

MA 42

Operating Instructions



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1 Introduction

Thank you for purchasing a quality product from the MAICO family. The Audiometer MA 42 is manufactured to meet all quality and safety requirements.

In designing the MA 42 we placed particular importance in making it a user-friendly device, meaning its operation is simple and easy to understand. All functions of the MA 42 are software controlled, allowing easy upgrades of new features and function in the future. That means that you have invested in a device that will meet your current and future needs.

The user manual should make it as easy as possible for you to become familiar with the functions of the MA 42. If you have problems or have ideas for further improvements, please get in touch with us.

Your MAICO-team

1.1 Intended Use Statement

The MA 42 is a portable or standalone audiometer intended to be used for the identification of hearing loss and the factors that contribute to the occurrence of the hearing loss in patients of all ages. It is intended to be used by audiologists, ENTs, hearing healthcare professionals, or other trained technicians in a hospital, clinic, healthcare facility or other suitable quiet environment as defined in ANSI S3.1 or equivalent.

1.2 Essential Performance

The following is considered essential performance:

- To generate and present stimulus signals in the audio range as specified in the applicable IEC 60645 series in normal condition
- Record and store patient response

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2 Description

The MA 42 is a portable two-channel audiometer with pure tone, speech and sound field audiometric testing. The device also includes special test function which include Master Hearing Aid, Decay (Carhart), SISI, ABLB and MLB. It can be used for ENT diagnostics and hearing aid fittings in the office, and for mobile audiometry in clinics and abroad.

The MA 42 audiometer delivers 11 air conduction (AC) test frequencies from 125 Hz to 8 kHz, with levels from -10 dB_{HL} to 120 dB_{HL}. Bone conduction (BC) can be tested with 10 test frequencies from 250 Hz to 8 kHz with levels from -10 dB_{HL} to 80 dB_{HL} (with the standard bone conductor B71). As an upgrade option, the MA 42 is also capable of high frequency audiometry up to 16 kHz. The large backlighted LCD-color display shows level, frequency, transducer, signal type, audiograms, and other information for each channel.

The sound presented to the patient's ear can be monitored by the examiner with an internal monitor speaker or external monitor phone.

The MA 42 performs tests using DD45 headphones, B71 bone conduction receiver, and optional insert phones or optional speakers. Built-in test signals include pure tone, pulse tone, warble tone, narrow band noise, white noise, and speech noise. Inputs include ports for live speech and a CD player for speech test material. Speech tests can also be played by recorded Wave files included on a removable SD memory card. Outputs have separate jacks for air conduction headphones, bone conduction transducer, optional insert phones, and optional sound field speakers. Optional transducers available include: TDH 39, insert phones, B 71W, B 81, HDA 200 and HDA 300.

As an additional feature, the patient management provides the possibility to store results in the device for further evaluation and documentation.

Results can be printed directly by a USB connected printer or stored as a PDF file on the included SD memory card or USB flash drive. The MA 42 can be connected to the PC via USB to track the session and store the results in NOAH or the MAICO Database.

In order to remain current with present and future technologies, the MA 42 is compatible with PCs, easy to use, extremely reliable, and is adaptable to future developments. It is also designed to be easily serviced as the need arises.

Automatic test programs make troubleshooting and the yearly calibration as effortless as possible. The speaker outputs can also be used as line level outputs for an external amplifier or active speaker. Contacting your authorized service center will allow a change to line output levels.

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3 Getting Started

3.1 Unpacking the Instrument

The MA 42 was carefully inspected and packed for shipping. However, it is a good practice to thoroughly inspect the outside of the shipping box for signs of damage. If any damage is noted, please notify the carrier immediately.

SAVE ALL THE ORIGINAL PACKING MATERIAL AND THE SHIPPING CONTAINER SO THE INSTRUMENT CAN BE PROPERLY PACKED IF IT NEEDS TO BE RETURNED FOR SERVICE OR CALIBRATION.

Notify the carrier immediately if any mechanical damage is noted. This will assure that a proper claim is made. Save all packing material so the claim adjuster can inspect it. Notify your dealer or MAICO when the adjuster has completed the inspection.

Please check that all accessories are received in good condition. The list of standard and optional accessories are listed in Chapter 11. **Only those accessories provided by MAICO Diagnostics are to be used to ensure product installations are respected and device failure avoided.** If any accessories are missing or damaged, immediately notify your dealer or MAICO.

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3.2 Calibration of the Device

The instrument, headphones, bone conductor oscillator, as well as the optional insert phone and loudspeaker match one another and have the same serial number (e.g. 0021520). Use of transducers not calibrated to this particular instrument will likely lead to incorrect thresholds, causing incorrect test results. If one of the acoustic transducers is replaced, the instrument must be recalibrated.

The use of non-calibrated audiometers can lead to incorrect measurements!

3.3 Where to Setup

The MA 42 should be operated in a quiet room, so that the audiometric examinations are not influenced by outside noises. Ambient sound pressure levels in an audiometry test room shall not exceed the values specified in the norm ISO 8253-1: 2010 or ANSI S3.1:1999. For use in noisier environments headphones with optional sound insulation muffs are available.

Electro-medical instruments which emit strong electromagnetic fields (e.g. microwaves or radiotherapy devices) can influence the function of the audiometer. Therefore the use of these instruments is not allowed in close proximity to the audiometer.

The test room must be at normal temperature, usually 15° C / 59° F to 35° C / 95° F, and the instrument should be switched on about 10 minutes before the first measurement to guarantee precise measuring results. If the device has been cooled down (e.g. during transport), please wait until it has warmed up to room temperature.

Caution: External devices such as a computer, printer, or Ethernet which are connected to the device must meet electrical safety requirements, such as IEC/EN 60601-1 or UL 60601-1. This is to avoid electrical shock to the user or the patient.

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3.4 Rear Panel Connections

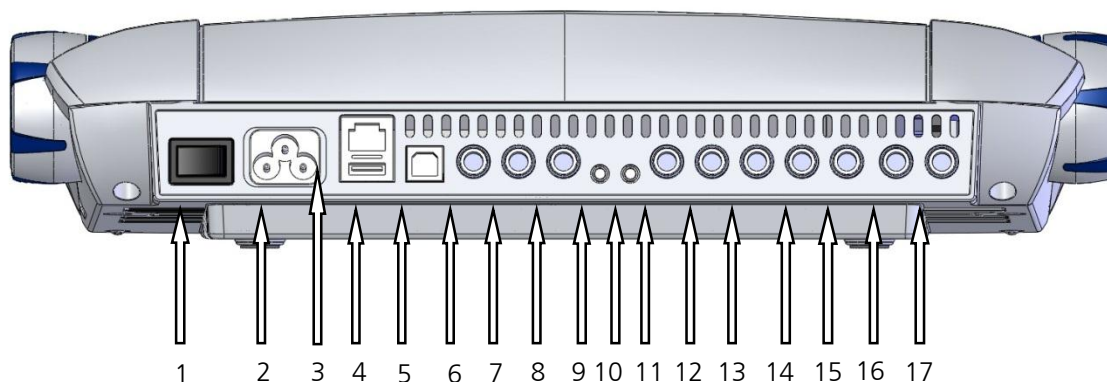


Figure 1– Rearview of the MA 42

| | |
|--|---------------------------------------|
| 1: Power switch | 10: CD Input |
| 2: Power socket 100-240 VAC / 50-60 Hz | 11: Speaker left channel |
| 3: Network socket | 12: Speaker right channel |
| 4: USB out socket | 13: Bone conduction receiver |
| 5: USB in socket | 14: Insert phone left channel |
| 6: Pat (patient response switch) socket | 15: Insert phone right channel |
| 7: Talk back microphone socket | 16: Phone left channel |
| 8: Mic (live voice microphone) socket | 17: Phone right channel |
| 9: Mon (monitor phone output) socket | |

Place the MA 42 on a stable counter or table. Plug the power cord into the power socket on the rear panel. Connect all accessories with the adequate sockets as shown above. Plug the power cord into a grounded outlet.

Turn on the instrument with the power switch which is located at the right side of the MA 42.

Note: A device should always be off when inserting or removing an accessory from the rear panel connectors.

The device performs its initialization and auto calibration. Please wait until the test screen appears, this can take up to 60 seconds. If an error is detected the test is stopped and a description of the error is shown on the display. In this case, please contact your local dealer or service.

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4. Working with the MA 42

The hearing level can be easily adjusted independently for each channel with a dial on each side of the instrument (1). For optimal convenience these level control dials are usable from the top or the side of the instrument. The instrument's default setting is in 5 dB steps and can be adjusted to 2 dB or 1 dB steps, as needed.



Figure 2 - Control Buttons

The ergonomic design of the MA 42 makes it easy to control the dB level, signal presentation, and frequency with one hand. The Stimulus presenter buttons (2) are the large blue button next to the dial. Store buttons (3) are located beside the left and right level control dials (1) and labeled with an 'S.' With the Stim button (8) you can change from presenter to interrupter mode. The corresponding LED lights up when a signal is presented. The frequency is changed with the Plus (4) and Minus (5) buttons for both channels together.

4.1 Using the Control Panel of the MA 42

The main functions of the MA 42 are directly accessible by using the functional buttons which are located around the display. The buttons have changing functionality, so the actual function of each button is shown in blue boxes adjacent to the button. To change the actual function displayed (9), (11), (13), (15), (17) on the screen, just press the corresponding button and a list of alternative functions will appear. To select a desired function, continue to press and release the button (quickly) until the test function is highlighted for selection

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to be made. The blue boxes on the right and left side of the screen (6), (7), (18), and (19) also provide easy access to setting controls. These functional buttons provide quick and easy access for test operation. For device customization, an extensive User Menu is available for advance users (see Chapter 7).

4.2 Functionality of Operating Elements

The following table describes the main functions of each button for the tone and speech audiometry screen:



Figure 3 - Control Panel MA 42

- (1) Level control: adjusts the signal level for the left/right ear.
- (2) Stim button: presents or interrupts the signal for the left/right ear.
- (3) Store button: stores results for the left/right ear or no response if button is pressed for 3 seconds.
- (4) Frequency Up: change to higher frequency for tone audiometry, enters a correct answer for word recognition score (WRS) testing, or selects the next word in the word list for speech recognition threshold (SRT) testing when the internal Wave files are used.
- (5) Frequency Down: change to lower frequency for tone audiometry, enters an incorrect answer for WRS testing, or selects a previous word in the word list for SRT testing when the internal Wave files are used.
- (6) Monitor: allows adjustment of monitor levels and talk back level. In the speech screen, the input calibration for microphone or CD player can be adjusted.

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- (7) Functional selector button: function changes based on testing screen (i.e. Tone or Speech).

Tone: new, to delete all stored results and start a new session.

Speech: reset the result percentage counter or play Wave file.

- (8) Channel Stim button/Talk: to change from presenter to interrupter mode, or to talk to the patient by pressing and holding the button down (only one Stim/Talk button should be pressed for Talk Forward capability).

- (9) Functional selector button: to select left, right, or swap.

- (10) Transducer selector button: to choose between Phones, Insert, Bone, and Speaker (only calibrated receivers are available for selection).

- (11) Functional selector button: function changes based on testing screen (i.e. Tone or Speech).

Tone: signal selector, to choose between tone, narrow band noise, white noise, or to switch the channel off.

Speech: select microphone, external CD player, Wave file, or speech noise as signal source.

- (12) Test signal selector button: for Steady, Pulse, Warble, or P&W (pulse and warble tone).

- (13) Functional selector button: function changes based on testing screen (i.e. Tone or Speech).

Tone: selects test for selected receiver, either the pure tone threshold, Hearing Level (HL), Most Comfortable Loudness (MCL), Uncomfortable Loudness (UCL), or Over Threshold test.

Speech: select Speech Recognition Threshold (SRT), Word Recognition Score (WRS), Master Hearing Aid (MHA), Most Comfortable Level (MCL), or Uncomfortable Level (UCL).

- (14) Select Unlock: Lock (locks presentation of the signal in both channels together), Track (activates the masking noise to automatically increase and decrease level in relationship to the signal), L&T (Lock and Track).


- (15) Functional selector button: function changes based on testing screen (i.e. Tone or Speech).

Tone: signal selector, to choose between tone, narrow band noise, white noise, or to switch the channel off.

Speech: select microphone, external CD player, Wave file, or speech noise as signal source.

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- (16) Transducer selector button: to choose between Phones, Insert, Bone and Speaker (only calibrated receivers are available for selection).
- (17) Functional selector button: to select left, right, or swap.
- (18) Functional selector button: to switch from the tone screen to the speech screen and back.
- (19) Functional selector button Menu: to enter the User Menu for settings to be adjusted, results can be printed or stored as PDF on SD memory card or USB flash drive, or the patient list can be entered.
- (20) SD memory card slot.
- (21) VU-Level meter.

Note: When a Function button is grey, this identifies it as an inactive button with the current test set-up (E.g. ).

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4.3 The Display of the MA 42

The instrument is set up to air conduction and pure tone by default. When starting the MA 42 the tone audiometry screen opens.

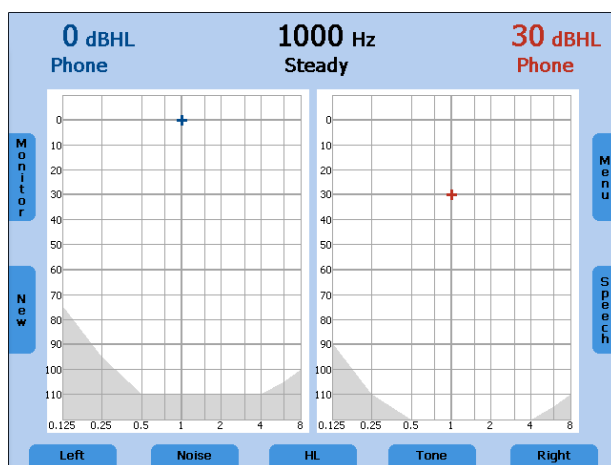


Figure 4 - Start Screen Tone Audiometry

The frequency is set to 1 kHz and the level of the tone to 30 dB_{HL} for the right channel, and 0 dB_{HL} noise for the left. All settings are shown on the display, as well as the function of the control panel buttons on the left and right side of the display. The level limits of the chosen transducer are marked by shading in the lower area of the audiogram.

The display has an energy saver function. The backlight of the display is automatically dimmed after approximately three minutes. Any action with the MA 42, such as pressing a button or rotating the dial, switches the backlight immediately on again.

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5 Measurement Methods of Audiometry

The patient should sit at a distance of at least 1 m from the device.

Eliminate any obstructions which will interfere with the placement of the earphone cushions on the ear (e.g. hair or eyeglasses). Ensure that headphones are always used with appropriate padded ear cushions.

Ensure the headphones are placed correctly: Red side on the right, blue side on the left. Adjust the headband of the headphones so that the receivers are at the correct height (the sound output grid should be exactly facing the ear canal).

Instruct the patient to press the patient response button when he hears the test tone.

For hygienic reasons it is important to clean the ear cushions of the headphones (see Chapter 8) after testing.

5.1 Tone Audiometry

The MA 42 supports the main tone audiometric testing methods. The following testing methods can be started out of the tone audiometry mode and the results will be documented in the instrument.

- Air conduction testing
- Bone conduction testing
- High tone audiometry (optional)
- Sound field testing
- Uncomfortable Loudness (UCL) Testing
- Most Comfortable Loudness (MCL)
- Over threshold test: Decay, SISI, ABLB, and MLB

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5.1.1 Pure Tone Testing

In the pure tone audiometry, the hearing threshold of the patient is measured in comparison with the normal hearing threshold. The examination starts with air conduction on the ear with better hearing.

Upon opening the Tone screen the following settings are displayed.

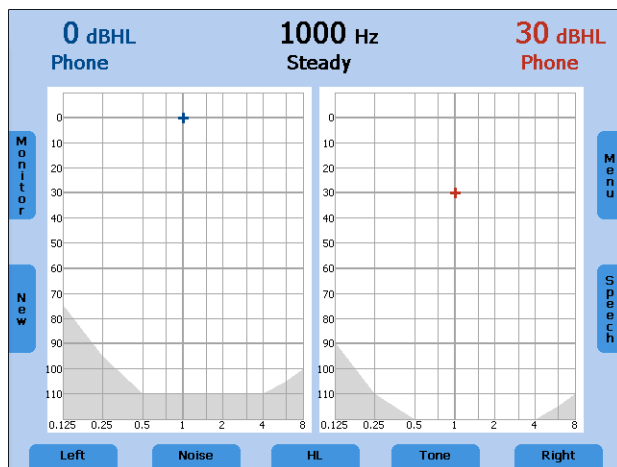


Figure 5 - Start Screen

Default setting: right channel is set to air conduction pure tone and the left channel to air conduction narrow band noise with manual masking. The frequency is automatically set to 1000 Hz.

The audiometer provides two channels, which can be separately routed to the left or right ear. Each channel can play back a signal and can be routed to one of the outputs. The signal can be set for each channel independently to tone, narrow band noise or white noise by the functional selector buttons (11) and (15).

Select the ear to be tested by pressing the Right or Left key (9), (17) on the control panel underneath the screen.

Next, select the transducer to be used, headphones (Phones), insert phones (Insert), bone conductor (Bone), or sound field speaker (Speaker) by pressing the appropriate button (10), (16). Only calibrated transducers are selectable. The level and frequency of each channel is displayed as a numerical value at the top of the screen and also as a cursor within the audiogram itself.

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The dB_HL level can be changed with the attenuator knobs on both sides (1) of the instrument. Set the level control dial to a value just below expected hearing loss and turn down the level of the other ear.

Use the frequency Plus (4) or Minus (5) keys to increase or decrease the frequency. Press the STIM button (the blue part next to the attenuator knobs) to present or interrupt the tone. The status LED above the Stim button will flash when the tone is presented.

Follow your preferred procedure for the evaluation of the hearing threshold.

Note: A warning prompt appears on the display in the event that the hearing level exceeds 100 dB_HL. The warning prompt disappears after approximately 1 second. As long as the prompt is visible on the display, no further entries can be made.

