 10 Ohm load; 60-20,000Hz -3dB
	Bone	7Vrms at 10 Ohm load; 60-10,000Hz -3dB
	Sound Field	7Vrms at min. 2kOhm load; 60-20,000 kHz -3dB
	Monitor	2x 3Vrms at 32 Ohm/1.5Vrms at 8 Ohm load; 60-20,000Hz -3dB
Free Field	Power Amplifier and Speakers-With an input of 7 Vrms-Amplifier and loudspeakers must be able to create a sound pressure level of 100 dB at a distance of 1 meter and meet the following requirements:	
	Frequency Response	125-250Hz, +0/-10 250-4000Hz ±3 dB 4000-6300Hz ±5 dB
	Total Harmonic Distortion	80 dB SPL <3% 100 dB SPL <10%
Special Tests	ALT (ABLB):	Tone alternating between Channel 1 and Channel 2: Channel 1 is 400 msec ON, 400 msec OFF followed by Channel 2, 400 msec ON, 400 msec OFF.
	SISI:	A level increment is added to a tone in the selected channel for 200 msec, every 5 seconds. The HL increments are in 1, 2 or 5 dB.
	High Frequency:*	Pure tone testing in the frequency range of 8,000 Hz to 20,000 Hz using circum-aural headphones.
	TEN:	TEN masking noise will be presented to the test ear. Pure tone stimuli between 500 and 4000 Hz may be used at 1, 2, or 5 dB increments to obtain TEN thresholds.
	QuickSIN:	Six (6) sentences with five (5) key words per sentence are presented in four-talker babble noise. The sentences are presented at pre-recorded signal-to-noise ratios. The SNR's used are 25, 20, 15, 10, 5, and 0.
	BKB-SIN:	18 List Pairs. The sentences are presented at prerecorded signal-to-noise ratios that decrease in 3-dB steps. Each list in the pair is individually scored, and the results of the two lists are averages to

		obtain the List Pair score. Results are compared to normative data to obtain the SNR Loss.
Special Tests (User Defined)	MLB Lombard test Pure Tone Stenger Speech Stenger SAL	
Communications and Monitoring	Talk Forward:	Permits the tester to speak through the test microphone into the selected transducer at approximately the level set by the front panel controls.
	Talk Back:	Allows the tester to listen to comments from the patient in the testing booth.
	Monitor:	The monitor headset or monitor speaker built into the instrument housing can be used by the tester to listen to Channel 1, Channel 2, Aux intercom, and/or Talk Back signals.
	Aux Intercom:	The built-in Auxiliary Intercom and Assistant headset allows the tester to speak directly to an Assistant without the patient hearing the conversation and allows the assistant to hear what is being presented to the patient.
Environmental Requirements	Temperature:	+15ºC to 40ºC (59 to 104ºF)
	Relative Humidity:	10% to 95% (non-condensing)
	Ambient Pressure Range:	98 kPa to 104 kPa
	Background Sound Level:	<35 dB(A)
	Storage Temperature:	0ºC to + 50ºC (32ºF to 122ºF)
	Transport Temperature:	-20ºC to + 50ºC (-4ºF to 122ºF)
Quality System	Manufactured, designed, developed and marketed under ISO 13485 certified quality systems	
Compliance/Regulatory Standards	Designed, tested and manufactured to meet the following domestic (USA), Canadian, European and International Standards: ANSI S3.6, IEC 60645-1, IEC 60645-2, ISO 389 ES 60601-1 American Standards for Medical Electrical Equipment IEC/EN 60601-1 International Standards for Medical Electrical Equipment CSA C22.2 # 601-1-M90 Medical Device Directive (MDD) to comply with EC Directive 93/42/EEC	

NOTES: * *Optional configuration*
** *The maximum HL values are applicable to the middle frequencies only*

Audiometric Standards

The AudioStar Pro is designed to meet or exceed the following standards:

Audiometer Standard Requirements - Type 1

1. ANSI S3.6 (2018) Specification for Audiometers (Type 1)
2. IEC 60645-1 (2017) Electroacoustics - Audiological Equipment - Pure-Tone Audiometers Type 1
3. IEC 60645-2 (2017) Electroacoustics - Audiological Equipment - Equipment for Speech Audiometry
4. ISO 389-1 Reference Equivalent Threshold SPLS for Pure Tones and Supra-Aural Earphones
5. ISO 389-2 Reference Equivalent Threshold SPLS for Pure Tones and Insert Earphones
6. ISO 389-3 Reference Equivalent Threshold Force Levels for Pure Tones and Bone Vibrator
7. ISO 389-4 Reference Levels for Narrow-Band Masking Noise
8. ISO 389-5 Reference Equivalent Threshold SPLS for Pure Tones in the Frequency Range 8 kHz to 16 kHz
9. ISO 389-7 Reference zero for the calibration of audiometric equipment
10. ISO 389-8 Reference zero for the calibration of audiometric equipment

Appendix 2: Calibration Reference & Maximum Levels

The AudioStar Pro is supplied from the factory calibrated for the transducers that were purchased with it. The exception is the speakers, as those must be calibrated in the environment where they will be used. The calibration data supplied from the factory is only valid for GSI supplied transducers and cannot be applied to non-GSI supplied transducers.

It is recommended that calibration of the instrument and transducers be performed annually by authorized GSI Representatives using appropriate calibration instrumentation. If periodic checks are also desired, the tables in this section provide the SPL values per frequency for each transducer. If the measured values are not within ± 5 dB at 125, 6,000, and 8,000 Hz in the earphones, the GSI AudioStar Pro should be scheduled for immediate maintenance.

It is not possible to select a dB HL value outside the limits for a particular transducer/ frequency combination. An attempt to change or select a hearing level control that is outside of the limit will cause the dB HL display to flash momentarily and then the test channel value will be replaced with NR (No Response). If an audiogram is displayed and the limits for a frequency/transducer are reached, the symbol for no response is displayed in the audiogram.

It is not possible to select a test frequency that is invalid for a particular transducer.

