The Phoenix Automated McCormick Toy Discrimination Tester

INSTRUCTIONS FOR USE
Release 3.0

Electrical Safety

The Phoenix Toy Discrimination Tester complies with the requirements of BS EN 60950-1: 2002 and therefore satisfies the essential requirements of the Low Voltage Directive 73/23/EEC.

The Phoenix is supplied with a compliant 9-18V DC SELV power source.

Under no circumstances should the Phoenix be used with a non-approved power source.

The Phoenix is supplied with a 15v 500mA external power regulator with a 2.1mm connector fitted as shown below.

⊖—(●—⊕ Tip is positive

Warning

This is a class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

Care of this product

When using electrical appliances, basic precautions should always be followed to reduce the risk of electric shock or injury, including the following:
• Read all instructions.
• Do not operate the appliance with a damaged cord or plug or if the device malfunctions, has been dropped or is damaged in any manner.
• If the device should fail despite the care taken in manufacture and testing, the device should be returned to Soundbyte Solutions (UK) Ltd.
• Never wipe with scouring powders, hand implements or alcohol based cleaner.
• Do not immerse cord, plug or device in water.
• Wipe clean with a soft cloth.

• **Before performing any maintenance tasks on the Phoenix please ensure that it is disconnected from 240v mains supply.**

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Introduction

This handbook describes the operation of the Phoenix Automated McCormick Toy Discrimination Test developed by Soundbyte Solutions (UK) Ltd in collaboration with the Institute of Hearing Research (IHR). The Phoenix provides facilities for performing a toytest in quiet, toytest in noise, and warble tones presented in either dB(A) or dB(SPL).

When assessing hearing loss in young and difficult-to-test children, the most trustworthy measures are obtained when more than one technique is attempted. Usually, the "best" value should be taken, if replicable, ie not just a single observation. The Phoenix Automated McCormick Toy Discrimination Tester adds to the repertoire in an important way, but no claim is made that use of other techniques is thereby rendered unnecessary.

The Phoenix is extremely simple to set up. The unit consists of a handset controller and a single speaker. The speaker is mounted on a rigid stand and should be connected to a convenient 240v supply using the DC adaptor provided. The speaker and handset should be connected to each other using the supplied lead.

The user interface is largely menu driven. This makes the Phoenix very easy to use whilst providing a great deal of flexibility. In order to keep the keypad layout as simple as possible, most keys have more than one function. The three possible modes are:

The function of each key will depend on which mode the user has selected, and will change automatically. These changes should be self-evident and will be described in greater detail later in this document.

1.0 Setting up

At the beginning of each testing session, the Phoenix should be positioned and assembled in the following manner:

! Position the speaker and stand such that the front face of the speaker is 1 metre from the anticipated position of the child's ear.

! Adjust the height of the speaker stand to set the centre of the speaker at roughly the same height as the anticipated position of the child's ear.

! Connect the handset to the speaker unit using the cable supplied.

! Connect the DC adaptor to the power connector on the rear of the speaker unit. Plug the DC adaptor into the mains supply and switch on using the switch on the back of the speaker. The handset should now display the current software revision.

! Press any key to clear the display and begin testing.

```
PHOENIX

Release 2.0


Press any key
```
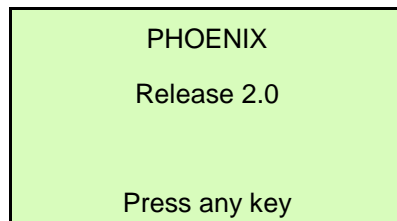
By pressing a key you will activate the main menu (section 2.2).

2.0 Using the Phoenix

The following sections describe how to navigate the Phoenix menu structures and how to use the Phoenix to perform toytests and warble tests.