Once a threshold value is established, press the Store (3) key in order to store the threshold. The appropriate symbol will be plotted on the audiogram. If the patient is not responding, the current value can be marked as “no response” by holding the store button pressed for 3 seconds. Once all frequencies are tested, choose the poorer ear and repeat the hearing threshold test.

Pulse Tone

If required, the test can also be performed with a pulsed tone. Set the test signal button (12) on Pulse and the pure tone will be switched to a pulsing tone.

Warble Tone

If required, the test can also be performed with a warble tone. Press the button (12) and the pure tone will frequency modulate. The warble tone can also be pulsed by selecting P & W (12).

Noise

The signal may be changed from a pure tone to narrow-band noise or white noise by pressing the signal key (11), (15) underneath the display, whichever one corresponds to the current test channel. This will change the status displayed in the test channel from “Tone” to “Noise.”

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5.1.1.1 Masking

Masking is required if there is a notable threshold difference between the left and right ears. It is possible for sound to be transmitted to both ears via bone conduction while testing the poorer ear. This is called "crossover."

Crossover occurs often while testing bone conduction, but it can also occur during air conduction testing. Relevant to crossover is the sound level received by the opposite ear. The difference between the original test signal in the test ear and the received signal in the opposite ear is called "interaural attenuation."

For bone conduction measurements the interaural attenuation is 0 to 15 dB. Bone conduction crossover is therefore possible even with a slight difference in hearing loss between ears.

To ensure that the patient will not experience crossover, mask the opposite ear. Masking increases the hearing threshold of the opposite ear when crossover is occurring. For bone conduction the masking signal is automatically routed to the opposite output of the phones or inserts.

The masking is done with a noise signal which is transmitted by the headphone. For pure tone audiometry a narrowband noise is used. This noise changes its center frequency according to the frequency of the test signal.

Manual Masking

The masking is switched on by selecting the signal source as noise (11) or (15) and then pressing the Stim button (8) on the side presenting the noise.

Note: Be cautious to set the noise to an appropriate level prior to selecting Stim (8) and turning on the masking noise to the patient.

Once the threshold has been established with the introduction of noise, press the Store button on either side of the instrument. The hearing threshold value will be stored in the audiogram with the corresponding masking symbol. The masking sound should be continuously presented for effective masking by pressing the Stim button (2). You can interrupt or turn off the masking signal by pressing the Stim button (2) again.

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Automatic Masking

With the manual masking, as described above, the masking level should be adjusted every time you change the test signal level. The MA 42 has a tracking function for easy masking.

Set the tone level and the masking level to a desired difference for effective masking. Press the Track button (14) to implement the automatic masking feature. The masking level is automatically changed if you adjust the test signal level (e.g. if the test level is at 30 dBHL and the masking level 50 dBHL and you change the test level to 45 dBHL the masking level will automatically adjust to 65 dBHL).

5.1.2 High Tone Audiometry (optional)

When available, pure tone hearing threshold of high frequencies from 8 kHz to 16 kHz can be tested. The High Tone option must be activated and a separate high tone transducer must be calibrated for all frequencies.

First select the corresponding output Phones by the button (10) or (16). The item High Tone is now available at the functional button (13). Select High Tone by pressing the functional button (13) until High Tone is highlighted. The high tone diagram is displayed, combining the left and right ears results. Additional frequencies from 8 kHz to 16 kHz can be selected now by the frequency Up (4) or Down (5) key. The test procedure is identical to the description in chapter 5.1.1 Pure Tone Testing.

If a transducer is selected which is not calibrated for high frequencies, the standard diagram will be displayed and high frequencies will not be available.

On the printout, pure tone audiometry results will appear in a high tone diagram combining left and right ear results.

5.1.3 Bone Conduction Testing

Bone conduction - the transmission of sound waves through the skull directly to the inner ear - provides information about the function of the inner ear. For a neural hearing loss the values of air conduction and bone conduction are the same. In this case a hearing loss of the middle ear can be eliminated.

Place the bone conduction oscillator so that the flat, circular side of the transducer is placed on the mastoid, at the noticeable ledge of the cranial bone

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behind the pinna. The other side of the headband is placed in front of the opposite ear.

Set the receiver selector to Bone (10) or (16) and the signal selector to Tone (11) or (15).

Perform the test the same way as for air conduction.

For hygienic reasons it is important to clean the bone oscillator (see chapter 8).

5.1.4 Sound Field Testing (optional)

Set the transducer selector (10) or (16) to Speaker. Perform the test the same way as for air conduction.

Warble tones should be used in the sound field since pure tones may not provide reproducible results in the typical test room.

When results are stored using soundfield an 'S' is displayed on the audiogram. This signals soundfield/speakers were used for testing and ear specific information cannot be determined.

Results may also be displayed with an 'A' on the tone screen, when speaker is selected as the transducer and Aided is selected from the functional button (13).

5.1.5 Uncomfortable Loudness (UCL) Testing

Testing of UCL can be measured using pure tone or speech stimuli. The purpose is to determine the dB level at which the stimuli become uncomfortable to the patient. The UCL is described as the level between very loud and loud perception of the test signal. This information is valuable for determining the patient's upper dynamic range limit.

Warning! Because this test uses high sound pressure levels, it is extremely important to perform this test using the utmost caution to avoid damaging the ear. To prevent the possibility of extreme discomfort by the patient, it is important to start the test with comfortable levels.

Press the test mode selector key (13) underneath the display repeatedly until UCL is highlighted. The LCD-display in the bottom row changes from HL to UCL to signal the test selection. Start as described in chapter 5.1.1 with a test level of 60

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dB_{HL}. Present the tone briefly (max. 1 s). If the signal was recognized by the patient as "not uncomfortable," increase the level and proceed as described before. If the signal was uncomfortable for the patient store the value. Proceed accordingly with other test frequencies.

5.1.6 Most Comfortable Loudness (MCL)

Testing of MCL can be measured using pure tone stimuli or speech. The purpose is to determine the most comfortable listening level for the patient for a given stimulus. The dB level at which the stimulus is the most comfortable is determined. This level might be described as the level at which the patient would be comfortable listening for an extended period of time. Press the test mode selector key (13) underneath the display and select MCL in order to test and store the Most Comfortable Loudness.

5.1.7 The SISI Test

The SISI (Short Increment Sensitivity Index) is guided by the principle that patients with cochlear impairment are hypersensitive to small intensity increments. The continuous test tone is increased by 1 dB for a period of 0.2 seconds every 4.8 seconds. Whenever the increment is heard the patient has to press the response switch. The MA 42 calculates the percentage of detected increments. The SISI test information and the test score are shown on the LCD display. The test will end automatically after 20 presented increments. The score is expressed as a percentage of ratio of the increments heard to the delivered increments (all increments heard = 100% and no increments heard = 0%). A high score indicates a cochlear impairment. A low score is related to normal hearing or conductive or retrocochlear pathology.

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5.1.7.1 Preparation of the SISI Test

To start the test select SISI with the functional selector button (13), choose OT Tests and SISI Test.

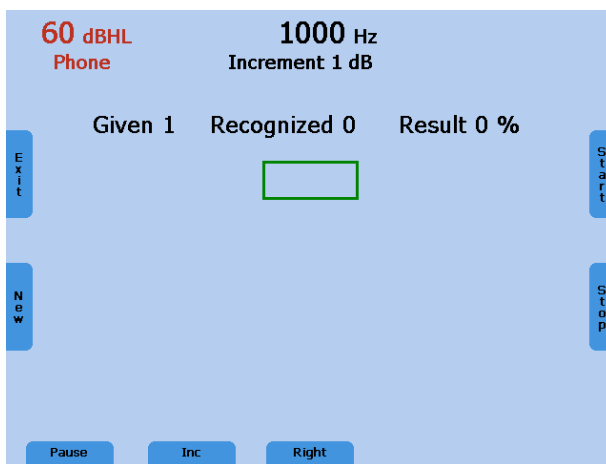


Figure 6 - Start Screen SISI Test

Select the test frequency with the frequency keys (4), (5). For the test you should choose the frequency where the maximum bone conduction hearing loss is measured as described in chapter 5.1.3.

Adjust the test intensity with the level control dial (1) to a value of 20 dB above the individual hearing threshold.

Recognize that in the SISI mode the test is presented continuously. You can interrupt the test by pressing the Pause (9) button. Press Start (19) to resume the test.

5.1.7.2 Training of the Patient

Only with careful training during the following conditioning phase can a valid test result can be achieved.

The training starts with level steps of 5 dB. That means a continuous tone, e.g. 65 dB_HL, is briefly increased by 5 dB, e.g. to 70 dB_HL. During the increment time, a green box is shown in the middle of the LCD display. The number of detected (recognized) increments is counted and shown on the display. Furthermore, the number of presented (given) increments is shown. Instruct the patient to press the patient response button when they hear a change in loudness from the continuous presentation tone. The response button must be pressed while the

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green box is displayed on the screen and thus the tone is being presented to the patient for this to be counted.

When the patient has understood the procedure of the test press the "Inc" button (11) to select the increment level for the test (i.e. 1, 2, 3, 4, or 5 dB increments). Once selected the increment level will be displayed at the top of the screen below the frequency.

5.1.7.3 Performing the SISI Test

When the patient is ready, set the increment to 1 dB and press the Start (19) button to run the SISI test.

Now 20 increments will be presented to the patient.

You can delay the test by pressing the Pause (9) button. This could be helpful in determining if the patient malingers.

The test will end automatically after 20 presented increments. The number of detected increments is counted and indicated as percentage of the presented increments. The result is only stored if a minimum 10 increments has been presented.

If you are sure that the result of the test is consistent you can abort the test at any time by pressing the Stop (18) button. The result is then indicated accordingly.

Retrocochlear hearing impairment is represented by low scores (< 25 %), cochlear defects by high scores (> 70 %). Press the EXIT (6) button to leave the SISI test.

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5.1.8 The Threshold Decay (Carhart) Test

This examination is conducted as a fatigue test in cases of sensitivity loss. To start the test select Decay with the functional selector button (13), choose OT Tests. When the screen advances, select Decay Test. Make sure that the correct transducer is selected in advance as you cannot change transducers in this screen.

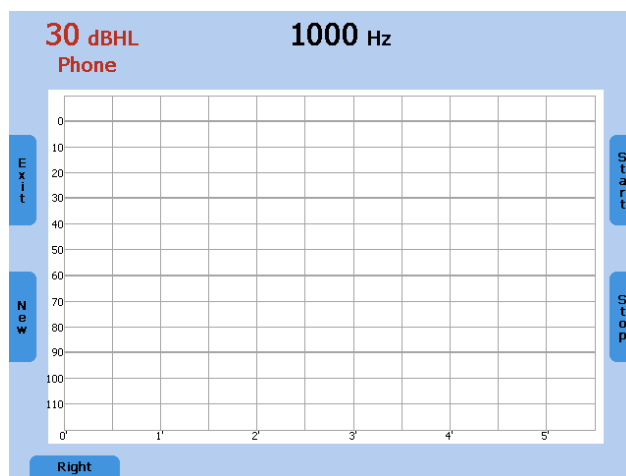


Figure 7 - Start Screen Decay Test

Select left or right ear (9) and the test frequency with the frequency keys (4), (5).

Adjust the test level with the intensity control dial (1). The level should be set to a value 5 dB above the individual pure tone hearing threshold at this frequency.

Instruct the patient to hold the response switch while the tone is heard and to release the switch as soon as the tone is no longer heard.

Press Start (19) to begin the test and present the test signal to the patient. The patient response LED lights and a stopwatch counts the seconds as long as the patient response switch is pressed. As soon as the patient releases the response switch, the level is increased for 5 dB.

The test stops automatically if the patient is able to hear the tone at the same level for 60 seconds or if the level is increased for 30 dB. Press Stop (18) to terminate the test manually.

5.1.9 ABLB

The ABLB (Alternate Binaural Loudness Balance) test is a recruitment test. Alternating tones between the two ears with headphones are used. The intensity

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of the tone in the better hearing ear is varied until the loudness of the tone is judged by the patient to be equivalent to a tone at a constant intensity in the normal ear. This is called loudness balance.

To start the test select OT Test with the functional selector button (13), choose ABLB, then the ABLB test screen will be displayed:

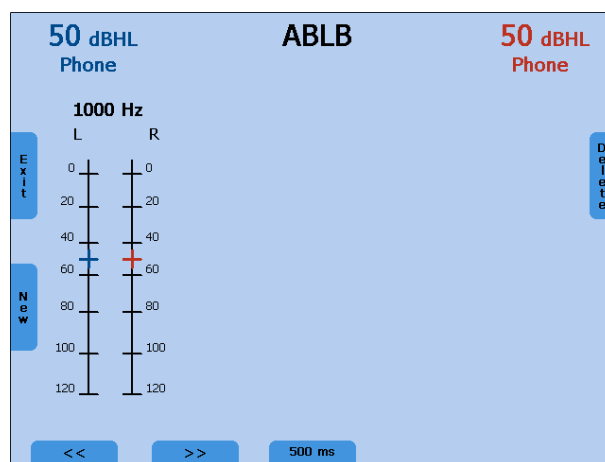


Figure 8 – ABLB Screen

The test can be performed at all frequencies between 125 Hz and 8 kHz. Select the test frequency by the frequency up and down key (4) and (5). Set the level of the better hearing ear 5 dB above the threshold. Present the left or right Stim button (2). Adjust the level of the hearing-impaired ear with the level control (1) until the loudness in both ears matches. Press the left or right Store button (3). Repeat the test for several levels.

To perform the test at another frequency, press the frequency up or down key (4) or (5). A new ladder diagram appears. Use the functional selector button (9) or (11) to jump to the previous or next diagram. Select 500 ms or 1000 ms as modulation time by the functional selector button (13). To exit the ABLB test screen press the EXIT button (6).

5.1.10 MLB

The MLB (**M**onaural **L**evel **B**alance) test is used to detect perceived loudness differences between two frequencies in the same ear. A tone with two alternating frequencies is presented to the same ear. The level of the frequency with normal hearing threshold is adjusted until it matches the loudness of the other frequency. The patient has to indicate if the loudness of both frequencies is equal.

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To start the test select OT Test with the functional selector button (13), choose MLB (15), then the MLB test screen will be displayed:

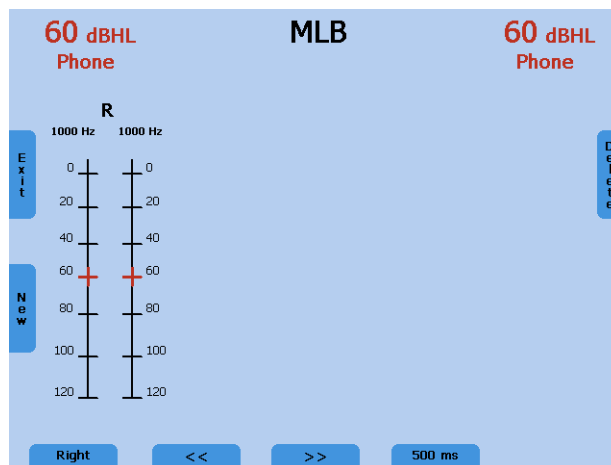


Figure 9 – MLB Screen

Select the left or right ear by the functional selector button (9). Then select left and/or right frequency up or down buttons (4) or (5) for selection of the frequencies to test. Adjust the level by the level controls (1). Present the stimulus using the Stim button (2). Press the Store button (3) to save the level of equal loudness. Repeat the procedure for several different levels.

To compare the loudness of further frequencies press the frequency up (4) or down button (5), a new ladder diagram will appear. Use the functional selector button, (9) or (11), to jump to the previous or next diagram. Select 500 ms or 1000 ms as modulation time by the functional selector button (13). To exit the MLB test screen press the Exit button (6).

5.1.11 Stenger

The Stenger test is used to confirm the presence of pseudohypacusis. During this test, two tones of the same frequency will be presented simultaneously to both ears, and only the louder tone will be perceived. Select HL to perform the Stenger test and setup the audiometer to present a tone in both ears (9,11, 15,17). Instruct the patient to press the response button when the tone is heard. Present a tone to the better hearing ear 10 dB above threshold and wait for the patient to indicate the tone has been heard. Now present the tone to the poorer ear 10 dB below the indicated threshold (the patient may "ignore" this tone). Present the tones simultaneously by pressing the lock functional button (14) and the Stim Mode button (8) to set it to interrupter mode. If the patient responds it

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is a negative. If the patient does not respond it is a positive Stenger, indicating that the tone is heard in the poorer ear and the patient is ignoring the stimulus.

5.1.12 Langenbeck

The Langenbeck noise audiometry investigates the hearing threshold of pure tones while masking noise is presented simultaneously to the same ear with a constant level for all frequencies. The tone in noise hearing threshold is typically as high as the level of the noise. The noise has a higher influence to neural hearing losses and the tone in noise hearing threshold will be increased. Set the signal of the first channel to tone and the signal of the second channel to noise and route both channels to the same ear. Set the level of the noise to a fix value and test the hearing threshold.

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5.2 Speech Audiometry

The MA 42 supports speech audiometry. To conduct speech tests using speech test material you can use a CD player, Wave files from SD memory card, or a microphone.

Caution: If you are using a CD player powered by electrical current, the player must meet electrical safety requirements, such as IEC 60601-1 or UL. This is to avoid electrical shock to either the patient or you. If you are not sure if your player meets these requirements it is safer to use battery power.

5.2.1 Input Calibration

The MA 42 must be calibrated to the particular speech test to ensure valid test levels. That means every time you change the speech test CD you must recalibrate the instrument.

To calibrate the CD speech input select CD with the signal selector key (11), (15). Press the Monitor button (6) and then InCal (19) and the calibration screen appears (see Input Calibration screen in Figure 10).

