T10 Ultrasound speaker/Microphone tester

The T10 is an ultrasound speaker with built-in test sounds for testing the performance of ultrasound microphones. If a suitable analog ultrasonic sound source is available, it can be connected to the T10 to play ”any” sounds – such as pre-recorded bat calls.

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GUARANTEE

The T10 (”The product”) is guaranteed against defects in material and workmanship for a period of one year from the date of purchase. In order for the guarantee to be granted, a proof of purchase (normally the original invoice/receipt) is required and the serial number label must not be removed from the product. Pettersson Elektronik AB, Sweden (“Pettersson”) will repair or replace the product if it proves to be defective during the guarantee period, provided it is returned to Pettersson. No other guarantee is expressed or implied.

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3. Repairs done by non-authorized technicians.

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Specifications are subject to change without notice.

Warning

The T10 can emit ultrasound at high sound levels. Prolonged exposure to high intensity ultrasonic signals may cause permanent hearing loss at audible frequencies. Please do not use the T10 close to your ears!

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Getting started

The T10 is powered from a 9V battery and to make the unit ready for use, a battery should first be installed. Remove the battery lid on the back of the case by sliding it in the direction of the arrow and connect the battery to the battery connector, paying attention to the polarity. Put the battery lid back into position and the unit is ready for use.

The T10 has a built-in amplifier and to turn the speaker on, press the ON/OFF push-button once. The green LED will then light. Pressing ON/OFF a second time will turn the unit off*. If the battery voltage is too low, the red LED will light (”BATTERY”). The battery should then be replaced.

Three different operating modes are available:

1. A signal with the frequency 40 kHz is emitted (mode selection switch in position ”40k”). This mode is suitable for a quick check of microphone performance.

2. A multiple-frequency signal (10, 20, 30, 40…… kHz) is emitted (mode selection switch in position ”MULTI”). This mode is suitable for a more advanced, comparative test of microphone performance.

3. An external, analog signal is connected to the speaker (mode selection switch in position ”EXT”). This mode can be used to play all types of ultrasonic signals through the speaker, e.g. from a separate signal generator, digital recorder or sound card. The sound source must be capable of playing signals of the desired frequency.

In order to test the T10 with an ultrasound detector, turn the T10 on by pressing the ON/OFF switch. Set the mode selection switch to the ”40k” position and turn the ultrasound detector on. The 40 kHz signal should be heard as a tone of constant frequency in the detector. Depending on the type of detector, some further adjustments may be required in order to make the signal audible (e.g. if it is a heterodyne detector it should be tuned to a frequency close to 40 kHz).

When using the T10 to test microphone performance, it is important to perform the measurements in a silent environment, i.e. try to minimize other sounds as much as possible.

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* When a new battery has been installed, the T10 automatically enters the ”ON” state (the green LED is lit). If you do not intend to use the speaker immediately after installning the battery, turn the speaker off by pressing the ON/OFF button.

Microphone test mode 1, 40 kHz

This mode is intended for a quick check of the microphone performance. The microphone is tested at a frequency of 40 kHz and the test shows if the microphone performs adequately or not at this frequency. Typically, this also means that the microphone works well at other frequencies. However, for a more accurate performance test, Microphone test mode 2 (Multi) is recommended.

When making acoustic measurements indoors, reflections from the room (walls, floor, ceiling, etc.) will affect the accuracy. In order to minimize such effects, the measurements can be made in an open area outdoors or in a fully damped (anechoic) room. However, if the instructions below are followed, sufficiently accurate results will be obtained also in a moderately damped room (i.e. a room with curtains, carpets and other soft materials).

Place the T10 close to the edge of a table and aim the microphone straight at the center of the speaker opening, perpendicular to the front of the T10:

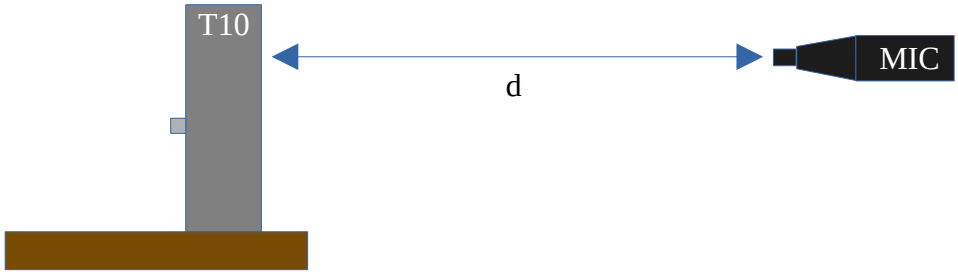

Figure 1. The measurement setup.