2.1 Menu navigation

The Phoenix is a menu driven device, so it is essential that the user be familiar with the menu structures and method of navigation. We have made every effort to keep this as simple as possible whilst maintaining a high level of user control over the Phoenix operation. The menu navigation functions are summarised in the table below:

⬆	Moves the selection cursor 1 line up the display screen.
⬇	Moves the selection cursor 1 line down the display screen.
Yes	Selects the current menu option on the display screen: i.e. the option next to the menu cursor.

2.2 Main menu

The main menu is used to select either the type of test to run, or user setup options. The menu options are shown below:

Menu option	Action
TOYTEST	Use this option to go to the toytest start menu. From here run the toytest in quiet or toytest in noise (section 2.3).
WARBLE TEST	Use this option to go to the warble test menu. From here you can run warble tests calibrated in dB(A) or dB(SPL) (section 2.4).
CAL CHECK	Use this option to play a short burst of masking noise at a level of 60 dB(A). Use a Sound Level Meter to check the output level and if necessary adjust the calibration knob on the rear of the loudspeaker (section 3.1).
SETUP	Use this option to enter the setup routine. This allows you to adjust the individual calibration settings for each target word and warble tone (section 3.2).

2.3   Toytest start menu

From the toytest start menu you can either select testing in quiet or testing in noise. You can also select the toy pair enable/disable routine, prior to testing. The toytest menu options are shown below:

Menu option	Action
TEST IN QUIET	Begin the toytest algorithm in quiet conditions (section 2.3.1).
TEST IN NOISE	Begin the toytest algorithm in noise (section 2.3.3).
SELECT TOYS	This option will enable the select toys routine. This allows you to add or remove toy pairs from the testing algorithm (section 2.3.6).
GO BACK	Returns to main menu (section 2.2).

2.3.1   Toytest in quiet

For a complete description of the functions associated with each key during the toytest see section 2.3.4.

If you haven't already done so, you can select/deselect toy pairs by pressing the <Menu> key. This will take you to the toytest option menu (section 2.3.5). Then choose the [SELECT TOYS] option. See section 2.3.6 for further details of the select toys routine. You can enter the toytest option menu whenever the handset is displaying the 'Next word' prompt.

The Phoenix will output randomly selected target words preceded by a lead in phrase. The output level of the stimuli is controlled by an adaptive rule which varies the intensity depending on whether the last toy was correctly, or incorrectly identified. The adaptive rule estimates the levels at which 71% of the presented words are correctly identified. This is undertaken in two stages:

Homing-in stage - to quickly get within the appropriate range, the first stage requires 2 reversals using a simple 1 down, 1 up rule with 12 dB steps.

Testing stage - the second stage employs a 2 down, 1 up rule with 6 dB steps and will end after 6 reversals. The choices of step size and number of reversals have been empirically determined to minimize the test-retest variability whilst achieving rapid convergence.

Having selected [TEST IN QUIET] from the toytest menu (section 2.3), the handset display will show the following message:

```
      READY TO START



       Press any key
```

Press any key to begin the test and the display will change as shown below:

```
        Next word

        Plane (72)

      Threshold =  00

      Reversals  =  00
```

Pre-defined dB offsets are used for each word in order that they are presented with equal difficulty. In this example, the unit has selected 'Plane' at random from the enabled toy pairs. The initial presentation level is 72 dB(A) and of course the displayed threshold and reversal count are zero at the start of the test.

The display indicates the next word to be spoken and the level at which the word will be output. Pressing the <Play> key will produce the output.

The display will change again to indicate that the word 'Plane' has been spoken. This is your prompt to press <Yes> or <No> depending on whether the word was correctly identified.

```
Word spoken

Plane (72)

Threshold  =  00

Reversals  =  00
```

If the child correctly identified the toy, the presentation level will be lowered to 60 dB(A) and a new target word selected from the enabled toy pairs. The display will indicate the next word selected.

```
Next word

Shoe (60)

Threshold  =  00

Reversals  =  00
```

Again, you should press <Play>. Following the speech output, the display will change to indicate the word spoken, which is your prompt to enter if the word was correctly identified.