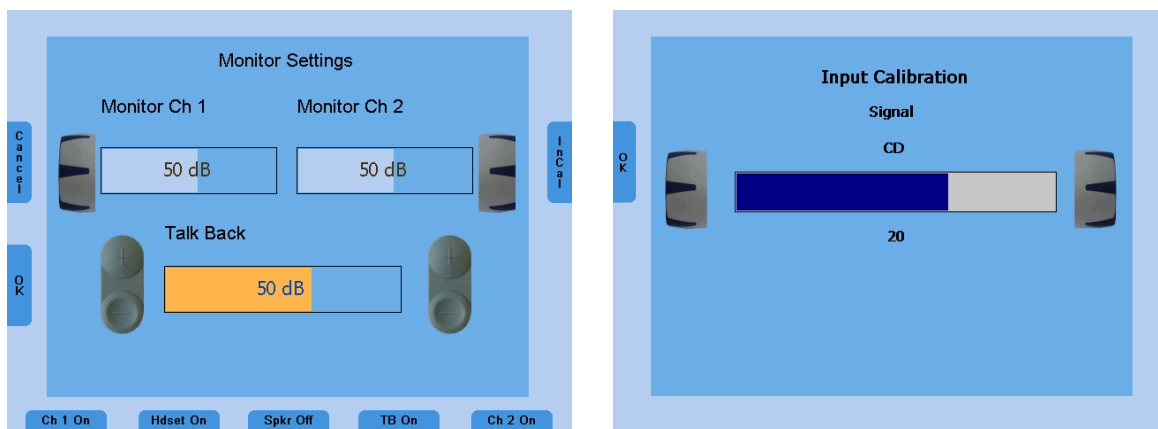


Figure 10 - Input Calibration

On every CD with speech test material you have a reference signal, such as a reference tone or speech simulating noise. Play back the reference signal from the CD. Use the left or right level control (1) and adjust the levels until the VU-meter (21) shows all yellow and one green light.

If one or more red lights are on, reduce the level using the corresponding dials (1).

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To calibrate the microphone for live voice testing, select MIC with the Signal selector key (11), (15). Press the Monitor button (6) and then InCal (19) and the calibration screen appears. Use the left or right level control (1) and adjust the levels until the VU-meter (21) shows all yellow and one green light.

Note: When multiple individuals use the device, input calibration will be required when switching to a new user. The device does store that last input calibration for ease of use.

Store the calibration and leave the calibration mode with the Exit button on the left side of the display.

The Wave files included with the device have been pre-calibrated and no input calibration is required.

5.2.2 Performing Speech Testing

Use the functional button Speech on the right side of the tone screen (18) to switch to speech testing. The speech test screen opens, the right ear is selected, and the level is set to the default value.

The Speech Recognition Threshold (SRT) is the hearing threshold for speech. It is the lowest level at which the patient correctly recognizes 50% of the speech. Speech testing can be done via recorded speech test material from CD, Wave files, or with the microphone and live voice using standardized word lists.

Ask the patient to repeat each word. Often times a carrier phrase such as, "Say the word _____" may be used. The patient should sit at a distance of at least 1 m from the device. Eliminate any obstructions which will interfere with the

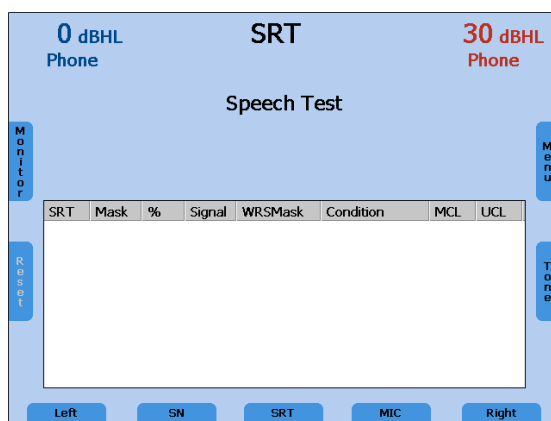


Figure 11 - Start Screen Speech Test

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placement of the earphone cushions on the ear (e.g. hair or eyeglasses). Ensure the headphones are put on correctly. Adjust the headband of the headphones so that the receivers are at the correct height (the sound output grid exactly facing the ear canal).

Note: When the patient is sitting in the same room as the tester, CD or Wave files is recommended for stimulus presentation.

The signal can be set to microphone, CD, Wave file, or switched off, for each channel independently by the functional selector buttons (11) and (15). Each channel can be routed to the left or right ear by the functional selector buttons (9) or (17), this enables flexible mixing.

Select Phones, Insert, Bone, or Speaker (only calibrated receivers are available) by the receiver select button (10), (16). Toggle to the required signal by the selector button (11) or (15) to MIC/CD/Wave.

5.2.3 Speech Audiometry with Microphone or CD Player

Connect the microphone or CD player to corresponding input on the rear side of your MA 42. Set the signal of the test channel to microphone or CD by the functional selector button (11), (15). Make sure that the input signal is calibrated correctly, as described above. Select the test SRT, WRS, MCL or UCL by the functional button (13).

For the SRT test familiarize the patient with a closed set of spondaic words at a level loud enough for them to hear and understand. Begin the test and decrease the level as the patient repeats the word. Once the threshold has been found press the Store button (3) to save the result. For the WRS test, the level remains fixed and correct or incorrect answers are entered by the frequency plus (4) and minus (5) button. Once the word list has been completed by the patient, press the Store button to save the established WRS score. To clear the word counter, press the Reset key (7) on the left side of the display.

If MCL is selected, the level is increased until the patient indicates the level is comfortable to listen to. Store the value by pressing the Store button (3). For the UCL testing the level is increased until the patient indicates the level is uncomfortable and the result can be saved by pressing the Store button (3).

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5.2.4 Speech Audiometry with Wave Files

If Wave is selected by the speech signal selector (11) or (15), a menu will pop-up with available word lists which are stored on the SD memory card (see Figure 12). A word list can be selected by using the level control (1) to scroll through the list. A list can be loaded by pressing the stimulus button.

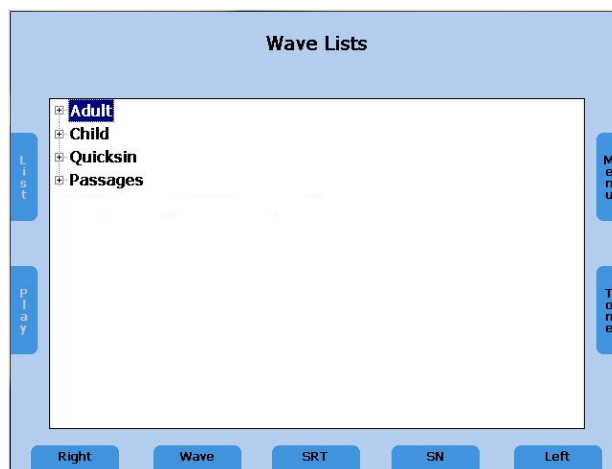


Figure 12 - List of Speech Test Wave Files

The words of the Wave file list will be displayed in the speech audiometry screen. The level is displayed as a numerical value at the top of the screen. The level can be changed with the level controls (1) on both sides of the instrument. Before starting the playback of the Wave files, the first word can be selected by the frequency up and down buttons (4) and (5). Press the functional button Play (7) to start. Once the speech test is started the test can only be stopped by pressing Cancel (18) or Store (3).

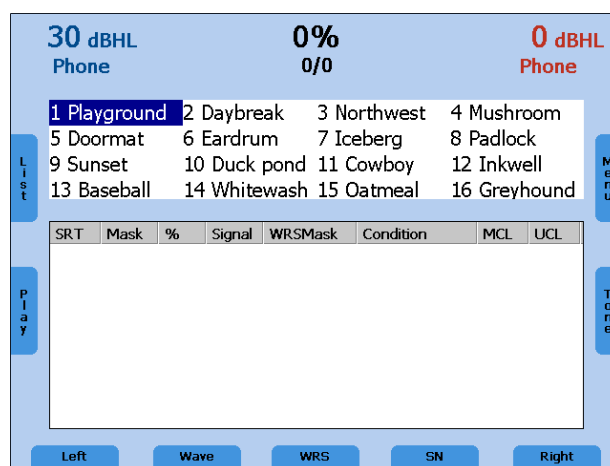


Figure 13 - Display of Words

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The procedure for the SRT, WRS, MCL, and UCL tests are the same for CD or microphone testing as described above. For the SRT test, a word must be selected in the word list by the frequency up (4) or down (5) key. When the button Play (7) is pressed, the selected word is presented. Increase or decrease the level when the patient has a correct or incorrect response until the SRT is estimated and store the result by pressing the Store (3) button.

For the WRS test, tally the correct words by pressing the frequency up (4) key and the incorrect words by pressing the frequency down (5) key. The next word will be played back automatically. The correct word is displayed green, while incorrect word is displayed red. By pressing Repeat (7), the word will be repeated. Once a wave file has been selected, the intensity cannot be changed. Select the presentation level before selecting Play (7).

The percentage of the speech discrimination score is displayed and will be stored in the speech table or audiogram as soon as Store (3) is pressed.

Press the functional button List (6) to load another word list.

MCL and UCL measurements are best performed with the Passage wave file include with the device. Select the ear for testing and Wave as the speech signal. A menu will pop-up with available word lists which are stored on the SD memory card, select Passages. Press the function button Play (7) to start the presentation. Rotate the level control (1) to increase the volume until the patient reports this is uncomfortably loud. Press Store (3) to save the results.

5.2.5 Masking

Speech audiometry has similar masking rules to those described in chapter 5.1.1.1 for pure tone audiometry. The signal of the non-testing ear is set to speech noise (SN), instead of narrowband noise, by the functional selector button signal (11) or (15). This channel needs to be set to interrupter mode by pressing the channel Stim button (8) for continuous presentation of the masking noise. Adjust the level of the masking channel by the corresponding level control (1) for effective masking.

5.2.6 Speech in Noise Tests

When performing speech in noise tests, speech and noise are given simultaneously in two channels but in the same ear. The speech source can be provided by a microphone, Wave files or an external CD-player. Select the signal

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source on one channel (button 11 or 13) and speech noise (SN) on the other channel.

To present the speech in noise in the same ear, the noise channel has to be routed to the same ear the speech channel (button 9 or 17). Please make sure that the speech is presented in interrupter mode (8) in order to present both signals simultaneously.

Speech-in-noise test, the QuickSIN™, was developed to provide a quick estimate of signal-to-noise ratio (SNR) loss. This test is incorporated into the MA 42, with selection made in the speech testing screen under the Wave file lists (11) or (15). The complete QuickSIN Speech-in-Noise Test manual, version 1.3 is provided in Appendix B. MA 42 does not incorporate the entire QuickSIN lists but provides Standard QuickSIN lists 1-12 (i.e. Track 3-14 from the CD recording). Note: Pre-calibration of the QuickSIN lists was implemented into the recording and installation of the Wave files on the MA 42. No input calibration is required.

5.2.7 Master Hearing Aid (MHA)

After you have completed the speech audiometry testing you may wish to demonstrate to the patient the difference a hearing aid can make. Use the MA 42 Master Hearing Aid (MHA) to adjust various frequency slopes for speech signals.

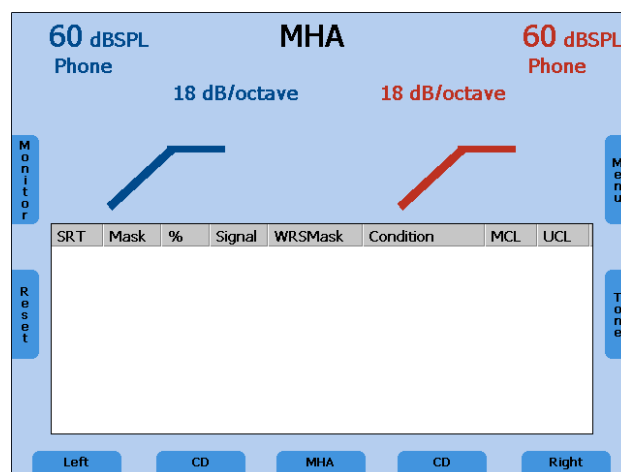


Figure 14 - Display Master Hearing Aid

The MHA feature utilizes input signals from the Live Voice (Mic), external CD/MP3 player or Wave files. These signals are then filtered to simulate the

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benefit of hearing aids in the case of a high frequency hearing loss. The level of the low frequencies can be reduced by 6 dB, 12 dB, and 18 dB per octave.

Begin by selecting a signal source in the speech mode with the functional selector button (11) or (15). Start the MHA function by pressing the Test Selection button (13). Press the stimulus mode (11) or (15) indicator to alternate between signal sources like the microphone or the CD. Change the dB presentation levels with the level control dials (1). The influence of the filters can be changed by using the Frequency Up (4) and Down (5) keys. The MHA function can be performed using monaural or binaural presentations.

5.3 Monitoring

All signals presented to the patient can be monitored by the examiner via a monitoring headset or the speakers integrated in the device. For this purpose, press the monitor button (6) and the monitor screen will appear. The monitor level of the left and right channel can be adjusted with the corresponding level control dial (1). The integrated speaker is switched on by pressing the button (13) and the external headset via the functional selector button (11). In order to hear the signal given to the patient, make sure to activate the corresponding channel for monitoring (buttons 9 and 17).

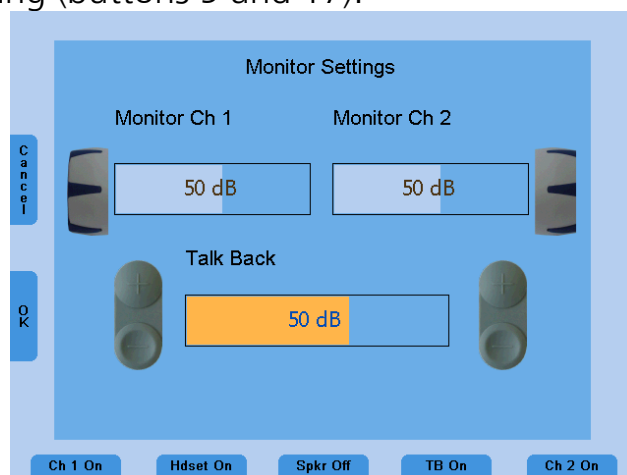


Figure 15 - Example for Monitoring Setting

The talk back microphone is activated by the button (15) and its level adjusted by the frequency up and down buttons (4), (5).

5.4 Talk Forward

Connect the microphone headset to the microphone socket (8) on the rear side of the device. A gooseneck microphone can also be connected.

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Note: Only connect the microphone when the unit is off.

To talk to the patient press and hold the Stim/Talk button (8) and speak into the microphone. Pressing only one Stim /Talk button is required to activate this feature. Adjust the level by the left or right level control (1) while holding down the Stim /Talk button.

5.5 Documentation of the Results

All stored results can be directly printed by a USB printer. Make sure that a compatible printer is connected to the USB port (4) and the device is correctly configured to the connected printer (refer to Menu Settings chapter 7.2).

The results can also be stored as PDF file on an SD memory card or USB flash drive to be transferred to a PC for further usage. The PDF file contains all the results of the measurement. An SD memory card needs to be inserted in the SD card slot (20) or a USB flash drive connected to the USB socket (4) on the rear side of the device.

Note: USB flash drive is the default in the Menu Settings. It is recommended using the USB flash drive for storing PDF results.

When the examination is complete, press the Menu button (19) in the tone or speech test mode. The User Menu is opened and the functionality of the functional buttons (11), (13) and (15) changes to PDF, Print and Patients.

To print out the results press the Print button (13). Make sure that a compatible printer is connected and the printer settings are correct.

To store the results on the SD memory card or USB flash drive, press the PDF button (11). A PDF will be created and stored on the SD memory card or USB flash drive for further transfer to a PC or printout via a PC connected printer. Make sure that the setting PDF Save Option is set to correct storage medium SD memory card or USB flash drive (chapter 7).

Enter the patient list by pressing the Patients button (15) to store the results.

After printing or creating a PDF you will automatically return to the tone or speech test mode.

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5.6 Patient Management

The Patient Management enables storing the results of the audiological tests on the SD memory card. The results can be loaded later to be reviewed, edited or printed. The patients can be stored by numbers or by entering name and birthdate. The demographic patient information can be entered by the level control (1) or a connected USB keyboard.

Enter the User Menu by pressing the Menu button (19) in the tone or speech audiometry screen. Press the button Patients (15) to display the patient list.

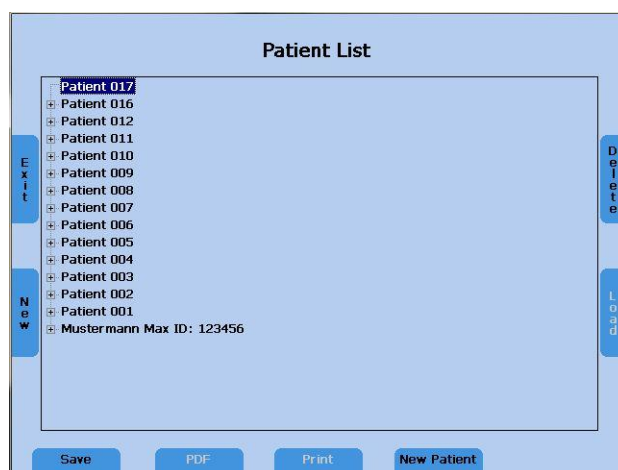


Figure 16 - Patient List

Select a patient by the level control (1) and press the Stim button (2) to display the stored sessions. Select a session and press the PDF button (11) to store the PDF on the SD memory card or USB flash drive. To print the results to a connected printer press Print (13). The patient information will only be included on the printout if it is done in the patient list, or if the PDF is created in the patient list screen.

Current results can be stored to a numbered patient or to a named patient. Entering the Patient List, a new numbered patient with a new number is selected automatically. Just press the Save button (9) to save the current session to this new patient number. To save the results to an existing patient, select a patient by the level controls and press the Save button (9).

To save the current results to a new patient with a new patient name, press the button New Patient (15) and a screen appears to enter the patients last name, first name, ID, and date of birth.

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New Patient

S T U V W X Y Z **A** B C D E F G H I J K

Last Name:

First Name:

ID:

Date of Birth:

Select a letter or number by rotating the level dials
Press the stimulus button to enter the letter or number
Use the frequency - and + buttons to jump to the next or previous field
Or connect a USB Keyboard to enter the names

Cancel OK Delete

No Name Login On

Figure 17 - New Patient

Enter the characters of the name by scrolling through the alphabet by the level controls (1) and enter the selected character by the Stim button (2). Jump to the next or previous field with the frequency up (4) or down (5) button. The date can be entered in the same manner with the level controls. Delete the last character or number by pressing the Delete button (19).