The hearing levels listed in the Max HL tables are maximum levels. These levels are achievable only if ANSI, ISO or GSI reference threshold levels, and not customized calibration values, are used. At no time will the hearing level limit exceed 120 dB HL.

Earphones - Pure Tone RETSPL

Transducer	DD45	DD45	TDH50	TDH50	HDA200/DD450
Impedance	10 Ω	10 Ω	60 Ω	60 Ω	23 Ω
Coupler	318-3	318-1	318-3	318-1	318-1
	RETSPL	RETSPL	RETSPL	RETSPL	RETSPL
125 Hz	47.5	45	47.5	45	30.5
160 Hz	40.5	38.5	40	38.5	26
200 Hz	33.5	32.5	33.5	32.5	22
250 Hz	27	27	26.5	27	18
315 Hz	22.5	22	22	22	15.5
400 Hz	17.5	17	17.5	17	13.5
500 Hz	13	13.5	13.5	13.5	11
630 Hz	9	10.5	10.5	10.5	8
750 Hz	6.5	9	8.5	9	6
800 Hz	6.5	8.5	8.5	8.5	6
1000 Hz	6	7.5	7.5	7.5	5.5
1250 Hz	7	7.5	7.5	7.5	6
1500 Hz	8	7.5	7.5	7.5	5.5
1600 Hz	8	8	8.5	8	5.5
2000 Hz	8	9	11	9	4.5
2500 Hz	8	10.5	10	10.5	3
3000 Hz	8	11.5	9.5	11.5	2.5
3150 Hz	8	11.5	9.5	11.5	4
4000 Hz	9	12	10.5	12	9.5
5000 Hz	13	11	12	11	14
6000 Hz	20.5	16	13.5	16	17
6300 Hz	19	21	13.5	21	17.5
8000 Hz	12	15.5	13	15.5	17.5
9000 Hz					19
10000 Hz					22
11200 Hz					23
12000 Hz			17.5	11	0
12500 Hz					27.5
14000 Hz					35
16000 Hz					56
18000 Hz					83
20000 Hz					105

- DD45 6ccm uses IEC60318-3 or NBS 9A coupler and RETSPL comes from PTB – DTU report 2009-2010. Force 4.5N ±0.5N
- DD45 Artificial ear uses IEC60318-1 coupler and RETSPL comes from ANSI S3.6 2018 and ISO 389-1 1998. Force 4.5N ±0.5N
- TDH50 6ccm uses IEC60318-3 or NBS 9A coupler and RETSPL comes from ANSI S3.6 2018. Force 4.5N ±0.5N
- TDH50 Artificial ear uses IEC60318-1 coupler and RETSPL comes from ANSI S3.6 2018 and ISO 389-1 1998 Force 4.5N ±0.5N
- HDA200 Artificial ear uses IEC60318-1 coupler with type 1 adaptor and RETSPL comes from ANSI S3.6 2018 and ISO 389-8 2004. Force 9N ±0.5N

Earphones - ANSI Speech RETSPL

Transducer	DD45	DD45	TDH50	TDH50	HDA200/DD450
Impedance	10 Ω	10 Ω	60 Ω	60 Ω	23 Ω
Coupler	318-3	318-1	318-3	318-1	318-1
	RETSPL	RETSPL	RETSPL	RETSPL	RETSPL
Speech	18.5	20	20	20	19
Speech Equ.FF.	18.5	19.5	17	18	18.5
Speech Non-linear	6	7.5	7.5	7.5	5.5
Speech noise	18.5	20	20	20	19
Speech noise Equ.FF.	18.5	19.5	17	18	18.5
Speech noise Non-linear	6	7.5	7.5	7.5	5.5
White noise in speech	21	22.5	22.5	22.5	21.5

- DD45 (G_F-G_C) PTB-DTU report 2009-2010.
- TDH50 (G_F-G_C) ANSI S3.6 2018.
- HDA200 (G_F-G_C) ANSI S3.6 2018 and ISO 389-8 2004.
- ANSI Speech level 12.5 dB + 1 kHz RETSPL ANSI S3.6 2018 (acoustical linear weighting)
- ANSI Speech Equivalent free field level 12.5 dB + 1 kHz RETSPL – (G_F-G_C) from ANSI S3.6 2018(acoustical equivalent sensitivity weighting)
- ANSI Speech Not linear level 1 kHz RETSPL ANSI S3.6 2018 (DD45-TDH50-HDA200) and IP30-B81 12.5 dB + 1 kHz RETSPL ANSI S3.6 2018 (no weighting)

Earphones - IEC Speech RETSPL

Transducer	DD45	DD45	TDH50	TDH50	HDA200/DD450
Impedance	10 Ω	10 Ω	60 Ω	60 Ω	23 Ω
Coupler	318-3	318-1	318-3	318-1	318-1
	RETSPL	RETSPL	RETSPL	RETSPL	RETSPL
Speech	20	20	20	20	20
Speech Equ.FF.	3.5	4.5	2	3	3.5
Speech Non-linear	6	7.5	7.5	7.5	5.5
Speech noise	20	20	20	20	20
Speech noise Equ.FF.	3.5	4.5	2	3	3.5
Speech noise Non-linear	6	7.5	7.5	7.5	5.5
White noise in speech	22.5	22.5	22.5	22.5	22.5

- DD45 (G_F-G_C) PTB-DTU report 2009-2010.
- TDH50 (G_F-G_C) ANSI S3.6 2018.
- HDA200 (G_F-G_C) ANSI S3.6 2018 and ISO 389-8 2004.
- IEC Speech level IEC60645-2 2017 (acoustical linear weighting)
- IEC Speech Equivalent free field level (G_F-G_C) from IEC60645-2 2017 (acoustical equivalent sensitivity weighting)
- IEC Speech Not linear level 1 kHz RETSPL (DD45-TDH50-HDA200) and IP30 - B81 IEC60645-2 2017 (no weighting)