The adaptive routine controlling the intensity will quickly reduce the stimulus level close to the hearing threshold for the child. As the test progresses and the presentation level drops, the child will be unable to identify the target word. When this occurs press the <No> key. This will result in the output level being increased and the reversal count recalculated. After 2 reversals using the 1 down, 1 up rule, the reversal counter will be reset to zero and the step size will be reduced to 6 dB. This is the start of the hearing threshold calculation algorithm. The hearing threshold will now be re-calculated each time a reversal occurs using the more complex 2 down, 1 up rule.

As each estimate for the hearing threshold is calculated, it is displayed on the handset along with the number of reversals used in calculating the threshold. The greater the number of reversals, the greater the accuracy of the threshold figure. The unit has been programmed to require 6 reversals to reach the end of the test.

```
Next word

Horse (30)

Threshold  =  28

Reversals  =  04
```

In this example, the calculated threshold is 28 dB after 4 reversals.

If the child is distracted whilst listening, it is possible to repeat the test phrase (at the same level) by pressing the <Repeat> key. Another lead in phrase such as 'point to the ... ' or 'show me the ...' will be used during the <Repeat> phase.

If, whilst the level is low, the child becomes uninterested, it may be possible to regain interest by repeating some toy names at a louder level. The <Repeat Louder> key adds 12 dB(A) to the test level and repeats the stimulus each time it is pressed. It is therefore possible to boost the test level up to the maximum level.

During the <Repeat Louder> phase, the threshold calculation is suspended. The handset will display a '#' symbol next to the threshold value to indicate this condition.

```
          Next word

          Horse (42)

       Threshold  =  28#

       Reversals  =  04
```

Having pressed <Repeat Louder> the function of the other keys is changed slightly (see section 2.3.4).

Repeat	Causes the phrase to be repeated at the new boosted level.
Yes	Causes the test to return to the same state as it was prior to entering <Repeat Louder> mode.
No	Causes a new toy to be presented at the new boosted level.

The test phase will continue with the adaptive algorithm controlling the presentation level and calculating the threshold. When the number of reversals reaches 6 and the end of the test has been reached, a beep will sound to indicate that the test is complete.

```
         Test Complete

         Press any key

       Threshold  =  28

       Reversals  =  06
```

You should note down the threshold value before pressing any key, which will take you to the toytest complete menu (section 2.3.2).

2.3.2   Toytest complete menu

The menu allows the user to access the following functions:

Menu option	Action
REPEAT TOYTEST	Go to the start of the toytest routine using the same toys as used in the previous test (section 2.3.1).
NEW TOYTEST	Go to the start of the toytest routine with all toy pairs enabled (section 2.3).
EXIT TOYTEST	Return to the select test menu (section 2.2).

2.3.3   Toytest in noise

The toytest in noise routine is run in exactly the same way as the toytest in quiet. The only difference being that the masker noise is gated on just prior to the speech output and remains on for the duration of the speech. The masker noise level remains constant at 60 dB(A) for its duration.

In addition, the attenuator step sizes are halved to 6 dB during the homing in stage and 3 dB for the testing stage.

2.3.4   Toytest keyboard summary

The function of each key during the toytest phase can be summarised as follows:

MENU	Press to access the toytest menu
Repeat Louder	Press to repeat louder, i.e. to attract the child's attention. Repeat Louder is ignored by the adaptive algorithm and persists until the next press of the <Yes> key.
Repeat	Press to repeat a word at the same level, e.g. if the child was not paying attention. (Only the last repeat is used by the adaptive algorithm).
Play	Press to play the current test word.
Yes	Press if the response was correct. This will input the presentation level into the threshold calculation routine and select the next test phrase and update the presentation level.
No	Press if the response was incorrect. This will input the presentation level into the threshold calculation routine and select the next test phrase and update the presentation level.