A USB keyboard can also be utilized to enter the patient information. Connect it to the USB in connector (4) and type in the characters and jump to the next field by the tab key. Press Enter to confirm the selected date and jump to the next date position. Press the functional button OK (6) to save the new patient and go back to the patient list. The new patient is selected and the current measurement results can be saved to this new patient by pressing the functional button Save (9).

Press the button No Name (9) to store the results only by a patient number, without entering a name or use Cancel (6) to go back to the Patient List without saving.

It is possible to lock the database and enter a login PIN if the language is set to English. Enter the Patient List and select New Patient by pressing the New Patient button (17). Select Login On by pressing the functional button Login On/Off (15). A screen will appear to set your personal four digit login PIN. Select four numbers between 0 and 9 by the level dial and enter each by pressing the Stim button (2) and confirm your personal login PIN by pressing the button Set (9).

Caution: Remember the PIN very well otherwise it is not possible to enter the patient list anymore!

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Each time you enter the patient list this PIN must be entered by selecting the digit by the level dial and entering it by pressing the STIM bar (2). Moving forward, the PIN will be required to enter the patient list. To deactivate the PIN, select Login Off after following the same steps as listed above.

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6 Quick Reference Guide

6.1 General Setup

6.1.1 Startup Settings

- Air conduction on both channels
- Pure tone on both channels
- 30 dB_{HL} on right channel, 0 dB_{HL} on left channel
- Presenter mode

6.1.2 Transducer Selection

Select the transducer to be used, headphones (Phones) or insert phones (Insert), by pressing the appropriate button.

Press either the right (10) or left (16) Transducer key to select the transducer (Phones, Insert, Bone, Speaker). The display shows the selected transducer at the top of the display screen below the presentation levels.

Note: Only those transducers calibrated to the device will be available for selection.

It is not possible to select Bone on both channels simultaneously. After a new selection the level will be reset to 30 dB_{HL}.

6.1.3 Signal Selection

Press either the right (11) or left (15) Signal key to select the signal. The display shows the selected signal on the bottom line of the display. The kind of Noise signal depends on the signal of the opposite channel.

6.1.4 Masking

Selection of masking noise will be activated by either the right (11) or left (15) Signal key (11) based on the non-test ear and the audiometer set-up.

For tone audiometry narrow band noise is used as the masking signal and for speech audiometry, speech noise is used.

6.2 Tone and Speech Audiometry

6.2.1 How to Select Tone or Speech Audiometry Mode

There are two modes of audiometry, Tone and Speech.

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Tone audiometry: shows level and frequency on the display.

Speech audiometry: shows level, correct and incorrect words, and speech discrimination percentage on the display.

Use the MODE button (18) to switch between tone and speech mode.

6.2.2 Tone Audiometry

Frequency Selection

Use one of the two sets of frequency keys (4) or (5) to select the frequency. The maximum and minimum frequency depends on the receiver you have selected.

Warble Tone

Press the Test signal button (12) to activate the warble tone. The LED will highlight Warble.

Pulse Tone

Press the Test signal button (12) to activate the pulse tone. The LED will highlight Pulse.

Overthreshold Tests

Press the Test mode button (13) until OT Tests is selected. The functional selector buttons below the display will show the available over threshold tests. The selection of OT tests include the Decay test (9), SISI test (11), ABLB test (13), and MLB test (15). Select the left or right ear and adjust the parameters. For the Decay or SISI test press the Start button (19) on the right side of the display to start the test. Stop the test by pressing the Stop button (18) on the right side of the display. To end the selected test, press the Exit button (6) on the left side of the display.

Tracking Function

Press the Track key (14) to activate tracking. Both channels will change level when only one attenuator is adjusted.

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STIM Mode Selection

Press Stim button (8) key to switch between continuous presentation and presentation by pressing the Stim button (2). When in continuous presentation mode the STIM buttons (2) functions as interrupters. The light above the Stim button is On if continuous presentation is selected.

Noise, CD, and Wave file speech signals are always in continuous presentation except when both channels are selected as noise.

Lock Function

Press the LOCK/UNLOCK (14) key to activate the interlock function. Signals from both channels will be presented simultaneously with the press of only one Stim button (2).

Select L&T (14) to interlock the stimulus presentation of both channels as well as the tracking of the levels.

Talk Forward Microphone

Press and hold the Stim button (8) to activate Talk Forward. Adjust the level by turning one of the attenuator knobs (1) while in the mode.

Talkback Microphone and Monitor Volume Control

Press the Monitor key (6) on the left side of the display and the volume control bars for Talkback and Monitor are shown.

Adjust the monitor volume with the right and left controls (1). Adjust the talkback microphone volume with the plus and minus keys (4) or (5). To store the actual settings press Ok (7). To cancel without saving press Cancel (6).

6.2.3 Speech Audiometry

To select speech audiometry, select Speech (18) and SRT or WRS test (13).

Note: When using Wave files for the SRT test use the frequency up (4) and down (5) key to select a word in the word list and press Play (7) to present the word to the patient.

For the WRS test the display shows the percentage of correctly repeated words once this is scored. To count the word correct, press one of the frequency up (4) keys. To count the word wrong, press one of the frequency down (5) keys. To clear the counter, press the Reset key (7) on the left side of the display.

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Speech Calibration

To calibrate the MIC or CD speech input, select the input with the Signal selector key (11) or (15). Press the Monitor button (6), the monitor setting screen appears, press now the Incal button (19) on the right side of the display and the calibration screen appears.

Play the reference signal with CD or talk into the microphone. Use the left or right level control (1) and adjust the levels until the VU-meter show all yellow and one green light. If one or more red lights are on, reduce the level using the corresponding dials (1).

Store the calibration and leave the calibration mode with the Ok (6) button on the left side of the display.

6.2.4 Documentation of the Results

Printout

Enter the User Menu by pressing the functional button (19) and press the button Print (13) to printout the results.

Store Results as PDF

Enter the User Menu by pressing the functional button (19) and press the button PDF (11) to save the results as PDF file on the SD memory card or USB flash drive.

Note: SD memory card or USB must be inserted into the device for saving to occur. System configuration designates where the results will be store and is set to USB from the factory. It is recommended to store PDF results to USB for easy transfer to a computer.

Store the Result in the Patient List

Enter the User Menu by pressing the functional button (19) and press the button Patient (15) to enter the patient list. Enter a new patient by pressing the button New Patient (15) or select a current patient by rotating the dial (1) to highlight the patient name and press (2) to select. It is also possible to print a result from the patient list or to create a PDF of the result. Select a stored session of a patient in the patient list and press the button PDF (11) or Print (13). In this case, the patient information will be included in the PDF or printout. Press the New button (7) in the patient list, to start a new session.

New Session

To clear and create a new session, select the New button (7) from the tone audiometry mode.

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7 User Menu

The User Menu enables the user to customize the device to meet their specific needs. Additionally, the menu allows the user to printout the results via USB printer, store the results as a PDF on an SD memory card or USB flash drive, and the ability to enter the patient list. To enter the User Menu press the Menu button (19) on the right side of the display.

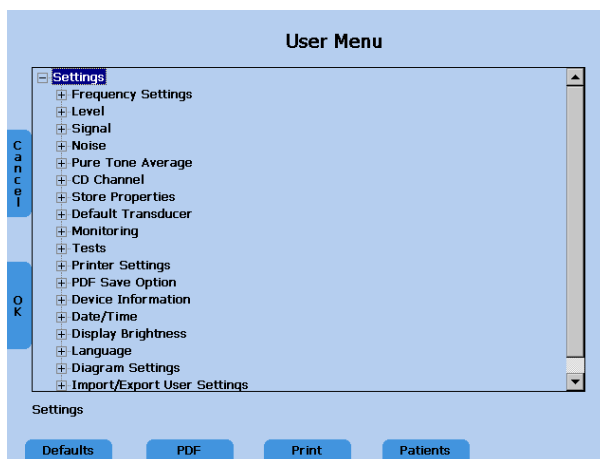


Figure 18 – User Menu Screen

To choose an item from the menu use the level control dials (1). A short description of the selected setting item will be displayed below the user menu list. To display the sub items or change the setting of the selected item press the Stim button (2). To confirm the changed setting press the Ok button (7) on the left side of the display, or press Cancel (6) in order to return to the test screen without any change.

Note: When changes have been made to the menu and saved, restart the device to confirm all changes are implemented.

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These menu items are available (bold reflects default setting):

| | | | |
|---------------|---------------------------|----------------------|--|
| | Frequency Settings | Frequency | Default frequency Set (On/Off): Set default frequency if side, transducer or signal type has changed |
| | | Frequency roll | Back: Frequency control jumps to 1000 Hz if the highest and lowest frequency was reached Stop: Frequency control function stops at highest and lowest frequency Wrap : Jumps to the lowest/highest frequency when the highest/lowest frequency is reached |
| | | Standard frequencies | Select/deselect: Lists available frequencies in device (all on) |
| | Level | Default level | On/Off: Set default level after changing signal type |
| | | Level Steps | 5; 2; 1 |
| | | Inverse Dialing | Change effect on dialing an encoder. This will change the direction of rotation of the dial required for increasing or decreasing the level of the signal (Dial Up; Dial Down) |
| | | Speech level unit | dB SPL/ dB HL : select the level unit for speech signals |
| Signal | | Default signal types | Defines which signals are selected by default: Signal/Noise or Signal/Signal |

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| | | |
|----------------------------|-----------------------------------|---|
| | Swap function | <p>Defines what happens if Swap is selected:</p> <p>Swap Ears, the left and right ear is interchanged, the signals of the channels remain</p> <p>Swap signals, only the signals are interchanged and the ears remain</p> |
| | Display of the left and right ear | <p>Same, left dial controls level of the left ear, right dial controls the level of the right ear</p> <p>Interchanged, left and right dial controls the level of the opposite ear</p> |
| | Presenter Duration | <p>Unlimited, signal is presented as long as the STIM bar is pressed</p> <p>1.5 Seconds, signal is switched off after 1.5 sec.</p> <p>User defined duration, user can define a maximum presentation duration</p> |
| | Interrupter / Presenter Mode | Default presenter or Interrupter mode |
| | Pulse | <p>500 ms, slow pulsing</p> <p>250 ms, fast pulsing</p> |
| Noise | Interrupter / Presenter | Default presenter or interrupter mode |
| PTA (Pure Tone Audiometry) | | Select/deselect frequencies for the calculation of the PTA value for the default transducer (500, 1k, 2k) |
| CD Channel | Select the CD Channel | Both/ Channel A /Channel B |

MA 42 Operating Instructions

| | | |
|--------------------|---|---|
| Store Properties | Change frequency after store | Moves to next test frequency after storing a threshold(on) or stays on same frequency after storing (off) |
| | Change level after store | Change in level after storing a threshold (Stay at the same test level (0 dB) or decrease by 10, 20, or 30 dB) |
| Default Transducer | Which transducers shall be used as default transducer | Headphones (on) or Inserts (off) |
| Monitoring | Monitoring w/ STIM key | Monitor only speech signals or all signals |
| Tests | Start Test | Tone/Speech , defines test which is load after startup |
| Printer Settings | Set Printer Settings | Opens a dialog to select a printer and configure its settings |
| PDF Save Option | Save on SD-Card | Stores PDF files always on a SD memory card |
| | Save on USB flash drive | Stores PDF files always on a USB flash drive |
| Device Information | Show information | Shows device information |
| Date/Time | Set Date/Time | Opens a dialog to change the date, time and the date format US or International |
| Display Brightness | | Change the display brightness from 1 – 100%, store new value by pressing the store button (3) |
| Language | | English/German/Italian/French/Spanish... |

MA 42 Operating Instructions

| | | |
|-----------------------------|---------------------------------|---|
| Diagram Settings | Display in speech test | Diagram(off) or Table(on) |
| | Number of diagrams in tone test | None audiogram, only the level and frequency, one combined audiogram or two separate audiograms for left and right |
| | Bone Lines | On/ Off , displays a dotted line, connecting the bone conduction results |
| Import/Export User Settings | Bone Symbol Setting | Int. Symbols/ US Symbols/ UK Symbols |
| | | Export User Settings to SD-Card/Import User Settings from SD-Card, provides the possibility to store the user settings on a SD-Card |

MA 42 Operating Instructions

7.1 Setup Date and Time

Select the item Date/Time in the User Menu by scrolling down with the left or right level control (1) and select the sub item Set Date/Time by the stimulus presenter bar (2). The following screen will appear:

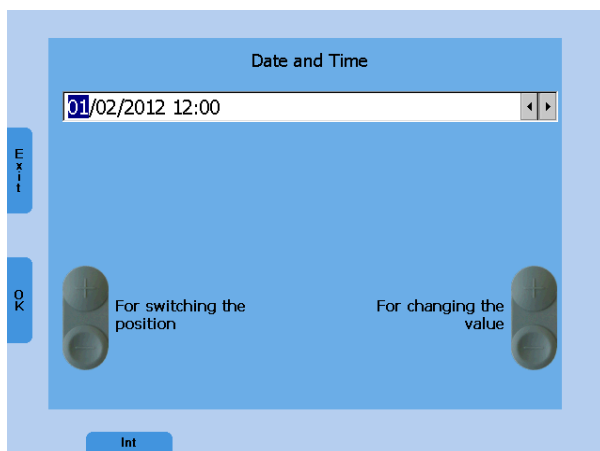


Figure 19 - Date and Time Settings

Set the date format to International or US by the functional button (9). Jump to the required position of the date or the time by the left frequency Up/Down button (4) or (5) and change the value by the right frequency Up/Down button (4) or (5) or left level control. Press the functional button Ok (7) to store the changes or Exit (6) to leave the Date/Time setting screen without saving the changes.

MA 42 Operating Instructions

7.2 Set Printer Settings

Select the printer by turning the left or right level control (1) down. The color mode is automatically adjusted. Only if the color mode is wrong, adjust the color mode as well. Jump to the field Paper size by pressing the stimulus presenter bar (2) several times and select A4 or Letter format by using the Store button (3). If the printer is connected to your Ethernet network select Ethernet as port.

Additionally, the IP address of the printer needs to be entered in the field "IP address." Select the number of the IP address by rotating the level controls and press the Store button (3) to enter the selected number.

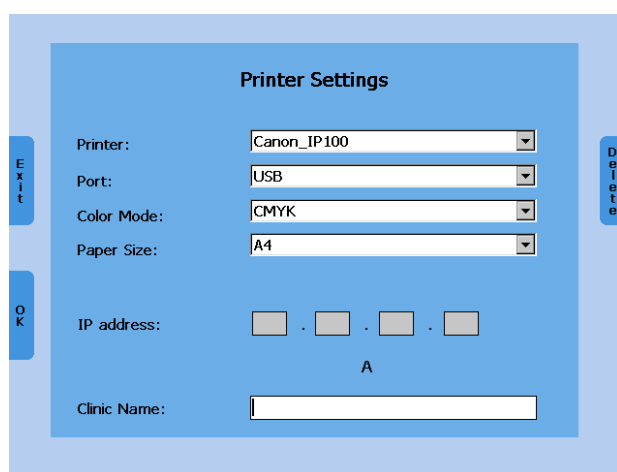


Figure 20 - Printer Settings

Save the settings and return to the User Menu by pressing the functional button Ok (7). Test your printer settings by a sample print before starting the audiological assessment. Wrong settings may require a restart of the device.

Enter the field clinic name by using the Stim button (2). Select letters by rotating the level control (1) and enter the selected letter by pressing the Store button (3). Save the settings and return to the User Menu by pressing the functional button Ok (7).

MA 42 Operating Instructions

8 Cleaning and Disinfection Recommendations

It is recommended that parts (device and accessories like headphones, ear cushions) which come in direct contact with the patient be subjected to standard cleaning and disinfecting procedure between patients. Please disinfect the instrument and its accessories in dependence on the specific existing infection potential.

Recommendations for cleaning and disinfection of MAICO device presented in this document are not intended to replace or contradict policies in effect or procedures required for infection control at the facility.

If there is not a high infection potential, MAICO recommends:

Before cleaning always switch off and disconnect the device from power supply.

For cleaning use a lightly dampened cloth with soap water solution

Disinfect the instrument and its accessories by wiping the surfaces with wet Sani-Cloth® Active wipes or a comparable product and allow them to take effect for the duration related to the specific disinfection aim listed in product data sheet of the disinfection product. Please follow also its instructions for cleaning.

- Wipe before and after each patient
- After contamination
- After infectious patients

Disinfect computer, keyboard, transport trolley etc. with Sani-Cloth® Active wipes:

- once a week
- after contamination
- when polluted

To avoid damage of the device and its accessories, please mind the following:

Do not autoclave or sterilize.

Do not use the device in the presence of fluid that can come into contact with any of the electronic components or wiring.

Should the user suspect fluids have contacted the system components or accessories, the unit should not be used until deemed safe by a MAICO certified service technician.

MA 42 Operating Instructions

9 Device Update

Insert the SD memory card into your computer and copy the update file MaicoMA4xseries.CAB to the SD memory card. Switch off the MA 42 and insert the SD memory card into the MA 42 and switch the device on. The update will be installed automatically. Wait until the update is finished and follow the instruction. Remove the SD memory card from the MA 42, it will boot up normally. Delete the update file from the SD memory card by your computer for normal use of the SD memory card.

MA 42 Operating Instructions

10 Connection to the PC

Install the software on your PC. This will allow you to use your device with NOAH™ and/or the MAICO Database. Connect the MA 42 by USB cable to the PC and turn on the device. The required driver will be installed. Please follow the installation procedure. When the installation program asks for permission to search for software, choose “Yes, this time only,” and click on the Next button.



Figure 21 – Installation Advice

Select automatic installation in the next dialog window and click again on the Next button. Wait until the MAICO MA4x family driver is installed and the operating system is updated. Click on the Finish button when the installation of the driver is completed. The new hardware is now ready to use.