Earphones - Pure Tone max HL

Transducer	DD45	DD45	TDH50	TDH50	HDA200/DD450
Impedance	10 Ω	10 Ω	60 Ω	60 Ω	23 Ω
Coupler	318-3	318-1	318-3	318-1	318-1
Signal	Max HL	Max HL	Max HL	Max HL	Max HL
Tone 125 Hz	90	90	85	85	100
Tone 160 Hz	95	95	90	90	105
Tone 200 Hz	100	100	95	95	105
Tone 250 Hz	110	110	105	105	110
Tone 315 Hz	115	115	110	110	115
Tone 400 Hz	120	120	115	115	115
Tone 500 Hz	120	120	120	120	115
Tone 630 Hz	120	120	120	120	120
Tone 750 Hz	120	120	120	120	120
Tone 800 Hz	120	120	120	120	120
Tone 1000 Hz	120	120	120	120	120
Tone 1250 Hz	120	120	120	120	110
Tone 1500 Hz	120	120	120	120	115
Tone 1600 Hz	120	120	120	120	115
Tone 2000 Hz	120	120	120	120	115
Tone 2500 Hz	120	120	120	120	115
Tone 3000 Hz	120	120	120	120	115
Tone 3150 Hz	120	120	120	120	115
Tone 4000 Hz	120	120	120	120	115
Tone 5000 Hz	120	120	115	115	105
Tone 6000 Hz	115	115	115	110	105
Tone 6300 Hz	115	110	110	105	105
Tone 8000 Hz	110	110	100	100	105
Tone 9000 Hz					100
Tone 10000 Hz					100
Tone 11200 Hz					95
Tone 12000 Hz			90	90	
Tone 12500 Hz					90
Tone 14000 Hz					80
Tone 16000 Hz					60
Tone 18000 Hz					30
Tone 20000 Hz					15

Earphones - NB noise effective masking level

Transducer	DD45	DD45	TDH50	TDH50	HDA200/DD450
Impedance	10 Ω	10 Ω	60 Ω	60 Ω	23 Ω
Coupler	318-3	318-1	318-3	318-1	318-1
	EM	EM	EM	EM	EM
NB 125 Hz	51.5	49	51.5	49	34.5
NB 160 Hz	44.5	42.5	44	42.5	30
NB 200 Hz	37.5	36.5	37.5	36.5	26
NB 250 Hz	31	31	30.5	31	22
NB 315 Hz	26.5	26	26	26	19.5
NB 400 Hz	21.5	21	21.5	21	17.5
NB 500 Hz	17	17.5	17.5	17.5	15
NB 630 Hz	14	15.5	15.5	15.5	13
NB 750 Hz	11.5	14	13.5	14	11
NB 800 Hz	11.5	13.5	13.5	13.5	11
NB 1000 Hz	12	13.5	13.5	13.5	11.5
NB 1250 Hz	13	13.5	13.5	13.5	12
NB 1500 Hz	14	13.5	13.5	13.5	11.5
NB 1600 Hz	14	14	14.5	14	11.5
NB 2000 Hz	14	15	17	15	10.5
NB 2500 Hz	14	16.5	16	16.5	9
NB 3000 Hz	14	17.5	15.5	17.5	8.5
NB 3150 Hz	14	17.5	15.5	17.5	10
NB 4000 Hz	14	17	15.5	17	14.5
NB 5000 Hz	18	16	17	16	19
NB 6000 Hz	25.5	21	18.5	21	22
NB 6300 Hz	24	26	18.5	26	22.5
NB 8000 Hz	17	20.5	18	20.5	22.5
NB 9000 Hz					24
NB 10000 Hz					27
NB 11200 Hz					28
NB 12000 Hz			22.5	16	
NB 12500 Hz					32.5
NB 14000 Hz					40
NB 16000 Hz					61
NB 18000 Hz					88
NB 20000 Hz					110
White noise	0	0	0	0	0
TEN noise	25	25	24.5	24.5	31.5

Earphones - NB noise max HL

Transducer	DD45	DD45	TDH50	TDH50	HDA200/DD450
Impedance	10 Ω	10 Ω	60 Ω	60 Ω	23 Ω
Coupler	318-3	318-1	318-3	318-1	318-1
	Max HL	Max HL	Max HL	Max HL	Max HL
NB 125 Hz	75	75	65	65	75
NB 160 Hz	80	80	70	70	80
NB 200 Hz	90	90	80	80	80
NB 250 Hz	95	95	85	85	85
NB 315 Hz	100	100	90	90	90
NB 400 Hz	105	105	95	95	95
NB 500 Hz	110	110	100	100	95
NB 630 Hz	110	110	100	100	95
NB 750 Hz	110	110	105	105	100
NB 800 Hz	110	110	105	105	100
NB 1000 Hz	110	110	105	105	100
NB 1250 Hz	110	110	105	105	95
NB 1500 Hz	110	110	105	105	100
NB 1600 Hz	110	110	105	105	100
NB 2000 Hz	110	110	100	100	100
NB 2500 Hz	110	110	100	100	100
NB 3000 Hz	110	110	100	100	100
NB 3150 Hz	110	110	100	100	100
NB 4000 Hz	110	110	100	100	100
NB 5000 Hz	110	110	100	100	95
NB 6000 Hz	105	105	95	95	90
NB 6300 Hz	105	100	95	90	90
NB 8000 Hz	100	100	90	85	90
NB 9000 Hz					85
NB 10000 Hz					85
NB 11200 Hz					80
NB 12000 Hz			75	75	
NB 12500 Hz					75
NB 14000 Hz					70
NB 16000 Hz					50
NB 18000 Hz					20
NB 20000 Hz					0
White noise	120	120	120	120	115
TEN noise	110	110	100	100	121

Earphones - ANSI Speech max HL

Transducer	DD45	DD45	TDH50	TDH50	HDA200/DD450
Impedance	10 Ω	10 Ω	60 Ω	60 Ω	23 Ω
Coupler	318-3	318-1	318-3	318-1	318-1
	Max HL	Max HL	Max HL	Max HL	Max HL
Speech	110	105	100	100	90
Speech Equ.FF.	100	100	90	90	85
Speech Non-linear	120	120	115	115	110
Speech noise	100	100	95	90	85
Speech noise Equ.FF.	100	95	85	85	80
Speech noise Non-linear	115	115	110	110	105
White noise in speech	95	95	95	95	90