Key functions are changed during the <Repeat Louder> phase and are summarised as follows:

MENU	Press to access the toytest menu
Repeat Louder	Adds another 12 dB to the presentation level and repeats the current word.
Repeat	Repeats the current word at the current (increased) test level.
Play	Press to play the current test word.
Yes	Returns to the test exactly as it was before entering the <Repeat Louder> phase.
No	Choose a new target word and repeat the sentence with the new word.

2.3.5   Toytest option menu

The menu allows the user to access the following functions:

Menu option	Action
SELECT TOYS	This option will enable the select toys routine. This allows you to add or remove toy pairs from the testing algorithm (section 2.3.6).
EXIT TOYTEST	This option will abandon the current toytest and jump to the end of test menu (section 2.3.2).
GO BACK	Returns to toytest routine.

2.3.6   Selecting toy pairs

When you enter the select toy pairs routine either from the toytest start menu or the toytest option menu, the screen will change as shown below:

• KEY	TREE
SPOON	SHOE
COW	HOUSE
PLANE	PLATE

Screen 1

The remaining toy pairs are displayed on a second screen as shown below: You can move between displays by moving the curser control with the menu up and menu down keys. The screens will scroll between the two options automatically.

• HORSE	FORK
DUCK	CUP
MAN	LAMB #

Screen 2

This pair has been disabled

In this example, the pair 'Man & Lamb' have been excluded from the test by pressing the <No> key when the cursor is next to MAN. The action associated with each key is summarised below:

MENU	Press to return to the point at which you called this menu.
⬆	Move the curser up one line. If you are at the top of page 2, the display will change to screen 1 with the curser at the bottom.
⬇	Move the curser down one line. If you are at the bottom of page 1, the display will change to screen 2 with the curser at the top.
Play	Press to return to the point at which you called this menu.
Yes	Enable the selected toy pair.
No	Disable the selected toy pair. The disabled pair will be marked with a # character.

2.4   Warble tone tests

To access the warble tone generator functions you should select [WARBLE TEST] from the main menu. You can then select either [WARBLE dB(A)] or [WARBLE dB(SPL)] from the warble tone test menu.

Once you have selected your test, the keys on the handset will have the following instructions:

MENU	Press to access the warble test menu.
dB up	Press this key to increment the dB level by one step size. This key will have no effect if the output is already at the maximum level.
dB down	Press this key to decrement the dB level by one step size. This key will have no effect if the output is already at the minimum level.
Play	Press to play the current warble tone for a period of 2 seconds.
Hz up	Press to select the next higher frequency setting. This key has no effect if you have already selected the maximum frequency of 5000 Hz.
Hz down	Press to select the next lower frequency setting. This key has no effect if you have already selected the minimum frequency of 250 Hz.

Warble tone tests must be conducted manually, ie. there is no built in algorithm to determine the hearing threshold at each frequency.

The warble tone generator has been factory calibrated and provided you have set up your Phoenix correctly and performed a calibration check, the warble tone output levels should be correct. There are two sets of warble tone calibration offsets built into the unit; dB(SPL) and dB(A). There are currently no universal standards for calibration of free field warble tones and the provision of both allows the user to select according to local custom.

There are a range of problems associated with any use of sounds in the free field. These problems include standing waves due to reflections from the walls and furniture within a room. The Phoenix calibration will only therefore be correct in the room in which it was calibrated. However, it should provide reasonably accurate output in most rooms used for clinical testing.

If large variations from the expected output are observed then we suggest the following:

1.   Modify the layout of your equipment. For example, it is a good idea to point the loudspeaker into a corner rather than directly at a flat surface.

2.   If equipment positioning fails to resolve the problem, then you will need to run the routine to calibrate warble tones. From the main menu select [SETUP] and then select [CAL WARBLE] (section 3.2.3).