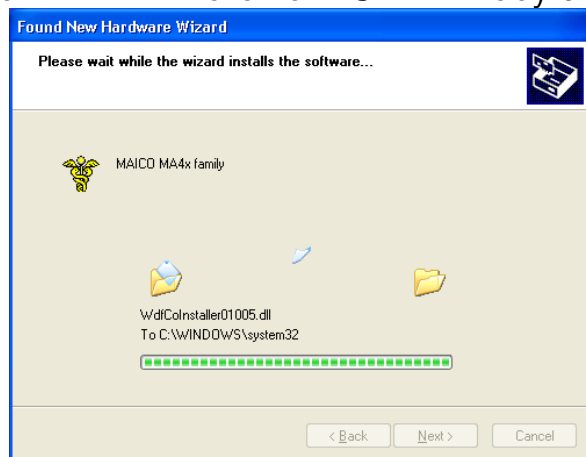















Figure 22 – Installation

Once the instrument is linked to the PC audiometry software, you are able to record the results while performing your audiological assessment. Make sure that the software is running and that a connection is built up before starting a new session.

MA 42 Operating Instructions

11 Regulatory Symbols

| Symbol | IEC Pub. | Description |
|---|--|--|
|  | 980 & 60601-1 | Serial Number |
|  | 980 & 60601-1 | Date of Manufacture |
|  | 980 & 60601-1 | Manufacturer |
|  | 980 & 60601-1 | Caution, Consult Accompanying Documents |
|  | 980 & 60601-1 | Return to Authorized Representative, Special Disposal Required |
|  | 980 & 60601-1 | Reference Number |
|  | 60601-1 | B Patient Applied Part According to IEC60601-1 |
|  | 980 & 60601-1 | Consult Operating Instructions |
|  | 60601-1 | Keep Dry |
|  | 60601-1 | Transport and Storage Temperature range |
|  | | Logo |
|  | 980 & 60601-1 | EU Authorized Representative |
|  | Medical Equipment Classified by Intertek Testing Services NA Inc. with respect to electric shock, fire, and mechanical hazards only, in accordance with UL 60601-1. Classified under the Medical Device Directive (93/42/EEC) as a Class IIa device. | Registration Label |

MA 42 Operating Instructions

12 Technical Data

EU Authorized Representative:



MAICO

Sickingenstr. 70-71

D-10553 Berlin

Germany

Standards:

ANSI S3.6, ANSI S3.43, IEC 60645-1,
IEC 60645-2, ISO 389

UL 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

Test Frequencies:

125 Hz – 8,000 Hz

8,000 Hz – 16,000 Hz optional*

Level Step:

5 dB, 2 dB or 1 dB level steps (user
selectable)

Maximum Sound Pressure Level:

AC with earphone DD 45:

- 10 dB_{HL} to 120 dB_{HL}

BC with B 71/B 71 W Bone Conduction
Oscillator:

- 10 dB_{HL} to 80 dB_{HL}

Insert earphones Ear 3A:

- 10 dB_{HL} to 120 dB_{HL}

Sound field speaker from Amp
(using SP90 Speaker Kit with AP70 Amplifier) :

Tones:

- 10 dB_{HL} to 100 dB_{HL}

Speech:

- 10 dB_{HL} to 90 dB_{HL}

Sound field speaker from MA 42
(using SP90 Speaker Kit):

Tones:

- 10 dB_{HL} to 90 dB_{HL}

Speech:

- 10 dB_{HL} to 70 dB_{HL}

Pure tone, Pulse tone, Warble tone

MA 42 Operating Instructions

Test Signal:

Masking Signals:

Narrow Band Noise: With the same center frequency resolution as pure tone

White Noise:

Speech Noise: 12 dB/octave above 1 kHz (+/-5 dB)

Speech Signals:

External CD-Player, Microphone, Wave File from SD memory card.

Modulation:

Pulse Tone:

0.25/0.5 s on time

Warble Tone:

5% sinus frequency modulation, repetition rate 5 Hz

Tests:

Tone:

HL, MCL, UCL

Speech:

SRT, WRS, MHA, MCL, UCL

Over Threshold Test

Decay, SISI, ABLB, MLB

Patient Response:

Handheld response switch

Monitor:

Build in monitor speaker, headset

Communication:

Talk forward and talk back

Data Connection:

USB, LAN Ethernet

External Devices:

CD-Player, USB Printer, USB keyboard

Supported Printers:

HP (PCL 3 and PCL 5e)
Epson (ESC/P2, LQ, Stylus Color)
Canon (iP100, iP90, BubbleJet)

Stimulus Functions:

Tone Presenter / Interrupter
Interlock (tone presentation of both channels simultaneously)
Tracking (fixed level difference between both channels)
Masking

MA 42 Operating Instructions

| | |
|-------------------------|--|
| Warm-up Time: | Less than 10 min after power on |
| Mode of Operation: | Continuous |
| Environment Conditions: | 15 - 35 °C / 59 - 95 °F (operation) 5 - 50 °C / 41 - 122 °F (transport) Humidity: 30 - 90% |
| Dimensions: | W x D x H: 34.5 x 20 x 8 cm / 13.4" x 7.9" x 3.2" 1.5 kg / 2.7 lbs |
| Weight: | 100 - 240 V~ 50/60 Hz ±10 % |
| Power Supply: | Approximately 60 VA |
| Power Consumption: | 2 x 1A slow blow |
| Device Fuses: | |

MA 42 Operating Instructions

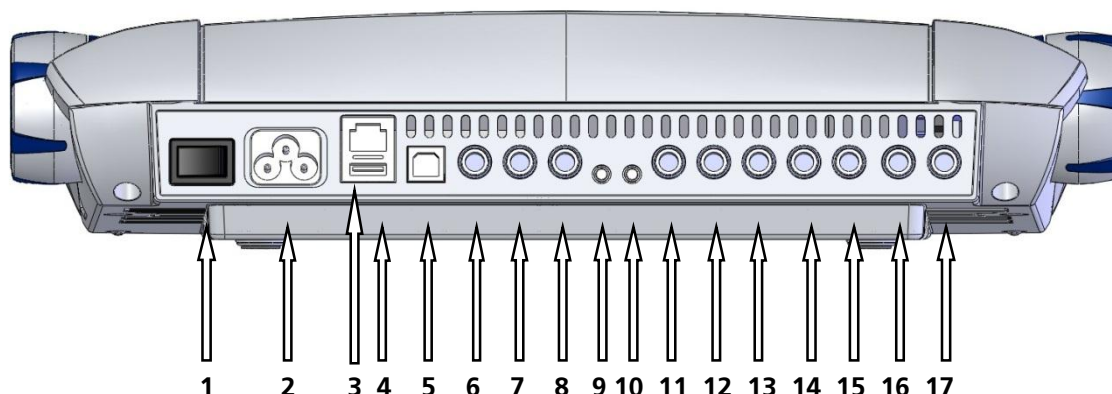


Figure 23 – Connection sockets of the MA 42

Connection Sockets:

- 1: On/Off
- 2: Power
- 3: Network
- 4: USB out
- 5: USB in
- 6: Pat (Patient Response Switch)
- 7: Talk Back microphone
- 8: Mic (Microphone)
- 9: Mon (Monitor Phone)
- 10: CD Input
- 11: Speaker Left
- 12: Speaker Right
- 13: Bone (Bone Conductor)
- 14: Insert Phone Left
- 15: Insert Phone Right
- 16: Phone Left (Headphone)
- 17: Phone Right (Headphone)

Specification

- Power
(100 ... 240 V~ 50/60 Hz)
- Ethernet
- USB 2.0
- USB 2.0
- $R_I = 500 \Omega$
- $Z_I = 1 \text{ k}\Omega$, $U_I = 0.38 - 500 \text{ mV}_{\text{eff}}$
- $Z_I = 1 \text{ k}\Omega$, $U_I = 0.38 - 500 \text{ mV}_{\text{eff}}$
- $Z_A = 250 \Omega$, $U_A = 8 \text{ V}_{\text{eff}}$
- $Z_I = 47 \text{ k}\Omega$, $U_I = 0.04 - 5 \text{ V}_{\text{eff}}$
- $Z_A = 4 \Omega$, $U_A = 8 \text{ V}_{\text{eff}}$
- $Z_A = 4 \Omega$, $U_A = 8 \text{ V}_{\text{eff}}$
- $Z_A = 4 \Omega$, $U_A = 8 \text{ V}_{\text{eff}}$
- $Z_A = 10 \Omega$, $U_A = 1 \text{ V}_{\text{eff}}$
- $Z_A = 10 \Omega$, $U_A = 1 \text{ V}_{\text{eff}}$
- $Z_A = 10 \Omega$, $U_A = 1 \text{ V}_{\text{eff}}$
- $Z_A = 10 \Omega$, $U_A = 1 \text{ V}_{\text{eff}}$

MA 42 Operating Instructions

Standard Accessories:

| Items | Part Number |
|---|-------------|
| DD45 Headphones | 8010880 |
| B71 Bone Conductor | 8010800 |
| Patient Response Switch | 8011091 |
| Power Cable | 8011392 |
| Mic/Monitor Headset | 8010870 |
| Adaptor, Stereo, 1/8" to 1/4" | 8010402 |
| Gooseneck Microphone | 8006479 |
| SD Memory Card w/ Wave Files (2 GB) | 8100885 |
| CD, Noah Audiometry Module and Maico DB | 8105958 |
| USB Flash Drive | 8106777 |
| 1 Meter USB Cable | 8004381 |
| Carrying Case | 8100797 |
| MA 42 Manual | 8106778 |
| MA 42 Quick Guide | 8106779 |

Optional Accessories:

| Item | Part Number |
|--|-------------|
| High Frequency Option (HDA200 and High Tone License) | 1000057 |
| EAR 3A Insert Phones | 8010959 |
| TDH 39 Headphones | 8010820 |
| Monitor Phone | 8111857 |
| Talk-Back Microphone | 8110026 |
| Sound Room Patch Cords (each) | 8004383 |
| Sound Room Kit | 8120006 |
| SP90 Free Field Speaker Kit | 8121128 |
| SP90 Speaker Kit with AP70 Amplifier | 8121130 |

MA 42 Operating Instructions

13 Warranty, Maintenance and After-Sales Service

The MAICO MA 42 is guaranteed for one (1) year.

This warranty is extended to the original purchaser of the instrument by MAICO through the distributor from whom it was purchased and covers defects in material and workmanship for a period of one (1) year from date of delivery of the instrument to the original purchaser.

The MA 42 may be repaired and serviced only by your dealer or by an authorized service center. We urgently advise you against attempting to rectify any faults by yourself or commissioning non-experts to do so.

Do not modify this equipment without authorization of the manufacturer. If this equipment is modified, appropriate inspection and testing must be conducted to ensure continued safe use of the equipment.

WARNING: No modification of this equipment is allowed.

In the event of repair during the guarantee period, please enclose evidence of purchase with the instrument.

In order to ensure that your instrument works properly, the MA 42 should be checked and calibrated at least once a year. This check has to be carried out by your dealer.

When returning the instrument for repairs it is essential to send all transducers (headphones, inserts, and bone conduction oscillators). Send the device to your dealer or to a service center authorized by your dealer. Please include a detailed description of faults. In order to prevent damage in transit please use the original packing, if possible, when returning the instrument.



Within the European Union it is illegal to dispose of electric and electronic waste as unsorted municipal waste. According to this, all MAICO products sold after August 13, 2005, are marked with a crossed-out wheeled bin. Within the limits of Article (9) of DIRECTIVE 2002/96/EC on waste electrical and electronic equipment (WEEE), MAICO has changed their sales policy. To avoid additional distribution costs we assign the responsibility for the proper collection and treatment according legal regulations to our customers.

Date of Manufacture.

MA 42 Operating Instructions

14 Safety Regulations



READ THIS ENTIRE MANUAL BEFORE ATTEMPTING TO USE THIS SYSTEM.

14.1 Electrical Safety



The MA 42 audiometer is constructed to comply with protection class I of the international standard IEC 60601-1 (EN 60601-1). The instruments are not intended for operation in areas with an explosion hazard.



Electrostatic discharge (ESD) according to IEC 61000-4-2. Use the device only in an electrostatic controlled environment. To avoid the risk of electric shock, this equipment must only be connected to supply mains with protective earth.

14.2 Measuring Security

To guarantee that the audiometer works properly, the instrument has to be checked and calibrated at least once a year.

The service and calibration must be performed by an authorized service center. In accordance with the regulations of the EU medical directive we will drop our liability if these checks are not done.

The use of non-calibrated audiometers is not allowed.

14.3 Device Control

The user of the instrument should perform a subjective instrument check once a week. This check can be done following the list for subjective instrument check (see Appendix A). For your own security, you should copy the enclosed list, fill it in once a week and store it in your files.

14.4 Operation

The instrument should only be handled and operated by trained personnel (audiologists, ENT doctors, or personnel with similar qualifications).

MA 42 Operating Instructions

14.5 Warnings and Statements

No modification of this equipment is allowed.

Maico will make available instructions and diagrams to repair devices that it deems appropriate to be repaired in the field.

No adverse effects have been reported from the materials used in this device based on 50 plus years of use with many different patient populations.

The operation of the device can be safely terminated by using the power switch found on the rear of the device or by disconnecting the power cable.

MA 42 Operating Instructions

Appendix A: Checklist for Subjective Audiometer Testing

- Clean the ear and head cushion!
- Untangle all lines when necessary!
- Are the headphone cushions in good condition?
If not → replace
- Are plugs and leads in good condition/undamaged?
- Are all controls working properly?
- Is the Patient Response Key working properly (if available)?
- Check batteries and renew if necessary!

Instrument:.....
 Manufacturer:.....
 Serial No.:.....
 Examiner:.....

Test Signal Quality

All the test frequencies in the below table indicate typical hearing level and can be changed when necessary:

Masking: "B" for Buzz tone, "G" for Noise, "V" for signal distortion, "S" for switching masking noise.

| | Right Ear | | | | | | | | Level | Left Ear | | | | | | | | |
|-----|-----------|-----|---|---|---|---|---|---|--------|----------|-----|---|---|---|---|---|---|-----|
| kHz | 0,25 | 0,5 | 1 | 2 | 3 | 4 | 6 | 8 | | 0,25 | 0,5 | 1 | 2 | 3 | 4 | 6 | 8 | kHz |
| AC | | | | | | | | | 30dBHL | | | | | | | | | |
| | | | | | | | | | 50dBHL | | | | | | | | | |
| | | | | | | | | | 70dBHL | | | | | | | | | |
| BC | | | | | | | | | 30dBHL | | | | | | | | | |
| | | | | | | | | | 50dBHL | | | | | | | | | |

* When noise "B", "G", "V" or "S" is blocked, inform the service center!

* When the test tone is heard at the masking ear, contact the service center!

MA 42 Operating Instructions

Air Conduction Audiogram

| | Right Ear | | | | | | | | Level | Left Ear | | | | | | | | |
|---------------------|-----------|-----|---|---|---|---|---|---|-----------------|----------|-----|---|---|---|---|---|---|---------------------|
| kHz | 0,25 | 0,5 | 1 | 2 | 3 | 4 | 6 | 8 | | 0,25 | 0,5 | 1 | 2 | 3 | 4 | 6 | 8 | kHz |
| | | | | | | | | | Should dBHL* | | | | | | | | | |
| Left Earpiece | | | | | | | | | Is dBHL | | | | | | | | | Left Earpiece |
| Right Earpiece** | | | | | | | | | Is dBHL | | | | | | | | | Right Earpiece** |

* Should is the last measurement of the patient.

**For inverted measurement please reattach the headphone.

If the frequency difference between "Should" and "Is" for one ear averages more than 10 dB, contact the SERVICE CENTER!

Bone Conduction Audiogram

| | Right Ear | | | | | | | | Level | Left Ear | | | | | | | | |
|-----|-----------|-----|---|---|---|---|---|---|-----------------|----------|-----|---|---|---|---|---|---|-----|
| kHz | 0,25 | 0,5 | 1 | 2 | 3 | 4 | 6 | 8 | | 0,25 | 0,5 | 1 | 2 | 3 | 4 | 6 | 8 | kHz |
| | | | | | | | | | Should dBHL* | | | | | | | | | |
| | | | | | | | | | Is dBHL | | | | | | | | | |

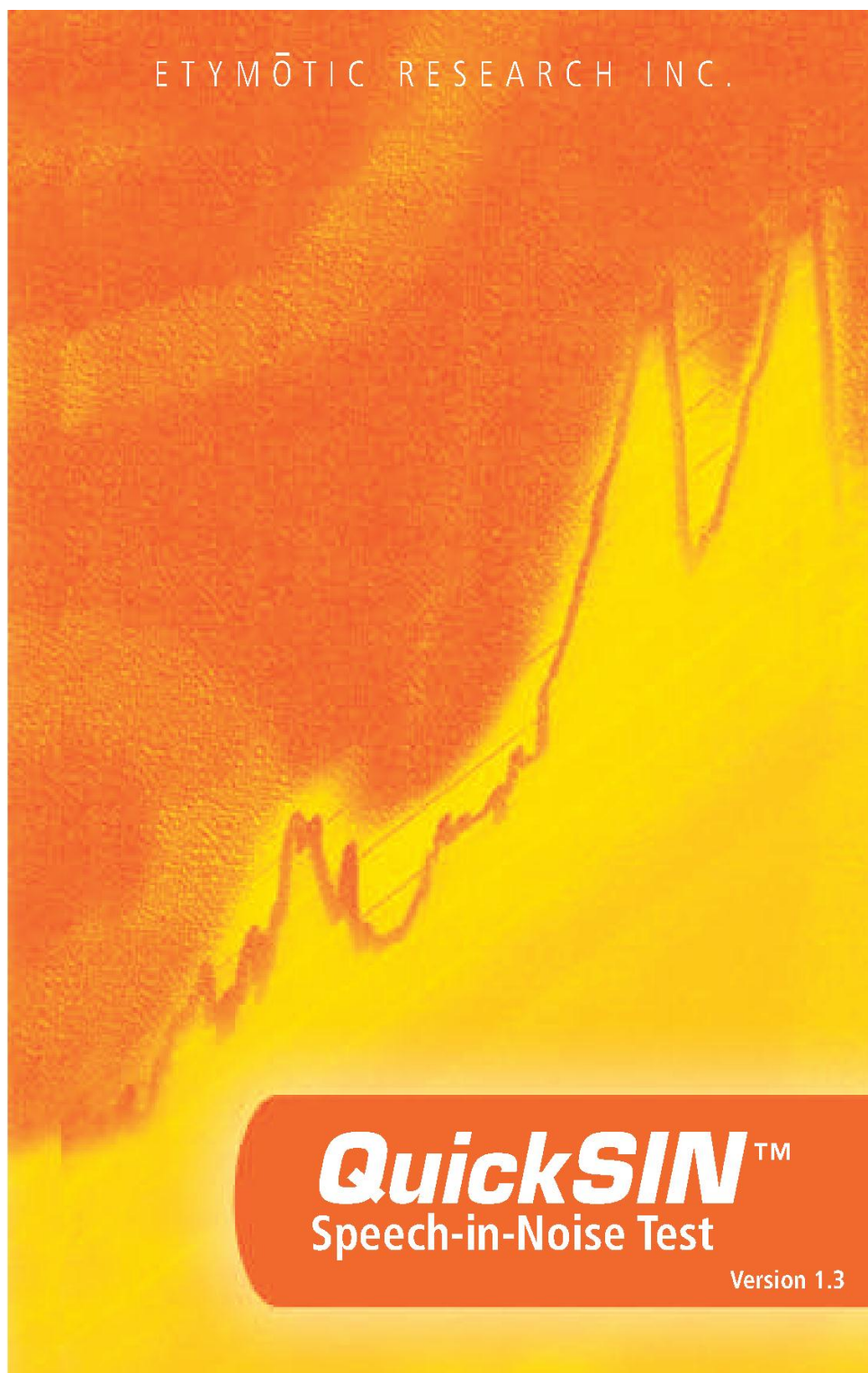
If the frequency difference between "Should" and "Is" for one ear averages more than 10 dB, contact the SERVICE CENTER!