Earphones - IEC Speech max HL

Transducer	DD45	DD45	TDH50	TDH50	HDA200/DD450
Impedance	10 Ω	10 Ω	60 Ω	60 Ω	23 Ω
Coupler	318-3	318-1	318-3	318-1	318-1
	Max HL	Max HL	Max HL	Max HL	Max HL
Speech	110	105	100	100	90
Speech Equ.FF.	115	115	105	105	100
Speech Non-linear	120	120	115	115	110
Speech noise	100	100	95	90	85
Speech noise Equ.FF.	115	110	100	100	95
Speech noise Non-linear	115	115	110	110	105
White noise in speech	95	95	95	95	90

Insert Earphones - Pure Tone RETSPL

Transducer	IP30	IP30
Impedance	10 Ω	10 Ω
Coupler	2ccm	711
	RETSPL	RETSPL
125 Hz	26	28
160 Hz	22	24.5
200 Hz	18	21.5
250 Hz	14	17.5
315 Hz	12	15.5
400 Hz	9	13
500 Hz	5.5	9.5
630 Hz	4	7.5
750 Hz	2	6
800 Hz	1.5	5.5
1000 Hz	0	5.5
1250 Hz	2	8.5
1500 Hz	2	9.5
1600 Hz	2	9.5
2000 Hz	3	11.5
2500 Hz	5	13.5
3000 Hz	3.5	13
3150 Hz	4	13
4000 Hz	5.5	15
5000 Hz	5	18.5
6000 Hz	2	16
6300 Hz	2	16
8000 Hz	0	15.5
9000 Hz		
10000 Hz		
11200 Hz		
12000 Hz		
12500 Hz		
14000 Hz		
16000 Hz		
18000 Hz		
20000 Hz		

- IP30 2ccm uses ANSI S3.7-1995 IEC60318-5 coupler (HA-2 with 5mm rigid Tube) and RETSPL comes from ANSI S3.6 2018 and ISO 389-2 1994
- IP30 Ear simulator uses ANSI S3.25- IEC60318-4 coupler and RETSPL comes from ANSI S3.6 2018 and ISO 389-2 1994

Insert Earphones - ANSI Speech RETSPL

Transducer	IP30	IP30
Impedance	10 Ω / 50 Ω	10 Ω / 50 Ω
Coupler	2ccm	711
	RETSPL	RETSPL
Speech		
Speech Equ.FF.		
Speech Non-linear	12.5	18
Speech noise		
Speech noise Equ.FF.		
Speech noise Non-linear	12.5	18
White noise in speech	15	20.5

- ANSI Speech level 12.5 dB + 1 kHz RETSPL ANSI S3.6 2018 (acoustical linear weighting)
- ANSI Speech Equivalent free field level 12.5 dB + 1 kHz RETSPL – (G_F-G_C) from ANSI S3.6 2018(acoustical equivalent sensitivity weighting)
- ANSI Speech Not linear level 1 kHz RETSPL ANSI S3.6 2018 (DD45-TDH50-HDA200) and IP30-B81 12.5 dB + 1 kHz RETSPL ANSI S3.6 2018 (no weighting)

Insert Earphones - IEC Speech RETSPL

Transducer	IP30	IP30
Impedance	10 Ω / 50 Ω	10 Ω / 50 Ω
Coupler	2ccm	711
	RETSPL	RETSPL
Speech		
Speech Equ.FF.		
Speech Non-linear	20	20
Speech noise		
Speech noise Equ.FF.		
Speech noise Non-linear	20	20
White noise in speech	22.5	22.5

- IEC Speech level IEC60645-2 2017 (acoustical linear weighting)
- IEC Speech Equivalent free field level (G_F-G_C) from IEC60645-2 2017 (acoustical equivalent sensitivity weighting)
- IEC Speech Not linear level 1 kHz RETSPL (DD45-TDH50-HDA200) and IP30 -B81 IEC60645-2 2017 (no weighting)

Insert Earphones - Pure Tone max HL

Transducer	IP30	IP30
Impedance	10 Ω	10 Ω
Coupler	2ccm	711
Signal	Max HL	Max HL
Tone 125 Hz	90	90
Tone 160 Hz	95	95
Tone 200 Hz	100	100
Tone 250 Hz	105	105
Tone 315 Hz	105	105
Tone 400 Hz	110	110
Tone 500 Hz	110	110
Tone 630 Hz	115	115
Tone 750 Hz	115	115
Tone 800 Hz	115	115
Tone 1000 Hz	120	120
Tone 1250 Hz	120	120
Tone 1500 Hz	120	120
Tone 1600 Hz	120	120
Tone 2000 Hz	120	120
Tone 2500 Hz	120	120
Tone 3000 Hz	120	120
Tone 3150 Hz	120	120
Tone 4000 Hz	115	115
Tone 5000 Hz	105	105
Tone 6000 Hz	100	100
Tone 6300 Hz	100	100
Tone 8000 Hz	95	95
Tone 9000 Hz		
Tone 10000 Hz		
Tone 11200 Hz		
Tone 12000 Hz		
Tone 12500 Hz		
Tone 14000 Hz		
Tone 16000 Hz		
Tone 18000 Hz		
Tone 20000 Hz		