2.4.1 The warble tone setup menu

The menu allows the user to access the following functions:

Menu Option	Action
SET STEP SIZE	Select this option to enter the routine to set the step size (section 2.4.2).
EXIT WARBLE	Select this option to abandon the warble test and return to main menu.
GO BACK	Select this option to return to the warble tone selected.

2.4.2 Select step size

To select the step size required use the blue < ⬆ > and < ⬇ > keys.

The available options are 1, 2, 5 and 10 dB. Press <Yes> to select the step size and return to the warble test. The warble test level will automatically be adjusted to the nearest multiple of the new step size.

3.0　　Calibration and setup

This section describes how to perform a quick calibration check prior to testing and how to perform a thorough calibration for all words and warble tones.

3.1　Quick calibration check

The quick calibration check should be performed each time the equipment layout is changed or prior to each set of tests. The test is very easy to perform.

Using a tripod mounted Sound Level Meter set to read dB(A) at 60 dB, position the microphone facing the Phoenix loudspeaker at a distance of 1m. This should be approximately the position of the child's head when the test procedure is carried out.

From the main menu (section 2.2) select [CAL CHECK]. This will produce a short burst of wideband noise at a level of 60 dB(A). Measure the output with your Sound Level Meter, and if it does not read 60 dB(A) you will need to adjust the calibration knob on the rear of the loudspeaker.

The calibration knob has vernier scale and you should make a note of its setting prior to adjustment. Release the locking lever and rotate the knob, higher numbers mean louder output. You will have to repeat the [CAL CHECK] to test the new setting and repeat until you get a reading of 60 dB(A).

When you are happy with the setting, lock the calibration knob with the locking lever and make a note of the new setting.

3.2　　　Complete calibration

Complete calibration should only be attempted if you are confident the you have the correct equipment and can complete the procedure. You can perform the calibration either on the toytest words or the warble tones, or both. The Phoenix will remember your revised calibration settings and use them for all subsequent tests.

To enter the calibration mode, from the main menu (section 2.2) select [SETUP].

3.2.1　　　Setup menu

This menu is used to select either toytest calibration or warble test calibration as shown below:

Menu Option	Action
CAL TOYTEST	Select this option to enter the routine to calibrate the toy test words (section 3.2.2).
CAL WARBLE	Select this option to calibrate the warble tones (section 3.2.3).
EXIT	Select this option to return to the main menu (section 2.2).

3.2.2   Calibration of toytest words

By selecting [CAL TOYTEST] from the setup menu you will enter the calibration routine for the toy test words. This routine allows you to step forward and backward through the set of words and adjust each one to give the correct output in your test environment.

Setup a Sound Level Meter as described in section 3.1. If the calibration knob is close to its upper limit you may wish to move it back to between 7.0 and 7.5. If you move the calibration knob during this procedure, you must perform both the toytest and warble test calibrations before using the Phoenix clinically.

When you enter this routine, the Phoenix will emit three short beeps and the screen will look like this:

CALIBRATE

TOYTEST

Key
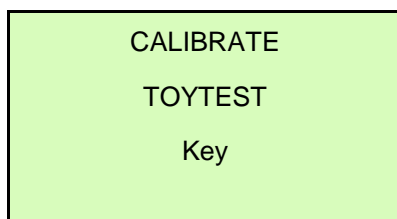
You can now use the keypad to navigate through the test words and adjust each output level as follows:

MENU	Press to return to the setup menu.
dB up	Press this key to raise the output level by one 1 dB for the selected word. To raise the level by 3 dB, press the key three times and then press <Play> to check the result.
dB down	Press this key to lower the output level by 1 dB for the selected word. To lower the level by 3 dB, press the key three times and then press <Play> to check the result.
Play	Press to play the current word with its new calibration setting.
⬆	Store the calibration data and select the next word forward for calibration.
⬇	Store the calibration data and select the next word back for calibration.