How to perform the test, depends on the type of microphone. Below are the instructions for various types of Pettersson microphones/devices. Other Pettersson microphones/detectors than those listed below as well as microphones of other brands can also be tested, e.g. by comparing the performance to a reference microphone of the same type. Such a test can be made by comparing test recordings of both microphones (where it is possible to make recordings) or by comparing the maximum detection range.

i) D240X Ultrasound detector

Set the GAIN switch to HIGH. Turn on the D240X and aim the microphone at the T10 as indicated in Figure 1, at a distance of ca. 0.4 m. The Overload indicator of the D240X should turn on. Slowly move the D240X away from the T10 while observing the Overload indicator. At some distance the indicator will start flickering (since the sound level will have decreased). Continue to move the D240X away from the T10 while also moving it slightly up/down/left/right to search for the spot that gives the strongest reception of the 40 kHz signal (i.e. the Overload indicator should remain on).

When you exactly have reached the distance where the Overload indicator no longer turns on (regardless of moving it up/down/left/right), measure the distance. If this distance is 0.8 meter or greater, the microphone has passed the test (it performs adequately).

ii) D500X Ultrasound detector Mk I, internal microphone

Turn on the D500X and set the Input Gain (F1/Recording settings) to 100. Make sure the active profile has the HP filter enabled (such as PROFILE 2). Aim the microphone at the T10 as indicated in the figure above, at a distance of 2 meter. Observe the reading of the sound level bar of the D500X display. Move the D500X slightly up/down/left/right to search for the strongest reception of the 40 kHz signal. Note the maximum reading of the sound level (the sound level bar is divided into 8 segments). If this reading is 4 segments or greater, the microphone performs adequately.

iii) D500X Ultrasound detector, external microphone (both Mk I and Mk II)

If fitted, remove the small horn from the microphone by pulling the horn straight away from the microphone tip. Do not put pressure on the horn sideways - this may damage the microphone! Connect the microphone to the D500X with a cable.

Turn on the D500X and set the Input Gain (F1/Recording settings) to 100. Make sure the active profile has the HP filter enabled (such as PROFILE 2). Aim the microphone at the T10 as indicated in the figure above, at a distance of 2 meter. Observe the reading of the sound level bar of the D500X display. Move the D500X slightly up/down/left/right to search for the strongest reception of the 40 kHz signal. Note the maximum reading of the sound level (the sound level bar is divided into 8 segments). If this reading is 4 segments or greater, the microphone performs adequately.

iv) M500 Ultrasound microphone

The M500 should be tested with the small horn fitted.

The test of the M500 is made by making a recording of the sound from the T10 and then analyzing the recording. The recording should be made with the BatSound Touch or BatSound Touch Lite software. The latter is free and can be downloaded from https://batsound.com/product/batsound-touch-lite/

Connect the M500 to the computer and start BatSound Touch (Lite). Aim the M500 at the T10 as indicated in the figure above, at a distance of 2 meter and start recording. Watch the computer screen and move the M500 slightly up/down/left/right to search for the strongest reception of the 40 kHz signal and keep the M500 in that position for at least a few seconds, then stop recording.

The analysis of the recording can be made in BatSound Touch, BatSound Touch Lite, BatSound or other similar programs. We will here use BatSound for the analysis. Other programs can also be used.

Open the sound file in BatSound, mark a time interval where the signal level is as high as possible and display a Power Spectrum for that interval. The duration of the time interval should be long enough (at least 1.5 sec.), which will make the noise floor smoother and the measurements easier.