Tested.....
Date:.....

MA 42 Operating Instructions

Appendix B: QuickSIN™ Speech-in-Noise Test Manual

QuickSIN™ is a trademark of Etymotic Research Inc. Reprinted with permission from Etymotic Research Inc.



MA 42 Operating Instructions

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MA 42 Operating Instructions

QUICK START (for full instructions, see page 6)

- Connect a CD player to the speech circuit of a standard audiometer.
- Using the calibration tone on Track 1, adjust both channels of the audiometer to read 0 VU. NOTE: Except for tracks 24-35, the target speech and background talkers were recorded together on both channels.
- Present the test with earphones or in a sound field, with the attenuator dial set to 70 dB HL. For subjects with PTA hearing losses greater than 45 dB HL, set the attenuator dial to a level that is "loud but OK."
- Instruct the patient to repeat the sentences spoken by the target (female) talker.
- When testing in a sound field, have the patient hold the talkback microphone close enough so that responses are clearly audible to the tester.
- Score the five key words underlined in each sentence, giving one point for each word repeated correctly.
- Add the number of words repeated correctly, totalled across all 6 sentences. Subtract the total correct from 25.5 to obtain SNR loss.

$$\text{SNR Loss} = 25.5 - \text{Total Correct.}$$

- To interpret the SNR loss score, see Table 1.

Table 1

| 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 |

MA 42 Operating Instructions

PURPOSE OF THE *QuickSIN*

The primary complaint of hearing-impaired persons is difficulty hearing 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).

The *QuickSIN* test was developed to:

- Provide a one-minute estimate of SNR loss
- Provide a quick way for clinicians to quantify a patient's ability to hear in noise
- Determine if extended high frequency emphasis improves or degrades understanding of speech in noise
- Assist professionals in choosing appropriate amplification and other assistive technologies
- Demonstrate that hearing aids with directional microphones improve speech intelligibility in noise
- Provide a large number of equivalent test lists for use in clinical and research work
- Provide information useful in counseling patients regarding realistic expectations

***QuickSIN* METHODOLOGY**

A list of six sentences with five 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 SNRs used are: 25, 20, 15, 10, 5 and 0, encompassing normal to severely impaired performance in noise.

MA 42 Operating Instructions

WHAT'S ON THIS CD?

The **QuickSIN** CD contains lists of sentences in noise (4-talker babble) that can be used to determine SNR Loss (signal-to-noise ratio loss). Each list takes about one minute to administer. There are eight blocks of recordings on this CD:

- 12 **standard** equivalent lists—**for basic SNR Loss testing**
 - 3 pairs of **standard** lists—**additional list pairs for research**
 - 3 practice lists (not equivalent to lists 1-12)—**for practice only**
-
- 12 lists with speech on channel 1 and constant-level babble on channel 2 (separated)—**to demonstrate directional microphone effectiveness**
-
- 12 lists recorded with 30 dB high frequency emphasis (**HFE**)—**for use with ski-slope losses**
 - 2 pairs of **HFE** lists—**additional list pairs for research**
 - 12 lists recorded with 30 dB **HFE** and low pass filtering (**HFE-LP**)—**for use in combination with the HFE lists to determine whether hearing aids with extended HFE will help or degrade speech intelligibility in noise**
 - 2 pairs of **HFE-LP** filtered lists—**additional list pairs for research**

TRACKS:

Track 1 1-kHz calibration tone

Track 2 Identification

Tracks 3-14 Standard **QuickSIN** lists 1-12.
These twelve lists are equivalent.

Tracks 15-20 List pairs. Lists 13/14, 15/16 and 17/18.

Tracks 21-23 Practice lists A, B and C. These lists are for practice only and are not equivalent to the standard lists or list pairs.

Tracks 24- 35 Lists 1-12 recorded with sentences on channel 1 and constant-level babble on channel 2. These lists can be used to demonstrate directional microphone performance (see page 11).

Tracks 36-47 Lists 1-12 recorded with 30 dB high-frequency emphasis (HFE). The HFE is used to make speech sounds audible for persons with ski-slope loss.

Tracks 48-51 Two list pairs with 30 dB **HFE**. List pairs 13/14 and 15/16.

Tracks 52-63 Lists 1-12 recorded with HFE plus 3-kHz low-pass brickwall filter; to be used in combination with the HFE lists to predict the outcome of fitting hearing aids with extended HFE (see page 10).

Tracks 64-67 Two list pairs with **HFE-LP**. List pairs 13/14 and 15/16.

Track 68 Speech spectrum noise recorded at 0 VU re: 1-kHz cal tone.

Track 69 Pink noise recorded at 0 VU re: 1-kHz cal tone.

MA 42 Operating Instructions

HOW TO USE THIS CD

Every CD has two channels: channel one (left) and channel two (right). The **QuickSIN** CD contains the identical recording on left and right channels on all tracks, except for Tracks 24-35, which have the target talker on the left and the 4-talker babble on the right.

Setup:

Connect a CD player to the external input of the audiometer. The **QuickSIN** test may be presented via loudspeaker, insert earphones or TDH earphones. When presenting the **QuickSIN** test via loudspeaker, present it through one loudspeaker only, with the subject seated facing the loudspeaker (0° azimuth). When using insert earphones or TDH earphones, you may present the test either monaurally or binaurally. Most normative data were collected using binaural presentation.

Calibration:

Using the 1-kHz calibration tone on Track 1, adjust the audiometer so that the VU meter reads "0." Some audiometers have two VU meters, one for each channel. When presenting the test via loudspeaker, it is only necessary to set the VU meter for the channel being directed to the loudspeaker. When presenting the test via earphones, it may be necessary with some audiometers to adjust both VU meters. NOTE: Tracks 24-35 were recorded with speech on one channel and babble on the other. When using these tracks, calibrate both channels.

Presentation Level:

For pure tone average (PTA) ≤ 45 dB HL, set the attenuator dial to 70 dB HL. For PTA of 50 dB HL or greater, set the attenuator dial to a level that is judged to be "loud, but OK." The sound should be perceived as loud, but not uncomfortably loud. (See Appendix A.) The practice lists on Tracks 21-23 can be used to determine the correct presentation level.

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." NOTE: When testing via loudspeaker, the talkback microphone should be held close to the patient's mouth so that responses are clearly audible to the tester.

Pausing:

Use the **PAUSE** button between sentences if the patient responds slowly.

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PRACTICE LISTS

Tracks 21-23 contain Practice Lists A-C. They can be used to familiarize the patient with the test protocol or to determine the “loud but OK” presentation level for persons with hearing loss of 50 dB HL and greater. These lists are NOT equivalent to lists 1-12 or list pairs, and do not reliably predict SNR Loss.

TRACK 21

Practice List A

Score

| | | |
|--|--------|-------|
| 1. The <u>lake sparkled</u> in the <u>red hot sun</u> . | S/N 25 | _____ |
| 2. <u>Tend</u> the <u>sheep while</u> the <u>dog wanders</u> . | S/N 20 | _____ |
| 3. <u>Take two shares</u> as a <u>fair profit</u> . | S/N 15 | _____ |
| 4. <u>North winds bring</u> <u>colds</u> and <u>fevers</u> . | S/N 10 | _____ |
| 5. A <u>sash</u> of <u>gold silk</u> will <u>trim</u> her <u>dress</u> . | S/N 5 | _____ |
| 6. <u>Fake stones shine</u> but <u>cost little</u> . | S/N 0 | _____ |
| TOTAL | | _____ |

TRACK 22

Practice List B

Score

| | | |
|---|--------|-------|
| 1. <u>Wake</u> and <u>rise</u> , and <u>step</u> into the <u>green outdoors</u> . | S/N 25 | _____ |
| 2. <u>Next Sunday is</u> the <u>twelfth</u> of the <u>month</u> . | S/N 20 | _____ |
| 3. <u>Every word</u> and <u>phrase</u> he <u>speaks</u> is <u>true</u> . | S/N 15 | _____ |
| 4. <u>Help</u> the <u>weak</u> to <u>preserve</u> <u>their strength</u> . | S/N 10 | _____ |
| 5. <u>Get</u> the <u>trust fund</u> to the <u>bank early</u> . | S/N 5 | _____ |
| 6. A <u>six comes</u> up <u>more often</u> than a <u>ten</u> . | S/N 0 | _____ |
| TOTAL | | _____ |

TRACK 23

Practice List C

Score

| | | |
|--|--------|-------|
| 1. <u>One step more</u> and the <u>board</u> will <u>collapse</u> . | S/N 25 | _____ |
| 2. <u>Take</u> the <u>match</u> and <u>strike</u> it <u>against</u> your <u>shoe</u> . | S/N 20 | _____ |
| 3. The <u>baby puts</u> his <u>right foot</u> in his <u>mouth</u> . | S/N 15 | _____ |
| 4. The <u>pup jerked</u> the <u>leash</u> as he saw a <u>feline shape</u> . | S/N 10 | _____ |
| 5. <u>Leave now</u> and <u>you</u> will <u>arrive</u> on <u>time</u> . | S/N 5 | _____ |
| 6. <u>She saw</u> a <u>cat</u> in the <u>neighbor's house</u> . | S/N 0 | _____ |
| TOTAL | | _____ |

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WHAT IS SNR LOSS?

We are interested in the patient's performance in noise compared to normal-hearing persons' performance in noise. We consider this difference in performance the **SNR Loss**.

Similar to the definition of pure tone hearing loss, SNR Loss is defined as the dB increase in signal-to-noise ratio required by a hearing-impaired person to understand speech in noise, compared to someone with normal hearing. A normal-hearing person requires about +2 dB signal-to-noise ratio (speech louder than the background noise by 2 dB) to identify 50% of key words in sentences on the **QuickSIN** test. The value of SNR Loss is derived from the SNR-50 (signal-to-noise ratio for 50% correct) score. A hearing-impaired person who requires speech to be 8 dB higher than the noise to achieve a 50% correct score would have a 6 dB SNR Loss (see Figure 1).

Different tests will give different values of SNR-50 for the same patient. We have found that changing from a female to male talker and using easier sentences decreases the normal SNR-50 by 5 dB from +2 to -3 dB, even though the babble noise is identical in both tests. Similarly, when continuous speech-spectrum noise is used, the reported SNR will differ by about 7 dB between computed rms calibration and traditional frequent-peak VU-meter readings (Ludvigsen and Killion, 1997). We've chosen to report **QuickSIN** scores in **SNR Loss** because it is substantially independent of calibration and test material. Calibration and/or test material differences that affect the SNR-50 values equally for normal and hearing-impaired subjects will cancel out in the SNR Loss calculation.

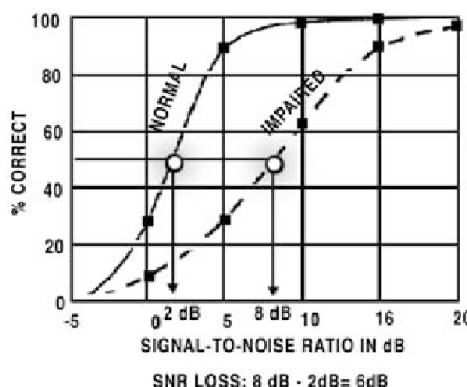


Figure 1 (From Killion, 2002)

SCORING:

Five key words are scored in each sentence. The key words are underlined on the score sheets. One point is given for each key word repeated correctly. The number of

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correct words for each sentence should be written in the space provided at the end of the sentence and the total correct calculated for the list. SNR Loss is calculated for each list by using the formula: $\text{SNR Loss} = 25.5 - \text{Total Correct}$.

Note: For greater accuracy, two or more lists should be averaged (see pp 19-20).

WHERE DOES THE NUMBER 25.5 COME FROM?

First we need to explain where the number 27.5 comes from. Following the Tillman-Olsen (1973) recommended method for obtaining spondee thresholds, we have a simple method for estimating SNR-50 using nothing more than the total number of words correct. In the Tillman-Olsen method, two spondees are presented at each level, starting at a level where all spondees are repeated correctly and decreasing in two dB steps until no responses are obtained for several words. The starting level plus 1 dB, minus the total number of spondees repeated correctly, is the spondee threshold. The simple arithmetic comes from the use of 2 dB steps and 2 words per step. If the audiometer only has 5 dB steps, the corresponding method would use 5 words per step and take the starting level plus 2.5 dB (half of the step size, just as in the case of 2 dB steps), minus the total number of spondees repeated correctly.

The **QuickSIN** has five words per step and 5 dB per step. Our highest SNR is 25 dB so we take $25 + 2.5 = 27.5$ minus the total number of words repeated correctly. This gives what we call **SNR-50**, the signal-to-noise ratio required for the patient to repeat 50% of the words correctly. For example, if someone repeats all the words correctly down to 15 dB SNR and then misses everything beyond that point, they gave 15 correct responses (five each at 25, 20, and 15 dB SNR). Since they scored 100% correct at 15 dB SNR and 0% correct at 10 dB SNR, their SNR-50 would be about 12.5 dB, halfway between 15 and 10. This is the value given by the formula $27.5 - 15 = 12.5$ dB.

THE FORMULA FOR SNR LOSS:

Since **SNR-50** for normal-hearing persons is 2 dB, we subtract 2 dB to derive the formula for a patient's **SNR LOSS**: $25.5 - (\text{Total words correct in 6 sentences})$

$$\begin{aligned}\text{SNR loss} &= \text{SNR-50} - 2 \text{ dB} \\ &= 27.5 - (\text{total words correct}) - 2 \text{ dB} \\ &= 25.5 - (\text{total words correct})\end{aligned}$$

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GUILT-FREE *QuickSIN* TEST: for ski-slope loss

High-Frequency Lists & Low-Pass-Filtered Lists

Figure 2 shows the high-frequency emphasis added to the *QuickSIN* lists to obtain the recordings labeled **HFE**. This frequency response was obtained from FIG 6 (1997) for 65 dB (normal speech) inputs for a patient with 60-70 dB ski-slope loss.

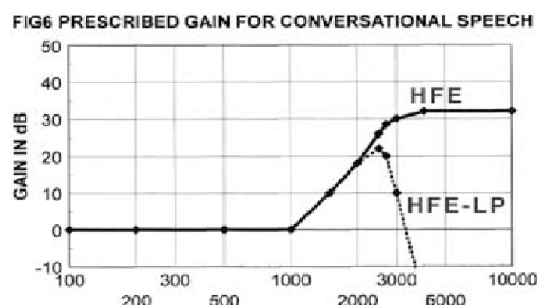


Figure 2

Data on ski-slope hearing loss from Skinner (1980), Rankovic (1991), and Turner and Cummings (1999) indicate that some patients do worse with the extended high frequency emphasis prescribed by popular formulae than if the emphasis is restricted to regions of better hearing. Other patients with similar audiograms seem to benefit from the extended high-frequency amplification.

A new set of recordings labeled **HFE-LP** were generated by low-pass filtering the **HFE** recordings with a brickwall filter set at 2.5 kHz. The resulting frequency response is also shown in Figure 2.

By comparing the SNR results obtained with the **HFE** and **HFE-LP** lists, it is possible to determine whether or not extended high-frequency amplification is useful. For a test accurate to 1.9 dB (95% confidence interval for the difference between the two conditions), four **HFE** and four **HFE-LP** lists are required, a total of 8 independent lists used alternately.

Example: Track 36 (list 1 with HFE) and Track 53 (list 2 with HFE-LP)
Track 38 (list 3 with HFE) and Track 55 (list 4 with HFE-LP)
Track 40 (list 5 with HFE) and Track 57 (list 6 with HFE-LP)
Track 42 (list 7 with HFE) and Track 59 (list 8 with HFE-LP)

Note: The same list is never used twice in this example.

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SEPARATED SPEECH & NOISE CHANNELS

Tracks 24-35 contain the 12 standard *QuickSIN* lists recorded with the speech and noise on two separate channels (target speech on channel one and 4-talker babble on channel two). The purpose of these lists is to provide a quick way to verify the effectiveness of hearing aids that have switchable directional microphones. On these tracks, both speech and babble were recorded at constant levels; therefore, the tester must establish and control the signal-to-noise ratios by selecting the presentation levels for both speech and babble channels, and manually change the level of the babble channel for each sentence to adjust the signal-to-noise ratio.

Directional Comparisons

A complete measurement of a directional hearing aid requires extensive laboratory facilities, but a good demonstration of the ability of directional hearing aids to reject sound from the sides and rear can be obtained in a standard test booth with loudspeakers located in the corners (at +45° and -45° or 0° and 180° azimuth).