As the toy test words are presented at a level which presents equal difficulty, rather than equal intensity, they should be calibrated according to the following table:

| KEY	59.0	TREE	62.0
SPOON	65.0	SHOE	57.0
COW	56.0	HOUSE	60.0
PLANE	61.0	PLATE	63.0
HORSE	61.0	FORK	58.0
DUCK	58.0	CUP	60.0
MAN	62.0	LAMB	58.0

When you are satisfied that all words are correctly calibrated, press the menu key to return to the setup menu (section 2.2).

3.2.3   Calibration of warble tones

By selecting [CAL WARBLE] from the setup menu (section 2.2) you will enter the calibration routine for the warble tones. This routine allows you to step forward and backward through the warble frequencies for both dB(A) and dB(SPL) and adjust each one to give the correct output in your test environment.

Setup a Sound Level Meter as described in section 3.1. If the calibration knob is close to its upper limit you may wish to move it back to between 7.0 and 7.5. If you move the calibration knob during this procedure, you must perform both the toytest and warble test calibrations before using the Phoenix clinically.

When you enter this routine, the Phoenix will emit three short beeps and the screen will look like this:

CALIBRATE

Warble

250 dB(A)
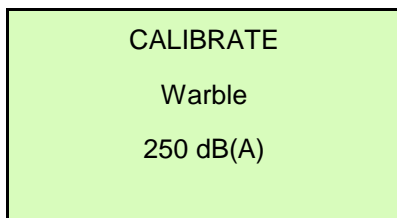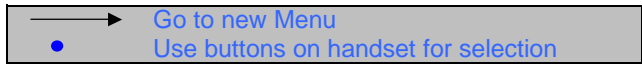
You can now use the keypad to navigate through the warble tones and adjust each output level as follows:

MENU	Press to return to the setup menu.
dB up	Press this key to raise the output level by one 1 dB for the selected frequency. To raise the level by 3 dB, press the key three times and then press <Play> to check the result.
dB down	Press this key to lower the output level by 1 dB for the selected frequency. To lower the level by 3 dB, press the key three times and then press <Play> to check the result.
Play	Press to play the current tone with its new calibration setting.
⬆	Store the calibration data and select the next frequency forward for calibration.
⬇	Store the calibration data and select the next frequency back for calibration.

The calibration sequence is as follows:
250 dB(A), 500 dB(A), 1000 dB(A), 2000 dB(A), 3000 dB(A), 4000 dB(A), 5000 dB(A)
250 dB(SPL), 500 dB(SPL), 1000 dB(SPL), 2000 dB(SPL), 3000 dB(SPL), 4000 dB(SPL), 5000 dB(SPL)

PHOENIX (IHR/AMTT) - MENU STRUCTURE

⟶ Go to new Menu
● Use buttons on handset for selection

INSTRUCTION REF:

NOTES

SECTION 1

```
PHOENIX
REVISON 2.0
Press any key
```

● Press UP/DOWN buttons to move between options
● Press YES buttons to select option

SECTION 2.2

```
TOYTEST
WARBLE TEST
CAL CHECK
SET UP
```
➤ Section 2.2
➤ Section 2.4   See below
   Play 60dB narrow band noise calibration check
➤ Section 3   See below

TOYTEST

SECTION 2.3

```
TEST IN QUIET
TEST IN NOISE
SELECT TOYS
GO BACK
```
➤ Section 2.3.1   Enter toytest routine with selected toys (all selected by default)
➤ Section 2.3.1   Enter toytest routine with selected toys (all selected by default) with noise enabled
➤ Section 2.3.6   Select toy pairs
➤ Section 2.2

SECTION 2.3.6

```
KEY        TREE
SPOON      SHOE
COW        HOUSE
PLANE      PLATE
HORSE      FORK
DUCK       CUP
MAN        LAMB
```