Insert Earphones - NB noise effective masking level

Transducer	IP30	IP30
Impedance	10 Ω	10 Ω
Coupler	2ccm	711
	EM	EM
NB 125 Hz	30	32
NB 160 Hz	26	28.5
NB 200 Hz	22	25.5
NB 250 Hz	18	21.5
NB 315 Hz	16	19.5
NB 400 Hz	13	17
NB 500 Hz	9.5	13.5
NB 630 Hz	9	12.5
NB 750 Hz	7	11
NB 800 Hz	6.5	10.5
NB 1000 Hz	6	11.5
NB 1250 Hz	8	14.5
NB 1500 Hz	8	15.5
NB 1600 Hz	8	15.5
NB 2000 Hz	9	17.5
NB 2500 Hz	11	19.5
NB 3000 Hz	9.5	19
NB 3150 Hz	10	19
NB 4000 Hz	10.5	20
NB 5000 Hz	10	23.5
NB 6000 Hz	7	21
NB 6300 Hz	7	21
NB 8000 Hz	5	20.5
NB 9000 Hz		
NB 10000 Hz		
NB 11200 Hz		
NB 12000 Hz		
NB 12500 Hz		
NB 14000 Hz		
NB 16000 Hz		
NB 18000 Hz		
NB 20000 Hz		
White noise	0	0
TEN noise	16	25

Insert Earphones - NB noise max HL

Transducer	IP30	IP30
Impedance	10 Ω	10 Ω
Coupler	2ccm	711
	Max HL	Max HL
NB 125 Hz	90	90
NB 160 Hz	95	95
NB 200 Hz	100	100
NB 250 Hz	105	105
NB 315 Hz	105	105
NB 400 Hz	105	105
NB 500 Hz	110	110
NB 630 Hz	110	110
NB 750 Hz	110	110
NB 800 Hz	110	110
NB 1000 Hz	110	110
NB 1250 Hz	110	110
NB 1500 Hz	110	110
NB 1600 Hz	110	110
NB 2000 Hz	110	110
NB 2500 Hz	110	110
NB 3000 Hz	110	110
NB 3150 Hz	110	110
NB 4000 Hz	110	110
NB 5000 Hz	105	105
NB 6000 Hz	100	100
NB 6300 Hz	100	100
NB 8000 Hz	95	90
NB 9000 Hz		
NB 10000 Hz		
NB 11200 Hz		
NB 12000 Hz		
NB 12500 Hz		
NB 14000 Hz		
NB 16000 Hz		
NB 18000 Hz		
NB 20000 Hz		
White noise	110	110
TEN noise	100	100

Insert Earphones - ANSI Speech max HL

Transducer	IP30	IP30
Impedance	10 Ω	10 Ω
Coupler	2ccm	711
	Max HL	Max HL
Speech (Non-linear)	110	105
Speech noise Non-linear	100	100
White noise in speech	95	85

Insert Earphones - IEC Speech max HL

Transducer	IP30	IP30
Impedance	10 Ω	10 Ω
Coupler	2ccm	711
	Max HL	Max HL
Speech (Non-linear)	100	105
Speech noise Non-linear	90	100
White noise in speech	85	85

Bone Vibrator - Pure Tone RETFL

Transducer	B81	B81
Impedance	10 Ω	10 Ω
Coupler	Mastoid	Forehead
	RETFL	RETFL
125 Hz		
160 Hz		
200 Hz		
250 Hz	67	79
315 Hz	64	76.5
400 Hz	61	74.5
500 Hz	58	72
630 Hz	52.5	66
750 Hz	48.5	61.5
800 Hz	47	59
1000 Hz	42.5	51
1250 Hz	39	49
1500 Hz	36.5	47.5
1600 Hz	35.5	46.5
2000 Hz	31	42.5
2500 Hz	29.5	41.5
3000 Hz	30	42
3150 Hz	31	42.5
4000 Hz	35.5	43.5
5000 Hz	40	51
6000 Hz	40	51
6300 Hz	40	50
8000 Hz	40	50
9000 Hz		
10000 Hz		
11200 Hz		
12000 Hz		
12500 Hz		
14000 Hz		
16000 Hz		
18000 Hz		
20000 Hz		

- B81 uses ANSI S3.13 or IEC60318-6 2007 mechanical coupler and RETFL come from ANSI S3.6 2018 and ISO 389-3 1994. Force 5.4N ±0.5N

Bone Vibrator - ANSI Speech RETSPL

Transducer	B81	B81
Impedance	10 Ω	10 Ω
Coupler	Mastoid	Forehead
	RETFL	RETFL
Speech (Non-linear)	55	63.5
Speech noise Non-linear	55	63.5
White noise in speech	57.5	66

- ANSI Speech level 12.5 dB + 1 kHz RETSPL ANSI S3.6 2018 (acoustical linear weighting)
- ANSI Speech Equivalent free field level 12.5 dB + 1 kHz RETSPL – (G_F-G_C) from ANSI S3.6 2018(acoustical equivalent sensitivity weighting)
- ANSI Speech Not linear level 1 kHz RETSPL ANSI S3.6 2018 (DD45-TDH50-HDA200) and IP30-B81 12.5 dB + 1 kHz RETSPL ANSI S3.6 2018 (no weighting)

Bone Vibrator - IEC Speech RETSPL

Transducer	B81	B81
Impedance	10 Ω	10 Ω
Coupler	Mastoid	Forehead
	RETFL	RETFL
Speech (Non-linear)	55	63.5
Speech noise Non-linear	55	63.5
White noise in speech	57.5	66

- IEC Speech level IEC60645-2 2017 (acoustical linear weighting)
- IEC Speech Equivalent free field level (G_F-G_C) from IEC60645-2 2017 (acoustical equivalent sensitivity weighting)
- IEC Speech Not linear level 1 kHz RETSPL (DD45-TDH50-HDA200) and IP30 - B81 IEC60645-2 2017 (no weighting)

Bone Vibrator - Pure Tone max HL

Transducer	B81	B81
Impedance	10 Ω	10 Ω
Coupler	Mastoid	Forehead
Signal	Max HL	Max HL
Tone 125 Hz		
Tone 160 Hz		
Tone 200 Hz		
Tone 250 Hz	50	35
Tone 315 Hz	60	45
Tone 400 Hz	70	55
Tone 500 Hz	70	55
Tone 630 Hz	75	60
Tone 750 Hz	75	60
Tone 800 Hz	75	60
Tone 1000 Hz	85	75
Tone 1250 Hz	90	80
Tone 1500 Hz	90	80
Tone 1600 Hz	90	75
Tone 2000 Hz	90	75
Tone 2500 Hz	85	70
Tone 3000 Hz	85	70
Tone 3150 Hz	85	70
Tone 4000 Hz	85	70
Tone 5000 Hz	70	55
Tone 6000 Hz	60	50
Tone 6300 Hz	55	45
Tone 8000 Hz	50	40
Tone 9000 Hz		
Tone 10000 Hz		
Tone 11200 Hz		
Tone 12000 Hz		
Tone 12500 Hz		
Tone 14000 Hz		
Tone 16000 Hz		
Tone 18000 Hz		
Tone 20000 Hz		