The following Power Spectrum settings should be used:

FFT size: 8192
FFT Window: Hanning
FFT Overlap: 50 %
Logarithmic amplitude scale (dB)

The difference in dB between the 40 kHz peak and the noise floor immediatly next to the peak should then be measured. Place the cursor at the noise floor, close to the 40 kHz peak and click once with the mouse. Then move the cursor to the top of the 40 kHz peak and read the difference at the bottom of the Power Spectrum window (the ”Distance” value). If this value is 63 dB or greater, the microphone has passed the performance test. See the figure below for an example. Note the two crosses where the cursor was placed. The ”Distance” value is 68.5 dB which is greater than 63 dB, so this microphone has passed the test.

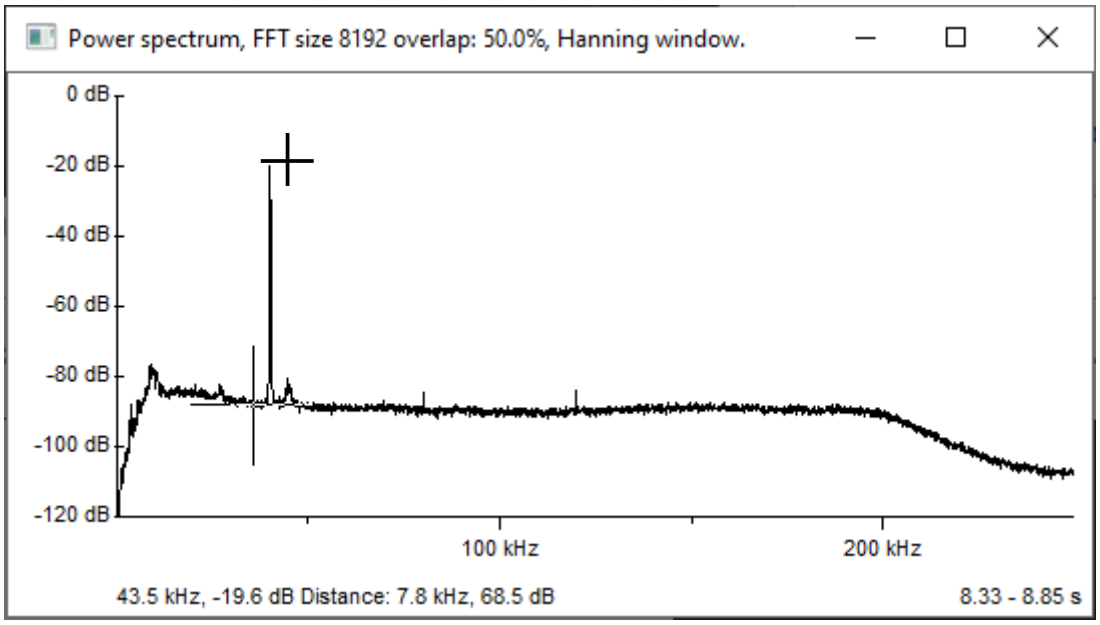

Figure 2. Measuring the dB difference between the 40 kHz peak and the noise floor.

v) M500-384 Ultrasound microphone

The M500-384 should be tested with the small horn fitted.

The test procedure for the M500-384 is identical to that of the M500, so please refer to this section for details. However, for the M500-384, the recording can be made with both the BatSound Touch (Lite) and the BatSound software. Many other sound recording programs can also be used.

vi) u256/u384 Ultrasound microphone

The test procedure for the u256 and u384 is essentially the same as that of the M500-384, so please refer to this section for details.

The u256/384 is considered to have passed the test if the measured difference between the peak and the noise floor is 73 dB or greater

Microphone test mode 2, multiple frequencies

In this mode, the T10 outputs a signal with frequencies that are multiples of 10 kHz (i.e. 10, 20, 30, 40….. kHz). That way, the microphone performance at all these frequencies can be evaluated at the same time.

This test mode assumes that a reference unit (known to have adequate performance) is available, i.e. a microphone of the same type as the unit for test. Recordings are made with both microphones and the power spectra of these are compared. If the power spectrum of the device under test is close enough to that of the reference microphone (i.e. the dB levels at the different frequencies are close enough), the tested microphone is considered to have adequate performance. The acceptable deviation depends on several factors and the user may decide about what is an acceptable deviation in each separate case.