It is important to remember that any test conducted in a sound booth will not precisely reflect results in the real world. By design, sound booths have minimal reverberation, and testing is conducted using a limited number of loudspeakers (usually two) that are in fixed locations. In this setup, it is possible that the location of the speakers may interact with the null of the directional microphone(s). Therefore, these measures should not be used to assess effectiveness of one directional microphone design vs. another (where differences are usually small) but rather as a general measure comparing OMNI to Directional, to verify that the directional microphones are working and providing directivity (rejection of sound from the sides and rear).

Procedure:

If the loudspeakers are located at +45° and -45°, test each ear separately. Position the patient in the sound booth so that speech is presented from in front at 45° and babble from behind at approximately 135°. Direct the speech (channel one) to the loudspeaker at 45° and direct the babble (channel two) to the loudspeaker at 135°.

Note: There are two possible “45 degree” orientations for the patient. The desired orientation places the aided ear between the loudspeakers. See Figure 3. When the other ear is tested, the patient will need to be rotated to face the opposite wall and the speech and babble switched to the opposite speakers.

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Directional Comparisons Continued

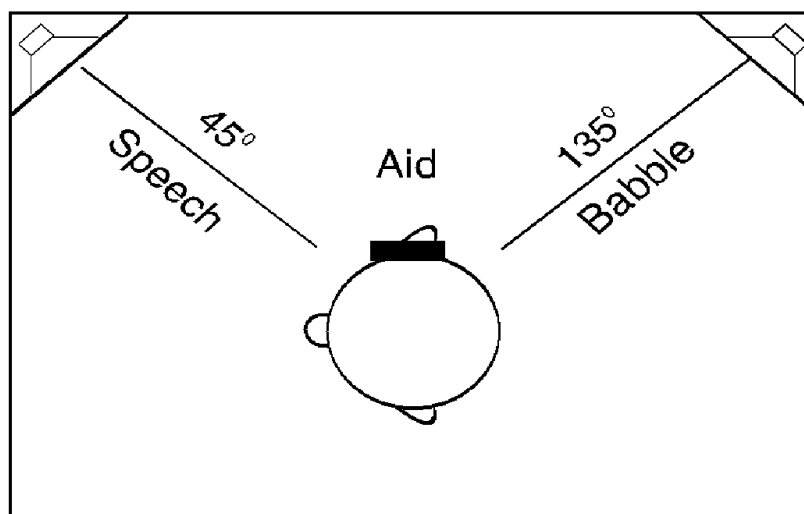


Figure 3

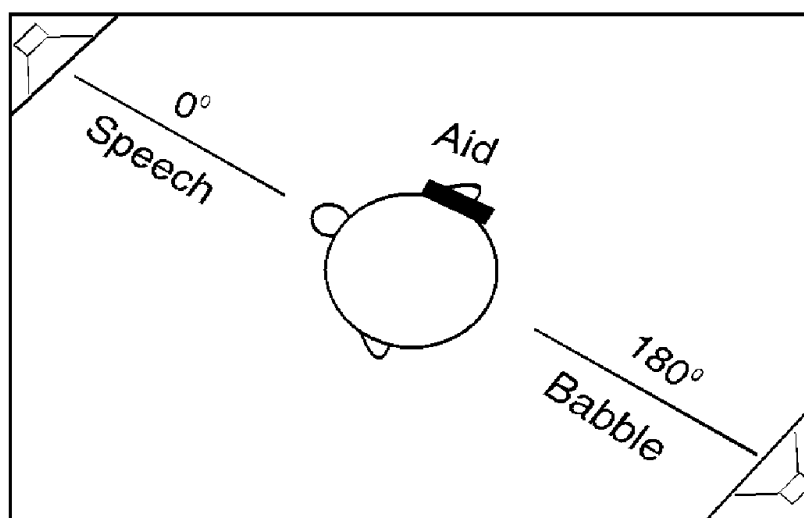


Figure 4

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If the loudspeakers are located at 0° and 180°, you may test each ear separately or both ears together. Position the patient in the sound booth so that speech is presented from in front at 0° and babble from behind at 180°. See Figure 4.

Since the babble noise on Tracks 24-35 is at a constant level, two types of demonstrations are possible:

1. **Subjective.** Calibrate both channels. Have the patient set the hearing aid/s to OMNI. Adjust the speech to 50 dB HL (65 dB SPL conversational speech level) and then adjust the noise to the level where the patient reports that it just prevents understanding the speech. Have the patient switch back and forth between OMNI and Directional positions on the hearing aid/s. The improved intelligibility in the directional mode should be obvious.
2. **Objective.** Calibrate both channels. Set the dial for channel one (front speaker) to 50 dB HL. Set the dial for channel two to 25 dB HL for the first sentence, and increase the dial setting for channel two (babble) by 5 dB for each succeeding sentence (see Table 2). Score each list as before to obtain SNR Loss. Test in OMNI and Directional. A minimum of three lists in each condition (six total) is required for a valid comparison to an accuracy of 1.5 dB at the 80% confidence level (see page 20). If you find a difference greater than 4 dB with one list in each condition, you have already reached the 95% confidence level.

| Table 2 | | | |
|------------|---------------------------|---------------------------|----------|
| | Channel 1 Dial (dB HL) | Channel 2 Dial (dB HL) | SNR (dB) |
| Sentence 1 | 50 | 25 | 25 |
| Sentence 2 | 50 | 30 | 20 |
| Sentence 3 | 50 | 35 | 15 |
| Sentence 4 | 50 | 40 | 10 |
| Sentence 5 | 50 | 45 | 5 |
| Sentence 6 | 50 | 50 | 0 |

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TEST DEVELOPMENT

The Original SIN Test

The original Etymotic Research Speech-In-Noise (SIN) Test was designed to assess word recognition performance in noise, with and without hearing aids. Test results are reported as signal-to-noise ratio (SNR) for 50% correct. This is consistent with normal audiometric practice, where threshold is defined as the level at which the patient responds 50% of the time. The recommended presentation levels for the SIN Test (70 dB HL and 40 dB HL) were selected to represent the range of typically loud and quiet speech levels encountered by most people in everyday life.

SIN Test Format

Sentence materials were used in the SIN Test because sentences spoken with natural dynamics have greater dynamic range than monosyllabic words, and are thus a more valid representation of real speech (Villchur, 1982). In the real world, the speech dynamic range is increased by the stress given to some words and syllables vs. the drop in level given to others. The effects of co-articulation are not well represented on monosyllabic word lists. Monosyllabic words, recorded and played back at specific intensity levels, are not representative of speech in the real world.

One drawback of using sentence materials, however, is that tests which use sentence formats sometimes present an entire sentence to obtain one scorable item (i.e. one word or the entire sentence is scored as correct or incorrect). The result is that significantly greater test time is needed for a given reliability compared to word scoring. The SIN and **QuickSIN** tests are “words in sentences” tasks, in which 5 words are scored in each sentence, providing a larger amount of scorable material in a given amount of time. The sentence materials used in the SIN and **QuickSIN** tests (IEEE sentences) use words that are typically not highly predictable from the surrounding context, resulting in a performance-intensity function that is not unlike that obtained with NU-6 monosyllables (Rabinowitz et. al., 1992). Indeed, an analysis of the relative independence of these words indicated that 25 words in five sentences, using half-word scoring, give the equivalent of 27 independent words with whole-word scoring.

Origin of SIN Test Sentence Materials

The IEEE (Institute of Electrical and Electronics Engineers) sentences were derived from the Harvard Phonetically Balanced Sentences, developed at Harvard University during World War II (Braida, 2000). The IEEE formed a subcommittee that was charged with developing practice guidelines for speech quality measurements to help communication engineers assess speech transmission systems. The 720 IEEE

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sentences (72 lists of 10 sentences each, with five key words in each sentence) were published as Appendix C in the 1969 document, “IEEE Recommended Practice for Speech Quality Measurements.” According to Silbiger (2000), the sentences used in the IEEE document were originally published in 1944 (Egan, 1944). The IEEE sentences were designed to have few contextual cues to aid in understanding, i.e. if a listener hears the first part of the sentence, s/he cannot likely “fill in” the remainder based on contextual cues and knowledge of the language.

As part of her doctoral dissertation, Fikret-Pasa (1993) obtained recordings of the IEEE sentences (female talker) from the Massachusetts Institute of Technology on DAT, and equalized them to correct for the high-frequency attenuation caused by the chest position of the recording microphone used at MIT. This recording was used in generating sentences for both the SIN and the *QuickSIN* tests.

Problems with the SIN Test:

Many practitioners reported that administration of the SIN Test was too time-consuming for clinical use, and scoring the test was difficult and cumbersome. After several in-depth analyses of the SIN Test, it was discovered that several of the lists were not equivalent, resulting in too few lists available for some clinical comparisons and research purposes (Bentler 2000). Some subjects could not attain a 50% correct score, even at the best (+15 dB) signal-to-noise ratio.

Background Noise

The choice of background noise is an important component of any test. The purpose of the SIN test was to obtain an estimate of difficulty hearing in noise that is representative of real-world performance. Sperry, Wiley & Chial (1997) found that a meaningful speech competitor had a significantly more adverse effect on word recognition performance compared to non-meaningful competitors (e.g. shaped noise or backward multitalker). While the spectrum and masking effects of speech-shaped noise are much easier to control, speech-shaped noise is not representative of the type of noise encountered by normal-hearing persons in their everyday environments.

The SIN and *QuickSIN* tests use a four-talker babble recording (Auditec of St. Louis) with one male and three females. The four-talker babble represents a realistic simulation of a social gathering, in which the listener may “tune out” the target talker and “tune in” one or more of the background talkers. It provides a good representation of the difficulty that patients face—the situation in which what they want to hear is speech, and what they don’t want to hear is also speech. During the *QuickSIN* test development, research subjects frequently commented, “This is what it sounds like to me; this is what it sounds like to have a hearing loss and try to listen in a noisy place!”

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QuickSIN Search for Sentence Equivalence

Alpha Versions

The original SIN Test used the first 360 sentences (lists 1-36) of the 720 IEEE sentences. The **QuickSIN** sentences were selected from among the remaining 360 sentences (lists 37-72) and were re-recorded, along with the four-talker babble, on separate tracks of an eight-track digital recorder. Thus, all subsequent re-recordings of a given sentence had the same time-locked sequence of babble. This was important because the conversational ebb and flow of the natural conversational speech produced by the four babble talkers meant that the overall noise level varied from moment to moment. Moreover, not all of the IEEE sentences are equivalent in terms of difficulty.

In order to determine the SNR-50 of each sentence *in its accompanying babble segment*, IEEE sentence lists 37-72 were recorded on the "Alpha-1 version" set of three CDs at nominal signal-to-noise-ratios of -1, +2, and +5 dB. The sentences were presented to sixteen normal-hearing subjects at 70 dB HL via ER-3A insert earphones. The three signal-to-noise ratios (-1, +2, and +5 dB) were presented in that order. An across-subject average SNR-50 was obtained for each sentence. This value was used to adjust the SNR on a sentence-by-sentence basis to an expected value of 2 dB, the grand average value. The resulting set of recordings became the Alpha-2 set of CDs.

At this point, the sentences were subjected to a taste test committee that required the sentences to be grammatically acceptable and contemporary (as opposed to the 1940s when the IEEE sentences were created). Sentences surviving the taste test were subjected to the following statistical criteria for SNR equivalence:

1. The standard deviation of the SNR-50 values across six normal-hearing adult subjects was less than 1.5 dB on the Alpha-2 recordings;
2. The mean SNR-50 value on six normal-hearing adult subjects was within 1.5 dB of their grand average on the Alpha-2 recordings;
3. The mean SNR-50 value on eight high-frequency-loss adult subjects was within 2 dB of their grand average on the Alpha-2 recordings;
4. The range of individual-word SNR-50 values within a given sentence exceeded 2 dB (data from six randomly-selected subjects from the 16 normal-hearing adult subject pool on the Alpha-1 recordings).

Beta Version

Starting with the original 360 sentences, the procedure just described eliminated all but 89 sentences, giving enough sentences for 14 lists of six sentences, one each at 25, 20, 15, 10, 5, and 0 dB SNR. Lists 1-14 on the Beta version used these 14 lists. Since we wanted at least 20 lists, we obtained another seven lists by opening up the standard deviation in #2 from 1.5 to 2.0 dB. Lists 15-21 on the Beta version of the **QuickSIN** test used the more lax criteria.

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Beta Site Protocol

CD recordings of the beta version *QuickSIN* lists (21 lists of six sentences each) were sent to approximately two dozen sites. The test protocol controlled for order and learning effects. Test/retest data were required for all 21 lists for both normal and hearing-impaired subjects.

Normal subjects

Beta version *QuickSIN* tests were analyzed for 26 normal-hearing listeners (14 subjects from eleven sites, and 12 subjects from a University of Iowa clinic) and 18 hearing-impaired subjects from ten sites. Some data were excluded from analysis if the test protocol was not followed correctly. Analysis of list presentation order indicated that adequate counter-balancing for list order was achieved. The across-subject average across lists for normal-hearing subjects was $\text{SNR-50} = 1.9 \text{ dB}$, nearly identical to the original SIN Test average of 2 dB.

Hearing-Impaired (simulated):

Normal-subject results alone are not adequate to determine list equivalence, since performance for normal-hearing listeners is typically determined primarily by the sentences recorded at 0 and 5 dB SNR. In order to check list equivalence for higher SNR levels, we simulated varying degrees of high-frequency hearing loss using filtering.

The 21 Beta-test lists were re-recorded using low-pass brickwall filter settings of 750 Hz, 850 Hz, 1100 Hz, 1400 Hz, and 2000 Hz. Each recording was presented to 25 normal-hearing subjects. Subjects were tested in three sessions over several days, and list number presentation order was varied to counterbalance for potential order effects. The most difficult condition (750 Hz low pass) was presented first, followed in order by the less difficult conditions. Testing was completed over several days, thus “learning effects” were not expected despite repeated presentations of the same lists.

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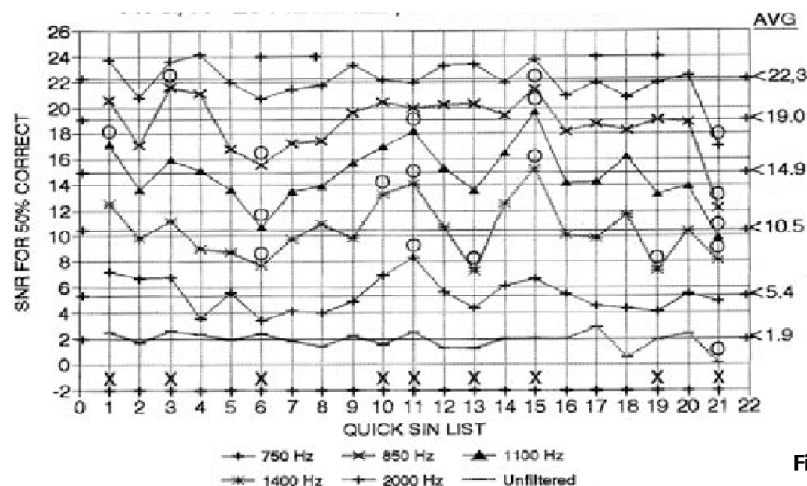


Figure 5

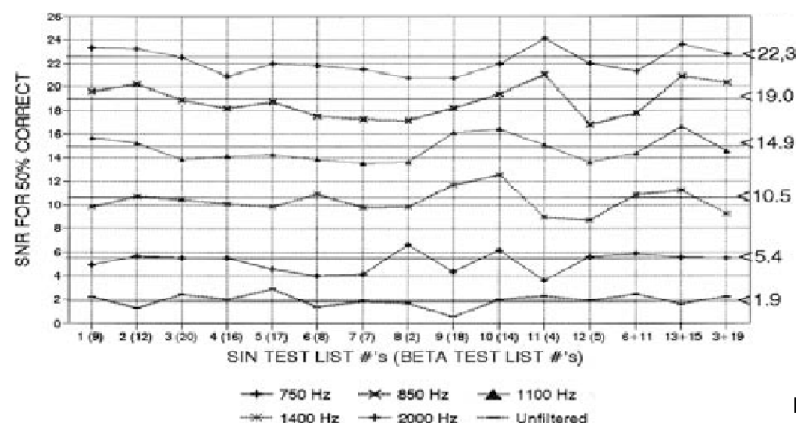


Figure 6

Figure 5 shows a plot of across-subject QuickSIN Beta averages for 25 normal-hearing adult subjects at each filtering condition. The twelve lists without an X exhibited SNR-50 values at *each* filtering condition that fell within ± 2.2 dB of the grand average. *In addition, three pairs of lists were found whose pair average met those criteria. (Typically one list score would be high and the other would be low under similar conditions.) By adding those paired lists, a total of 15 equivalent lists became available (12 lists plus 3 list pairs).*

Figure 6 shows a plot of the across-subject average data (renumbered lists) for the lists included on the final *QuickSIN* CD.

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RELIABILITY (STATISTICS MADE USEFUL)

A **QuickSIN** score obtained in one minute from a single list is accurate to about 1.8 dB at the 80% confidence level. By “about” we mean that 80% of the time (four times out of five) the “true” score (obtained from many lists) will be within 1.8 dB of the single-list test score. Statisticians would say we have “an 80% confidence level” that the true **QuickSIN** score will be within ± 1.8 dB of the measured score. To put these numbers in perspective, a typical clinical threshold is accurate to about 5 dB at the 80% confidence level. In other words, one time out of five a threshold can be expected to be 5 dB or more above or below the recorded value. An 80% confidence level is normally adequate for clinical testing, where the results of any one test are used in context with other factors. In the case of a test of SNR Loss, for example, the clinician will already have formed an idea of the patient’s communication difficulty from conversations with the patient. A 95% confidence level is common for research reporting, where a reduced risk of error is normally required. Using a statistical criterion that gives a 95% confidence level reduces the probability of error to one time in twenty.

Table 3 below shows the number of lists required for a given accuracy for confidence levels of 80%, 90% and 95%.