Bone Vibrator - NB noise effective masking level

Transducer	B81	B81
Impedance	10 Ω	10 Ω
Coupler	Mastoid	Forehead
	EM	EM
NB 125 Hz		
NB 160 Hz		
NB 200 Hz		
NB 250 Hz	71	83
NB 315 Hz	68	80.5
NB 400 Hz	65	78.5
NB 500 Hz	62	76
NB 630 Hz	57.5	71
NB 750 Hz	53.5	66.5
NB 800 Hz	52	64
NB 1000 Hz	48.5	57
NB 1250 Hz	45	55
NB 1500 Hz	42.5	53.5
NB 1600 Hz	41.5	52.5
NB 2000 Hz	37	48.5
NB 2500 Hz	35.5	47.5
NB 3000 Hz	36	48
NB 3150 Hz	37	48.5
NB 4000 Hz	40.5	48.5
NB 5000 Hz	45	56
NB 6000 Hz	45	56
NB 6300 Hz	45	55
NB 8000 Hz	45	55
NB 9000 Hz		
NB 10000 Hz		
NB 11200 Hz		
NB 12000 Hz		
NB 12500 Hz		
NB 14000 Hz		
NB 16000 Hz		
NB 18000 Hz		
NB 20000 Hz		
White noise	42.5	51
TEN noise		

Bone Vibrator - NB noise max HL

Transducer	B81	B81
Impedance	10 Ω	10 Ω
Coupler	Mastoid	Forehead
	Max HL	Max HL
NB 125 Hz		
NB 160 Hz		
NB 200 Hz		
NB 250 Hz	40	25
NB 315 Hz	50	35
NB 400 Hz	60	45
NB 500 Hz	60	45
NB 630 Hz	65	50
NB 750 Hz	65	50
NB 800 Hz	65	50
NB 1000 Hz	70	60
NB 1250 Hz	75	60
NB 1500 Hz	75	60
NB 1600 Hz	75	60
NB 2000 Hz	70	55
NB 2500 Hz	65	50
NB 3000 Hz	65	50
NB 3150 Hz	65	50
NB 4000 Hz	60	50
NB 5000 Hz	55	45
NB 6000 Hz	50	40
NB 6300 Hz	45	35
NB 8000 Hz	40	30
NB 9000 Hz		
NB 10000 Hz		
NB 11200 Hz		
NB 12000 Hz		
NB 12500 Hz		
NB 14000 Hz		
NB 16000 Hz		
NB 18000 Hz		
NB 20000 Hz		
White noise	70	60
TEN noise		

Bone Vibrator - ANSI Speech max HL

Transducer	B81	B81
Impedance	10 Ω	10 Ω
Coupler	Mastoid	Forehead
	Max HL	Max HL
Speech		
Speech Equ.FF.		
Speech Non-linear	60	50
Speech noise		
Speech noise Equ.FF.		
Speech noise Non-linear	50	40
White noise in speech	60	50

Bone Vibrator - IEC Speech max HL

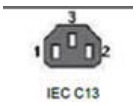
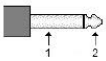
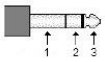
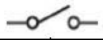
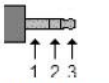
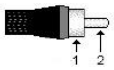
Transducer	B81	B81
Impedance	10 Ω	10 Ω
Coupler	Mastoid	Forehead
	Max HL	Max HL
Speech		
Speech Equ.FF.		
Speech Non-linear	60	50
Speech noise		
Speech noise Equ.FF.		
Speech noise Non-linear	50	40
White noise in speech	60	50

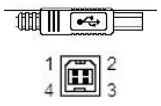
Free Field Speakers – ANSI RETSPL and Max HL

	Binaural RETSPL dB					Max HL dB[1]		
						Basic Speakers	GSI High Performance Speakers	GSI High Performance Speakers with external Amplifier
	0° [4]	45° [4]	90° [4]	135° [3]	180° [3]	45°	45°	45°
Hz								
125	22	21.5	21	21.5	22	70	70	75
160	18	17	16.5	17	18	75	75	75
200	14.5	13.5	13	13.5	14.5	80	80	75
250	11.5	10.5	9.5	10	12	80	80	90
315	8.5	7	6	7	9	80	80	90
400	6	3.5	2.5	3.5	6.5	90	90	95
500	4.5	1.5	0	1.5	5	95	100	110
630	3	-0.5	-2	-0.5	3.5	95	100	110
750	2.5	-1	-2.5	-1.5	2.5	95	105	110
800	2	-1.5	-3	-2	1.5	95	105	110
1000	2.5	-1.5	-3	-2.5	0.5	95	105	110
1250	3.5	-0.5	-2.5	-2.5	1	95	105	110
1500	2.5	1	-2.5	-2	1	100	105	110
1600	1.5	-2	-3	-2.5	0	100	105	110
2000	-1.5	-4.5	-3.5	-2	0	100	105	115
2500	-4	-7.5	-6	-2	-1.5	100	105	115
3000	-6	-11	-8.5	-4	-3.5	105	105	115
3150	-6	-11	-8	-4	-3.5	105	105	115
4000	-5.5	-9.5	-5	-0.5	-0.5	105	105	115
5000	-1.5	-7.5	-5.5	2.5	3	100	100	105
6000	4.5	-3	-5	3	9.5	95	95	105
6300	6	-1.5	-4	2.5	11	95	95	100
8000	12.5	7	4.1	8.5	16.5	80	80	75
9000	14	9	7	10.5	18.5	85	85	85
10000	14	9.5	8	10	18	80	80	80
11200	13	9	6	8	16	80	80	80
12500	12.5	11	4.5	6.5	15	75	75	75
Speech	14.5	12.5	11	10	13	90 [2]	96 [2]	102 [2]