● Press NO button to de-select pairs - it will default to include all pairs unless de-selected. A "#" sign appears next to those de-selected pairs
● Press YES to select a previously de-selected toy pair
● Press UP/DOWN buttons to move between pairs
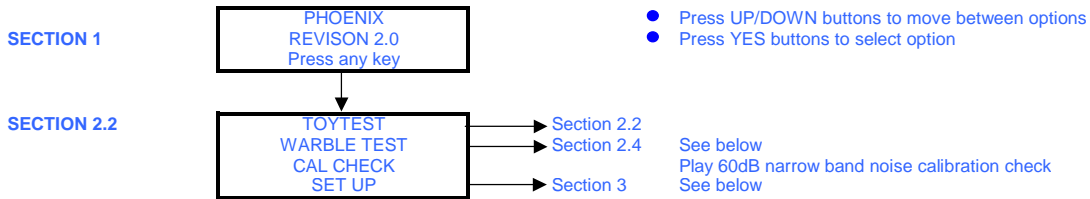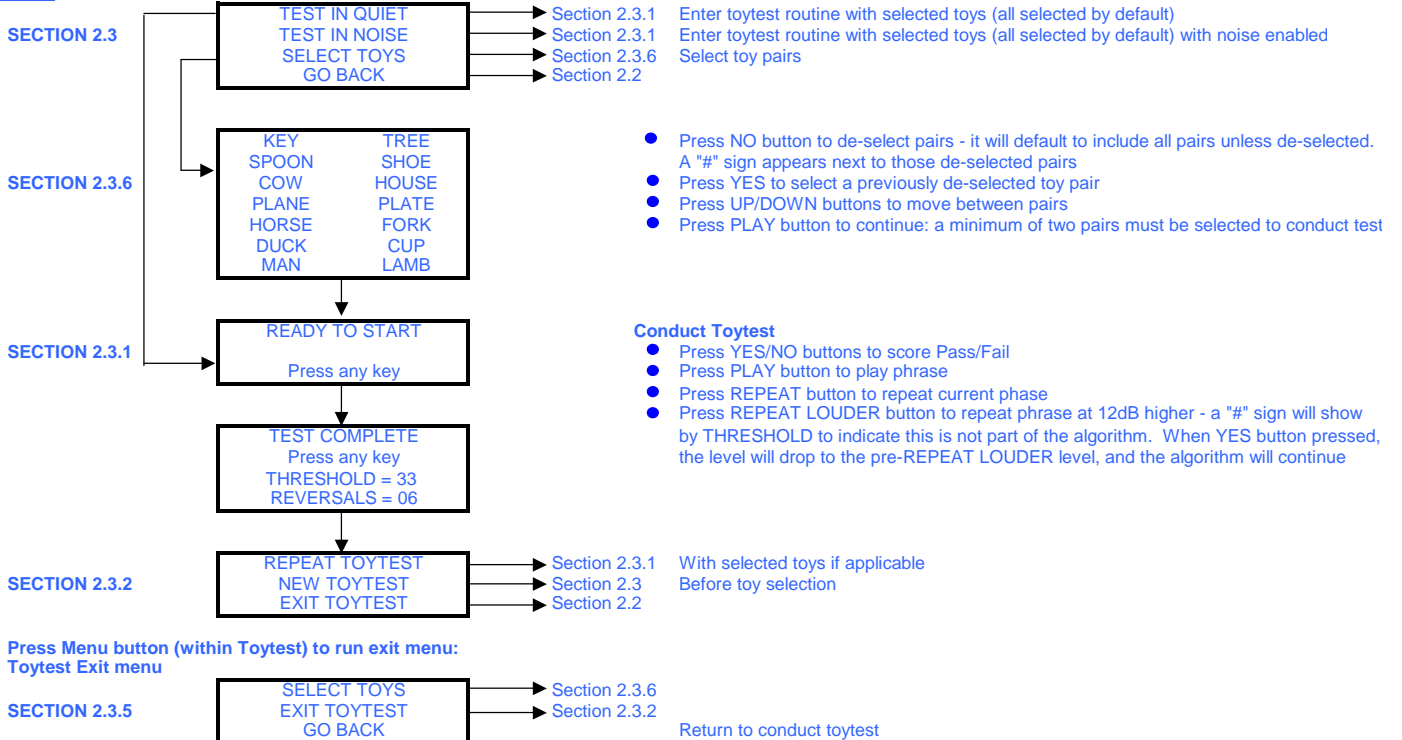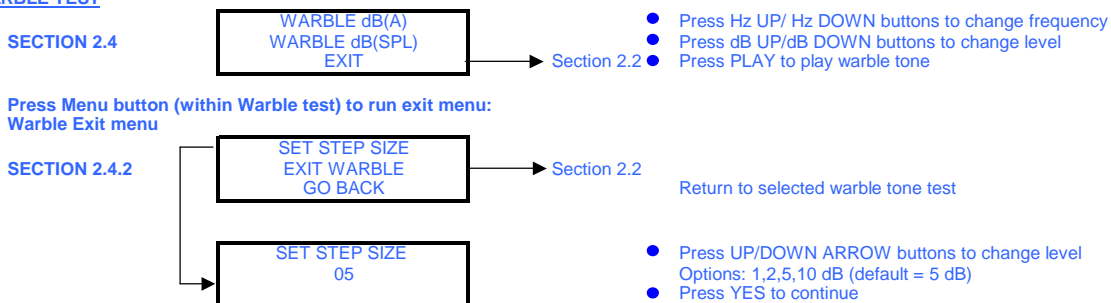● Press PLAY button to continue: a minimum of two pairs must be selected to conduct test