Table 3

| Number of Lists | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 95% C.I. \pm , in dB | 2.7 | 1.9 | 1.6 | 1.4 | 1.2 | 1.1 | 1.0 | 1.0 | 0.9 |
| 90% C.I. \pm , in dB | 2.2 | 1.6 | 1.3 | 1.1 | 1.0 | 0.9 | 0.8 | 0.8 | 0.7 |
| 80% C.I. \pm , in dB | 1.8 | 1.3 | 1.0 | 0.9 | 0.8 | 0.7 | 0.7 | 0.6 | 0.6 |

The numbers in Table 3 are based on the rms average standard deviation of 1.4 dB in SNR found for the hearing-impaired subjects included in the Beta-site testing. This figure comes from two numbers: a) the 1.3 standard deviation derived from the combined individual test-retest scores, and b) the across-list standard deviation of 0.6 dB. If only normal-hearing subjects are used, the appropriate standard deviation drops from 1.4 dB to 1.25 dB. A standard deviation of 1.4 dB is slightly better than the standard deviation which would have been expected based on the original SIN Test. That standard deviation of 0.7 dB, multiplied by the square root of five, would predict a standard deviation of 1.6 dB for the **QuickSIN** test which uses only one sentence at each level compared to five sentences at each level on the SIN Test. The more careful preselection of sentences used in the **QuickSIN** test may have contributed to the slightly better result.

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COMPARISON BETWEEN TWO CONDITIONS

Averaging the results of several **QuickSIN** lists improves the reliability compared to a single list. This is particularly important when **QuickSIN** lists are used to compare two conditions, often two hearing aids or hearing aid adjustments. In this case, the real differences may not be large.

Table 4 below gives the number of lists required for the *comparison between two conditions* at an 80%, 90% or 95% confidence level. For a critical difference of 1.9 dB, for example, four lists are required for *each* condition at the 95% level. For a critical difference of 1.4 dB at the 95% confidence level, eight lists are required for each condition. For a simple example, one list in each condition with the assumed standard deviation of 1.4 dB gives a 95% confidence level of $1.96 \times 1.41 \times 1.4 = 3.9$ dB.

To improve from 80% to 95% confidence level at a given criterion requires an approximate doubling of test time. Example: Two lists in each condition gives a 1.8 dB critical difference at the 80% confidence level; four lists in each condition provide 1.9 dB at the 95% confidence level, and five lists in each condition provide 1.7 dB at the 95% confidence level.

Table 4

| Lists per Condition | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|----------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| 95% C.D. \pm , in dB | 3.9 | 2.7 | 2.2 | 1.9 | 1.7 | 1.6 | 1.5 | 1.4 | 1.3 |
| 90% C.D. \pm , in dB | 3.2 | 2.2 | 1.8 | 1.6 | 1.4 | 1.3 | 1.2 | 1.1 | 1.1 |
| 80% C.D. \pm , in dB | 2.5 | 1.8 | 1.5 | 1.3 | 1.1 | 1.0 | 1.0 | 0.9 | 0.8 |

When comparing HFE and HFE-LP conditions for a patient with ski-slope loss, one might well accept an 80% confidence level (one in five chance of being wrong), and consider anything less than 1.5 dB as not practically significant. In this case, Table 4 indicates that three lists in each condition would suffice. This will typically take six minutes, which is relatively small compared to the time often taken fighting feedback. (A relaxed criterion of 1.8 dB would require only two lists in each condition, or four minutes of testing). If the test results indicate that high-frequency emphasis which ends at about 2.5 kHz gives as good or better scores, the clinician can abandon the feedback fight without guilt.

MA 42 Operating Instructions

LISTS 1-6

List 1

TRACKS 3, 24, 36, 52

Score

1. A white silk jacket goes with any shoes. S/N 25 _____
 2. The child crawled into the dense grass. S/N 20 _____
 3. Footprints showed the path he took up the beach. S/N 15 _____
 4. A vent near the edge brought in fresh air. S/N 10 _____
 5. It is a band of steel three inches wide. S/N 5 _____
 6. The weight of the package was seen on the high scale. S/N 0 _____
- 25.5 - TOTAL = _____ SNR loss **TOTAL** _____

List 4

TRACKS 6, 27, 39, 55

Score

1. The sense of smell is better than that of touch. S/N 25 _____
 2. He picked up the dice for a second roll. S/N 20 _____
 3. Drop the ashes on the worn old rug. S/N 15 _____
 4. The couch cover and hall drapes were blue. S/N 10 _____
 5. The stems of the tall glasses cracked and broke. S/N 5 _____
 6. The cleat sank deeply into the soft turf. S/N 0 _____
- 25.5 - TOTAL = _____ SNR loss **TOTAL** _____

List 2

TRACKS 4, 25, 37, 53

Score

1. Tear a thin sheet from the yellow pad. S/N 25 _____
 2. A cruise in warm waters in a sleek yacht is fun. S/N 20 _____
 3. A streak of color ran down the left edge. S/N 15 _____
 4. It was done before the boy could see it. S/N 10 _____
 5. Crouch before you jump or miss the mark. S/N 5 _____
 6. The square peg will settle in the round hole. S/N 0 _____
- 25.5 - TOTAL = _____ SNR loss **TOTAL** _____

List 5

TRACKS 7, 28, 40, 56

Score

1. To have is better than to wait and hope. S/N 25 _____
 2. The screen before the fire kept in the sparks. S/N 20 _____
 3. Thick glasses helped him read the print. S/N 15 _____
 4. The chair looked strong but had no bottom. S/N 10 _____
 5. They told wild tales to frighten him. S/N 5 _____
 6. A force equal to that would move the earth. S/N 0 _____
- 25.5 - TOTAL = _____ SNR loss **TOTAL** _____

List 3

TRACKS 5, 26, 38, 54

Score

1. Pitch the straw through the door of the stable. S/N 25 _____
 2. The sink is the thing in which we pile dishes. S/N 20 _____
 3. Post no bills on this office wall. S/N 15 _____
 4. Dimes showered down from all sides. S/N 10 _____
 5. Pick a card and slip it under the pack. S/N 5 _____
 6. The store was jammed before the sale could start. S/N 0 _____
- 25.5 - TOTAL = _____ SNR loss **TOTAL** _____

List 6

TRACKS 8, 29, 41, 57

Score

1. The leaf drifts along with a slow spin. S/N 25 _____
 2. The pencil was cut to be sharp at both ends. S/N 20 _____
 3. Down that road is the way to the grain farmer. S/N 15 _____
 4. The best method is to fix it in place with clips. S/N 10 _____
 5. If you mumble your speech will be lost. S/N 5 _____
 6. A toad and a frog are hard to tell apart. S/N 0 _____
- 25.5 - TOTAL = _____ SNR loss **TOTAL** _____

MA 42 Operating Instructions

LISTS 7-12

List 7

TRACKS 9, 30, 42, 58

Score

1. The kite dipped and swayed, but stayed aloft. S/N 25 _____
 2. The beetle droned in the hot June sun. S/N 20 _____
 3. The theft of the pearl pin was kept secret. S/N 15 _____
 4. His wide grin earned many friends. S/N 10 _____
 5. Hurdle the pit with the aid of a long pole. S/N 5 _____
 6. Peep under the tent and see the clown. S/N 0 _____
- 25.5 - TOTAL = _____ SNR loss TOTAL _____

List 10

TRACKS 12, 33, 45, 61

Score

1. Dots of light betrayed the black cat. S/N 25 _____
 2. Put the chart on the mantel and tack it down. S/N 20 _____
 3. The steady drip is worse than a drenching rain. S/N 15 _____
 4. A flat pack takes less luggage space. S/N 10 _____
 5. The gloss on top made it unfit to read. S/N 5 _____
 6. Seven seals were stamped on great sheets. S/N 0 _____
- 25.5 - TOTAL = _____ SNR loss TOTAL _____

List 8

TRACKS 10, 31, 43, 59

Score

1. The sun came up to light the eastern sky. S/N 25 _____
 2. The stale smell of old beer lingers. S/N 20 _____
 3. The desk was firm on the shaky floor. S/N 15 _____
 4. A list of names is carved around the base. S/N 10 _____
 5. The news struck doubt into restless minds. S/N 5 _____
 6. The sand drifts over the gill of the old house. S/N 0 _____
- 25.5 - TOTAL = _____ SNR loss TOTAL _____

List 11

TRACKS 13, 34, 46, 62

Score

1. The marsh will freeze when cold enough. S/N 25 _____
 2. A gray mare walked before the colt. S/N 20 _____
 3. Bottles hold four kinds of rum. S/N 15 _____
 4. He wheeled the bike past the winding road. S/N 10 _____
 5. Throw out the used paper cup and plate. S/N 5 _____
 6. The wall phone rang loud and often. S/N 0 _____
- 25.5 - TOTAL = _____ SNR loss TOTAL _____

List 9

TRACKS 11, 32, 44, 60

Score

1. Take shelter in this tent, but keep still. S/N 25 _____
 2. The little tales they tell are false. S/N 20 _____
 3. Press the pedal with your left foot. S/N 15 _____
 4. The black trunk fell from the landing. S/N 10 _____
 5. Cheap clothes are flashy but don't last. S/N 5 _____
 6. At night the alarm roused him from a deep sleep. S/N 0 _____
- 25.5 - TOTAL = _____ SNR loss TOTAL _____

List 12

TRACKS 14, 35, 47, 63

Score

1. The hinge on the door creaked with old age. S/N 25 _____
 2. The bright lanterns were gay on the dark lawn. S/N 20 _____
 3. He offered proof in the form of a large chart. S/N 15 _____
 4. Their eyelids droop for want of sleep. S/N 10 _____
 5. There are many ways to do these things. S/N 5 _____
 6. We like to see clear weather. S/N 0 _____
- 25.5 - TOTAL = _____ SNR loss TOTAL _____

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LISTS 13-18 (PAIRS)

Lists 13-18 do not meet the criteria for equivalence as individual lists, but do in the pairs shown. The average scores from list pairs 13/14, 15/16 and 17/18 are equivalent to lists 1-12.

List 13

TRACKS 15, 48, 64

Score

1. The dusty bench stood by the stone wall. S/N 25 _____
 2. We dress to suit the weather of most days. S/N 20 _____
 3. The water in this well is a source of good health. S/N 15 _____
 4. That guy is the writer of a few banned books. S/N 10 _____
 5. The door was barred, locked and bolted as well. S/N 5 _____
 6. A big wet stain was on the round carpet. S/N 0 _____
- 25.5 - TOTAL = _____ SNR loss **TOTAL** _____

List 14

TRACKS 16, 49, 65

Score

7. The team with the best timing looks good. S/N 25 _____
 8. Sit on the perch and tell the others what to do. S/N 20 _____
 9. The early phase of life moves fast. S/N 15 _____
 10. Tea in thin china has a sweet taste. S/N 10 _____
 11. The latch on the back gate needs a nail. S/N 5 _____
 12. A whiff of it will cure the most stubborn cold. S/N 0 _____
- 25.5 - TOTAL = _____ SNR loss **TOTAL** _____

List 15

TRACKS 17, 50, 66

Score

1. Poached eggs and tea must suffice. S/N 25 _____
 2. They sang the same tunes at each party. S/N 20 _____
 3. A gold vase is both rare and costly. S/N 15 _____
 4. Cod is the main business of the north shore. S/N 10 _____
 5. A round mat will cover the dull spot. S/N 5 _____
 6. A good book informs of what we ought to know. S/N 0 _____
- 25.5 - TOTAL = _____ SNR loss **TOTAL** _____

List 16

TRACKS 18, 51, 67

Score

7. The thaw came early and freed the stream. S/N 25 _____
 8. It takes a lot of help to finish these. S/N 20 _____
 9. Roads are paved with sticky tar. S/N 15 _____
 10. It's a dense crowd in two distinct ways. S/N 10 _____
 11. Raise the sail and steer the ship northward. S/N 5 _____
 12. Jerk the dart from the cork target. S/N 0 _____
- 25.5 - TOTAL = _____ SNR loss **TOTAL** _____

List 17

TRACK 19

Score

1. The point of the steel pen was bent and twisted. S/N 25 _____
 2. There is a lag between thought and act. S/N 20 _____
 3. Seed is needed to plant the spring corn. S/N 15 _____
 4. This horse will nose his way to the finish. S/N 10 _____
 5. The dry wax protects the deep scratch. S/N 5 _____
 6. Twist the valve and release hot steam. S/N 0 _____
- 25.5 - TOTAL = _____ SNR loss **TOTAL** _____

List 18

TRACK 20

Score

7. Read just what the meter says. S/N 25 _____
 8. Clams are small, round, soft, and lasty. S/N 20 _____
 9. The line where the edges join was clean. S/N 15 _____
 10. A round hole was drilled through the thin board. S/N 10 _____
 11. The cloud moved in a stately way and was gone. S/N 5 _____
 12. A plea for funds seems to come again. S/N 0 _____
- 25.5 - TOTAL = _____ SNR loss **TOTAL** _____

MA 42 Operating Instructions

APPENDIX A

CATEGORIES OF LOUDNESS

7. Uncomfortably Loud
6. Loud, But OK
5. Comfortable, But Slightly Loud
4. Comfortable
3. Comfortable, But Slightly Soft
2. Soft
1. Very Soft

Valente and Van Vliet (1997)

MA 42 Operating Instructions

APPENDIX B

TECHNICAL NOTE: CROSSTALK

On Tracks 24-35, the target speech and the babble are recorded on separate channels, but a small amount of interchannel crosstalk (-65 dB) exists on the *QuickSIN* CD. The typical CD player with a 1/8th-inch stereo plug can increase the crosstalk another 20-30 dB, and most cassette players have even greater crosstalk between their magnetic playback heads. Under normal conditions none of these levels will be audible, but during silent periods on the sentence channel, a faint babble can sometimes be heard in the background. None of these crosstalk levels will affect normal usage of these tracks.

MA 42 Operating Instructions

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MA 42 Operating Instructions

QuickSIN™ Speech-in-Noise Test

| | |
|---------------------|--|
| Track 1 | Calibration Tone |
| Track 2 | Identification |
| Tracks 3-14 | QuickSIN Lists 1-12 |
| Tracks 15-20 | QuickSIN List Pairs 13/14, 15/16, 17/18 |
| Tracks 21-23 | Practice Lists A, B, C |
| Tracks 24-35 | Separated Speech and Babble |
| Tracks 36-47 | HFE: Lists 1-12 (30 dB high-frequency emphasis) |
| Tracks 48-51 | HFE List Pairs 13/14, 15/16 |
| Tracks 52-63 | HFE-LP Lists 1-12 (HFE plus 3 kHz low-pass) |
| Tracks 64-67 | HFE-LP List Pairs 13/14, 15/16 |
| Track 68 | Speech Spectrum Noise Recorded at 0 VU re: cal tone on Track 1 |
| Track 69 | Pink Noise Recorded at 0 VU re: cal tone on Track 1 |

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Re-recording: Larry Revit / Revitronix

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MA 42 Operating Instructions

Appendix C: EMC Compatibility

Portable and Mobile RF communications equipment can affect the MAICO MA 42. Install and operate the MAICO MA 42 according to the EMC information presented on this page and the next 4 pages.

The MAICO MA 42 has been tested for EMC emissions and immunity as a standalone instrument. Do not use the MAICO MA 42 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 MAICO 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. UL 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

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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 MAICO MA 42 is intended for use in the electromagnetic environment specified below. The customer or the user of the MAICO MA 42 should assure that it is used in such an environment. | | |
| Emissions Test | Compliance | Electromagnetic environment - Guidance |
| RF Emissions CISPR 11 | Group 1 | The MAICO MA 42 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. The MAICO MA 42 is suitable for use in all commercial, industrial, business, hospital, and residential environments. |
| RF Emissions CISPR 11 | Class B Limits | |
| Harmonic Emissions IEC 61000-3-2 | Class A Category | |
| Voltage Fluctuations / Flicker Emissions IEC 61000-3-3 | Complies | |

MA 42 Operating Instructions

Recommended Separation Distances between Portable and Mobile RF Communications Equipment and the MAICO MA 42

The MAICO MA 42 is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the MAICO MA 42 can help prevent electromagnetic interferences by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the MAICO MA 42 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 $d = 1.17\sqrt{P}$ | 80 MHz to 800 MHz $d = 1.17\sqrt{P}$ | 800 MHz to 2.5 GHz $d = 2.23\sqrt{P}$ |
| 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.

MA 42 Operating Instructions

| Guidance and Manufacturer's Declaration - Electromagnetic Immunity | | | |
|---|--|--|---|
| The MAICO MA 42 is intended for use in the electromagnetic environment specified below. The customer or the user of the MA 42 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 | ± 6 kV contact ± 8 kV air | ± 6 kV contact ± 8 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 | $<5\%$ UT ($>95\%$ dip in UT) for 0.5 cycle 40% UT (60% dip in UT) for 5 cycles 70% UT (30% dip in UT) for 25 cycles 5% UT ($>95\%$ dip in UT) for 5 sec | $<5\%$ UT ($>95\%$ dip in UT) for 0.5 cycle 40% UT (60% dip in UT) for 5 cycles 70% UT (30% dip in UT) for 25 cycles 5% UT ($>95\%$ dip in UT) for 5 sec | Mains power quality should be that of a typical commercial, hospital, or residential environment. If the user of the MAICO MA 42 requires continued operation during power mains interruptions, it is recommended that the MA 42 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: UT is the a.c. mains voltage prior to application of the test level. | | | |

MA 42 Operating Instructions

| Guidance and Manufacturer's Declaration - Electromagnetic Immunity | | | |
|--|---|---------------------|---|
| The MAICO MA 42 is intended for use in the electromagnetic environment specified below. The customer or the user of the MA 42 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 | <p>Portable and mobile RF communications equipment should be used no closer to any part of the MA 42, including cables than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter.</p> <p>Recommended separation distance</p> $d = 1.17\sqrt{P}$ $d = 1.17\sqrt{P} \quad 80 \text{ MHz to } 800 \text{ MHz}$ $d = 1.17\sqrt{P} \quad 800 \text{ MHz to } 2.5 \text{ GHz}$ <p>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:</p>  |
| <p>Note 1: At 80 MHz and 800 MHz, the higher frequency range applies.</p> <p>Note 2: These guidelines may not apply to all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.</p> | | | |

(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 MA 42 is used exceeds the applicable RF compliance level above, the MA 42 should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the MA 42.

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

Specifications are subject to change without notice



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