1) When using the Calibration App, the Custom Max procedure must be utilized.
2) To achieve the maximum output level the crest factor per ANSI S3.6 (2018) is reduced.
3) The angle 135 and 180 degrees are from E.A.G Shaw and M.M Vaillancourt publication 1985
4) Based on ANSI S3.6-2018 / ISO 389-7

Appendix 3: PIN Assignments

Socket	Connector	Pin 1	Pin 2	Pin 3	Pin 4
Mains		Live	Neutral	Earth	
Headphones x2; Inserts; Bone		Ground	Signal		
Patient Response x 2; Gooseneck Mic		Ground	DC Bias	Signal	
		-			
Ext. CD		Ground	CD2	CD1	
Talk Forward; Talk Back		Ground	DC Bias	Signal	
Monitor Headset Spkr		Ground	Signal 2	Signal 1	
Aux		Ground	Right	Left	
FF1 & FF2 FF3 & FF4		Ground	Signal		
VRA		Ground	Right	Center	Left

USB A x 4 (Host)		USB B (Device	
	1. +5V DC 2. Data - 3. Data + 4. Ground		1. +5V DC 2. Data - 3. Data + 4. Ground
HDMI			
	1. Data2+ 2. Ground 3. Data2- 4. Data1+		
	5. Ground		
	6. Data1-		

	7. Data0+	
	8. Ground	
	9. Data0-	
	10. Clock+	
	11. Ground	
	12. Clock-	
	13. CEC	
	14. Reserved	
	15. SCL	
	16. SDA	
	17. Ground	
	18. +5V DC	
	19. Hot Plug Detect	
5 Pol Din (SPKR 1&2)		
	1. OUT-FF+	
	2. Ground	
	3. OUT-FF2+	
	4. OUT-FF1-	
	5. OUT-FF2-	
LAN Ethernet	Not Supported	

Appendix 4: EMC Compatibility

Portable and Mobile RF communications equipment can affect the GSI AudioStar Pro. Install and operate the GSI AudioStar Pro according to the EMC information presented on this page and the next 4 pages.

The GSI AudioStar Pro has been tested for EMC emissions and immunity as a standalone instrument. Do not use the GSI AudioStar Pro adjacent to or stacked with other electronic equipment. If adjacent or stacked use is necessary, the user should verify normal operation in the configuration.

The use of accessories, transducers and cables other than those specified, with the exception of servicing parts sold by GSI as replacement parts for internal components, may result in increased EMISSIONS or decreased IMMUNITY of the device. Anyone connecting additional equipment is responsible for making sure the system complies with the IEC 60601-1-2 standard.

Electromagnetic Compatibility

Although the instrument fulfils the relevant EMC requirements precautions should be taken to avoid unnecessary exposure to electromagnetic fields, e.g. from mobile phones, etc. If the device is used adjacent to other equipment it must be observed that no mutual disturbance appears.

Electrical Safety, EMC and Associated Standards

1. ES 60601-1: Medical Electrical Equipment, Part 1 General Requirements for Safety

2. IEC/EN 60601-1: Medical Electrical Equipment, Part 1 General Requirements for Safety

3. CAN/CSA-C22.2 No. 60601-1: Medical Electrical Equipment, Part 1 General Requirements for Safety Electrical Equipment for Laboratory Use

4. IEC/EN 60601-1-1: Collateral Standard, Safety Requirements for Medical Electrical Systems

5. IEC/EN 60601-1-2: Medical Electrical Equipment, Part 1 - Electromagnetic Compatibility - Requirements and Tests

6. Essential Requirements of the current European Union Medical Device Directive 93/42/EEC

7. RoHS (Restriction of the use of certain Hazardous Substance)

8. WEEE (Waste Electrical & Electronic Equipment) Legislation

Guidance and Manufacturer's Declaration - Electromagnetic Emissions

The GSI AudioStar Pro is intended for use in the electromagnetic environment specified below. The customer or the user of the GSI AudioStar Pro should assure that it is used in such an environment.

Emissions Test	Compliance	Electromagnetic environment - Guidance
RF Emissions CISPR 11	Group 1	The GSI AudioStar Pro uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF Emissions CISPR 11	Class B Limits	The GSI AudioStar Pro is suitable for use in all commercial, industrial, business, hospital, and residential environments.
Harmonic Emissions IEC 61000-3-2	Class A Category	
Voltage Fluctuations / Flicker Emissions IEC 61000-3-3	Complies	

Recommended Separation Distances between Portable and Mobile RF Communications Equipment and the GSI AudioStar Pro

The GSI AudioStar Pro is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the GSI AudioStar Pro can help prevent electromagnetic interferences by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the AudioStar Pro as recommended below, according to the maximum output power of the communications equipment.

Rated Maximum Output Power of Transmitter W	**Separation distance according to frequency of transmitter m**		
	150 kHz to 80 MHz $d = 1.17$	80 MHz to 800 MHz $d = 1.17$	800 MHz to 2.5 GHz $d = 2.23$
0.01	0.12	0.12	0.23
0.1	0.37	0.37	0.74
1	1.17	1.17	2.33
10	3.70	3.70	7.37
100	11.70	11.70	23.30

For transmitters rated at a maximum output power not listed above, the recommended separation distance *d* in meters (m) can be estimated using the equation applicable to the frequency of the transmitters, where *P* is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

NOTE 1: At 80 MHz and 800 MHz, the higher frequency range applies.

NOTE 2: These guidelines may not apply to all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

Guidance and Manufacturer's Declaration - Electromagnetic Immunity

The GSI AudioStar Pro is intended for use in the electromagnetic environment specified below. The customer or the user of the AudioStar Pro should assure that it is used in such an environment.