SECTION 2.3.1

```
READY TO START

Press any key
```

Conduct Toytest
● Press YES/NO buttons to score Pass/Fail
● Press PLAY button to play phrase
● Press REPEAT button to repeat current phase
● Press REPEAT LOUDER button to repeat phrase at 12dB higher - a "#" sign will show by THRESHOLD to indicate this is not part of the algorithm. When YES button pressed, the level will drop to the pre-REPEAT LOUDER level, and the algorithm will continue

```
TEST COMPLETE
Press any key
THRESHOLD = 33
REVERSALS = 06
```

SECTION 2.3.2

```
REPEAT TOYTEST
NEW TOYTEST
EXIT TOYTEST
```
➤ Section 2.3.1   With selected toys if applicable
➤ Section 2.3   Before toy selection
➤ Section 2.2

Press Menu button (within Toytest) to run exit menu:
Toytest Exit menu

SECTION 2.3.5

```
SELECT TOYS
EXIT TOYTEST
GO BACK
```
➤ Section 2.3.6
➤ Section 2.3.2
   Return to conduct toytest

WARBLE TEST

SECTION 2.4

```
WARBLE dB(A)
WARBLE dB(SPL)
EXIT
```
● Press Hz UP/ Hz DOWN buttons to change frequency
● Press dB UP/dB DOWN buttons to change level
➤ Section 2.2 ● Press PLAY to play warble tone

Press Menu button (within Warble test) to run exit menu:
Warble Exit menu

SECTION 2.4.2

```
SET STEP SIZE
EXIT WARBLE
GO BACK
```
➤ Section 2.2
   Return to selected warble tone test

```
SET STEP SIZE
05
```
● Press UP/DOWN ARROW buttons to change level
   Options: 1,2,5,10 dB (default = 5 dB)
● Press YES to continue

SET UP

SECTION 3

```
CAL TOYTEST
CAL WARBLE
EXIT
```
   Perform toytest calibration
   Perform warble test calibration
➤ Section 2.2

Press Menu button (within Set-up) to run exit menu:
Set-up Exit menu

```
EXIT
GO BACK
```
➤ Section 2.2
   Return to calibration loop