When the T10 is set to this test mode, the output level is much lower than the 40 kHz mode and it is possible to put the microphone in direct contact with the front of the T10 (actually, the M500, M500-384 and the external D500X microphone can all be inserted into the center hole of the openings for the speaker, if the microphone horn is first removed). Positioning the microphone this close to the T10 reduces the influence of room reflections significantly. Regardless of the distance between the speaker and microphone, it is crucial that the conditions (e.g. the mic position) for the different measurements are identical. Making a few test recordings is recommended, in order to obtain an understanding of how the mic position influences the results.

In order to determine the performance of the microphone under test, the power spectrum of this recording is compared to that of the reference recording, as shown in Figure 3. The comparison should be made for each one of the frequencies. Figure 3 shows how the 40 kHz peaks are compared (the microphone under test is 9.5 dB weaker than the reference microphone at that frequency).

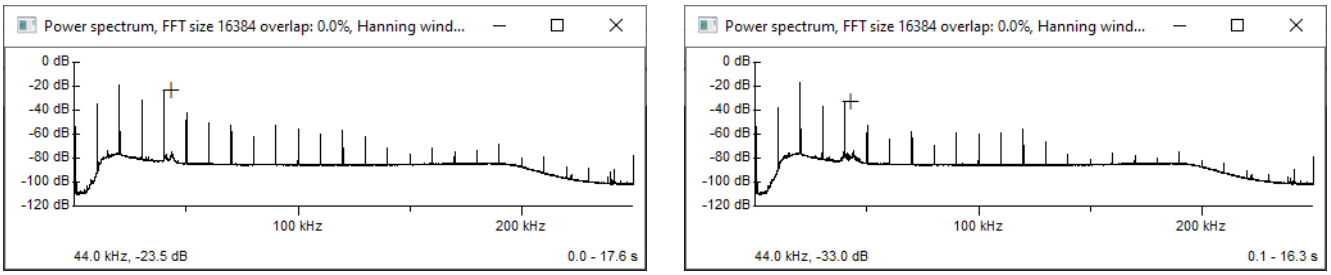

Figure 3. Comparing the power spectra of the reference microphone (left) and the microphone under test (right).

Note

The peaks in the power spectrum do not indicate the frequency response of the microphone. They should only be used to compare the microphone under test with the reference microphone at each separate frequency.

Mode 3, External sound source

The T10 can also be used as an ultrasound speaker with built-in amplifier. That way, it can play any type of sounds, not just the test signals. Using the T10 in this mode requires some knowledge in using/connecting audio devices, so it is recommended for experienced users only.

In order to use it as a speaker, an analog signal source should be connected to the RCA jack at the back of the T10 housing and the mode selection switch set to the ”EXT” position. The signal source can be e.g. a signal generator (typically used to play signals with one constant frequency), a recorder or a computer with a sound card. Regardless of the type of source, it must of course be capable of playing the desired frequencies.

One possible way of using the T10 in this mode is for reproducing pre-recorded bat calls. This can be useful e.g. to learn how to use a bat detector (without actually having access to live bats) or to use the T10 as a bat lure. If a recorder or computer/sound card is used as signal source, attention must be paid to the frequency range of these devices. In particular, the sampling frequency must be high enough. At a sampling frequency of 96 kHz, the typical maximum sound frequency is around 45 kHz and at 192 kHz sampling frequency the typical maximum signal frequency is around 90 kHz. Please note that a high sampling frequency is in itself not a guarantee that the device will be able to play high signal frequencies and this must be verified for each separate device.

If the recorded sound file that you wish to play has a different sampling frequency than that of the selected playback device, the sound file must first be resampled. For instance, the sound file may have been recorded at 384 kHz sampling frequency, while the playback device uses 192 kHz sampling frequency.

There are various programs available for resampling of sound files, one of which is Audacity.

Specifications

Sound level in 40 kHz mode:	90 dB SPL @ 25 cm (+/- 2 dB)
Current consumption:	typ. 11-25 mA, depending on the signal type and level
Battery type:	9 V, 6LR61 (not included)
Max. voltage applied at external input:	1 V rms
Input impedance of external input:	1.6 kohm
Size:	25 x 60 x 108 mm (connector, switches excluded)
Weight:	ca. 110 g., including battery

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