Immunity Test	IEC 60601 Test Level	Compliance	Electromagnetic Environment-Guidance
Electrostatic Discharge (ESD) **IEC 61000-4-2**	±8 kV contact ±15 kV air	±8 kV contact ±15 kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material the relative humidity should be greater than 30%.
Electrical Fast Transient/Burst **IEC 61000-4-4**	±2 kV for power supply lines ±1 kV for input/output lines	±2 kV for power supply lines ±1 kV for input/output lines	Mains power quality should be that of a typical commercial, hospital, or residential environment.
Surge **IEC 61000-4-5**	±1 kV differential mode ±2 kV common mode	±1 kV differential mode ±2 kV common mode	Mains power quality should be that of a typical commercial, hospital, or residential environment.
Voltage Dips, Short Interruptions and Voltage Variations on Power Supply Lines **IEC 61000-4-11**	**<5% *U*T** (>95% dip in *U*T) for 0.5 cycle **40% *U*T** (60% dip in *U*T) for 5 cycles **70% *U*T** (30% dip in *U*T) for 25 cycles **5% *U*T** (>95% dip in *U*T) for 5 sec	**<5% *U*T** (>95% dip in *U*T) for 0.5 cycle **40% *U*T** (60% dip in *U*T) for 5 cycles **70% *U*T** (30% dip in *U*T) for 25 cycles **5% *U*T** (>95% dip in *U*T) for 5 sec	Mains power quality should be that of a typical commercial, hospital, or residential environment. If the user of the GSI AudioStar Pro requires continued operation during power mains interruptions, it is recommended that the AudioStar Pro be powered from an uninterrupted power supply.
Power Frequency (50/60 Hz) **IEC 61000-4-8**	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.

NOTE: *U*T is the a.c. mains voltage prior to application of the test level.

Guidance and Manufacturer's Declaration - Electromagnetic Immunity

The GSI AudioStar Pro is intended for use in the electromagnetic environment specified below. The customer or the user of the AudioStar Pro should assure that it is used in such an environment.

Immunity Test	IEC 60601 Test Level	Compliance	Electromagnetic Environment-Guidance
Conducted RF IEC 61000-4-6 Radiated RF IEC 61000-4-3	3 Vrms 150 kHz to 80 MHz 3 V/m 80 MHz to 2.5 GHz	3 Vrms 3 V/m	Portable and mobile RF communications equipment should be used no closer to any part of the AudioStar Pro, including cables than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. Recommended separation distance $d = 1.17$ $d = 1.17$ 80 MHz to 800 MHz $d = 1.17$ 800 MHz to 2.5 GHz where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in meters (m). Field Strengthens from fixed RF transmitters, as determined by an electromagnetic site survey (a*), should be less than the compliance level in each frequency range (b*). Interference may occur in the vicinity of equipment marked: 

NOTE 1: At 80 MHz and 800 MHz, the higher frequency range applies.
NOTE 2: These guidelines may not apply to all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

(a*) Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the AudioStar Pro is used exceeds the applicable RF compliance level above, the AudioStar Pro should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the AudioStar Pro.

(b*) Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m.

Appendix 5: Reference Materials

Moore, B.C.J. (2004). Dead regions in the Cochlea: Conceptual Foundations, Diagnosis, and Clinical Applications. *J Ear and Hearing 2004; 25; 98-116*. USA. Lippincott Williams & Wilkins.

Moore, B.C.J., Glasberg, B.R., Stone, M.A. (2004). New Version of the TEN Test With Calibrations in dB HL. *J Ear and Hearing 2004; 25; 478-487* Lippincott Williams & Wilkins.

Moore, B.C.J. (White Paper) Audiometer Implementation of the TEN(HL) Test for Diagnostic Cochlear Dead Regions.

Martin, F.N. (1994). *Introduction to Audiology* (fifth edition). Englewood Cliffs. Prentice Hall

Gelfland. S.A. (1997). *Essentials of Audiology).* New York. Thieme.

Hattler, K.W. (1971). The Development of the LOT-Bekesy Test for Nonorganic Hearing Loss. *J Speech Hear Res 1971;14;605-617*

Wilber, L.A. (1999), In F. Musiek (Ed.). "*Contemporary Perspectives in Hearing Assessment"* (pp. 1-20). Needham Heights. Allyn&Bacon.

American Speech-Language-Hearing Association. (2005). *Guidelines for Manual Pure-Tone Threshold Audiometry* [Guidelines]. Available from www.asha.org/policy.

ANSI/ASA S3.5-1997 (R2017). Methods for Calculation of the Speech Intelligibility Index.

Margolis, R.H. and Morgan, D.E. (2004). Automated Pure-Tone Audoimetry: An Analysis of Capacity, Need and Benefit. *American Journal of Audiology* Vol.17 109-113 December 2008. doi:10.1044/1059-0889(2008/07-0047) © American Speech-Language-Hearing Association

Penrod, J.P. (1994). Speech Threshold and Word Recognition/Discrimination Testing. In J. Katz (Ed.), "*Handbook of Clinical Audiolog."* (pp.147-164). Baltimore. Williams & Wilkins

Wilson, R. H. & Strouse, A. L. (1999), In F. Musiek (Ed.). "*Contemporary Perspectives in Hearing Assessment"* (pp. 21-66). Needham Heights. Allyn&Bacon.

Penrod, J.P. (1994). Speech Threshold and Word Recognition/Discrimination Testing. In J. Katz (Ed.), "*Handbook of Clinical Audiolog."* (pp.147-164). Baltimore. Williams & Wilkins

American Speech-Language-Hearing Association. (1988) *Determining Threshold Level for Speech* [Guidelines). Available from www.asha.org/policy

Penrod, J.P. (1994). Speech Threshold and Word Recognition/Discrimination Testing. In J. Katz (Ed.), "*Handbook of Clinical Audiolog."* (pp.147-164). Baltimore. Williams & Wilkins

Northern, J.L. & Downs, M.P. (1991). *Hearing In Children"(* fourth edition). Baltimore. Williams & Wilkins