The ultrasound detector D 230 is an easy-to-handle instrument for conversion of ultrasound to audible sound. It is primarily intended for studying bats and other animals emitting ultrasound. The detector has two independent ultrasound conversion systems; a heterodyne system and a frequency division system (divide-by-ten). The detector is equipped with a digital display to provide a very accurate value of the tuned frequency. Before using the detector, please read the following information!
Further information on the identification of different bat species using ultrasound detectors may be found in the literature (e.g. Barataud: The inaudible world, available from Pettersson Elektronik).

The D230 comes with a soft carrying case. For protection of the detector we recommend you keep it in this case when not in use. The detector should be placed with the display upwards in the case.

INTRODUCTION

With the bat detector D 230, ultrasound in the range 10 - 120 kHz may be transformed into the audible frequency range. Although the main application for the D 230 is studying bioacoustic ultrasound (bats, rodents, bush crickets etc.), the detector can be used in many other situations where detection of ultrasound is involved (ultrasonic intruder systems, leaks in pressurized systems, corona discharges etc.).

The transformed sounds are monitored either through the built-in loudspeaker or through headphones connected to the PHONES socket. A tape recorder may be connected to the TAPE socket to make recordings of the transformed sounds or the direct microhone signal (if the COMment button is pressed, the microphone signal is directly connected to the TAPE output to enable the recording of spoken comments on the tape).

THE FIRST TIME

The detector is powered from one 9 V battery. An alkaline battery will last for appr. 25 hours. Insert a new battery and turn the VOLUME control clockwise to switch on the detector. The LCD display shows the tuned frequency (heterodyne system only!) and the LCD backlight is turned on. The LCD backlight also serves as a battery condition indicator, so if the backlight is too weak to read the display in darkness, it is time to replace the battery! To test the detector, perform the following steps.

Set the HET/DIV switch to the HETerodyne position. Adjust the VOLUME control so that a weak noise is heard in the loudspeaker. Then turn the FREQUENCY control to give a display reading of approximately 20 kHz and gently snap your fingers near the microphone (at the front of the detector). A scraping sound should then be heard in the loudspeaker. Another good ultrasound source is a jingling bunch of keys.

The frequency control works in the following way. The display shows the center of the frequency range (approximately 10 kHz wide), which will be transformed. If the control is set to 30 kHz, you can listen to ultrasonic frequencies between approximately 25 and 35 kHz.

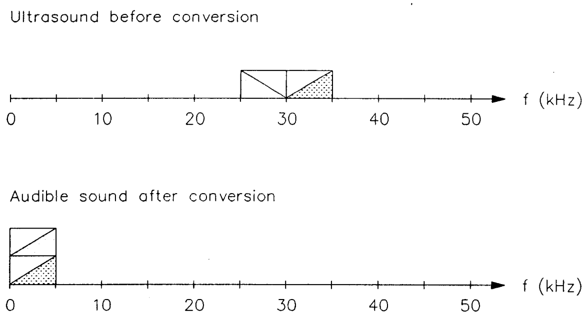
Repeat this exercise with the frequency division system (i.e. set the HET/DIV switch to the DIV position). Here the entire frequency range is made audible regardless of the setting of the FREQUENCY control.

If the volume control is turned up too high, acoustic feedback (a howling sound) may occur, particularly when the detector is working in the frequency division mode. This is a consequence of the broadband behaviour of the frequency division system; the highest frequencies from the loudspeaker are picked up by the microphone, amplified and fed to the loudspeaker again. To avoid this, simply turn down the volume control or use headphones instead.

SOME TECHNICAL INFORMATION

The Heterodyne System.

Several different principles exist to convert ultrasound into audible sound. As mentioned above, one of the systems in the D 230 is based on the heterodyne principle. This technique means that a limited frequency range is selected for conversion into the audible range. If the frequency control is set to 30 kHz, the range from appr. 25 to 35 kHz will be transformed. This is illustrated in the figure below.



Assume an ultrasound source of constant frequency is to be monitored. When the frequency control is turned from low frequencies to higher, a high-pitched tone will be heard in the loudspeaker when the frequency setting is appr. 5 kHz lower than the frequency of the ultrasound source. The closer the tuned frequency comes to the ultrasound's frequency, the lower the frequency fo the loudspeaker tone gets. When both frequencies are identical the resulting output frequency becomes zero, i.e. nothing is heard in the loudspeaker. If you continue to turn the frequency control to higher frequencies, a tone will again be heard in the loudspeaker, however this time the frequency will increase as the tuned frequency increases. By tuning the frequency control up and down it is possible to locate the frequency resulting in a zero Hz output frequency (the tuned frequency then equals the frequency of the ultrasound).

NOTE: Although the example above well illustrates the heterodyne principle, constant frequency sounds are very rare in practice, so there you will only be able to get an approximate measure of the signal frequency.

The Frequency Division System.

Using the detector in the frequency division mode, the entire frequency range 10-120 kHz is made audible at the same time. This means that you will not miss any bat activity just because the frequency control was out of tune, as may be the case with the heterodyne system. On the other hand, since the frequency division system is a broadband system, the sensitivity is a little lower, so in order to detect the bats at long distance the heterodyne system may be preferred.

The frequency division system counts cycles of the incoming ultrasound and generates one output cycle for each ten cycles of the input signal, i.e. the frequency is ten times lower than the original frequency. The frequency division system used in the D 230 is of the more advanced "retained amplitude" type. This means that the amplitude of the output signal will follow that of the input signal (see the figure on next page).

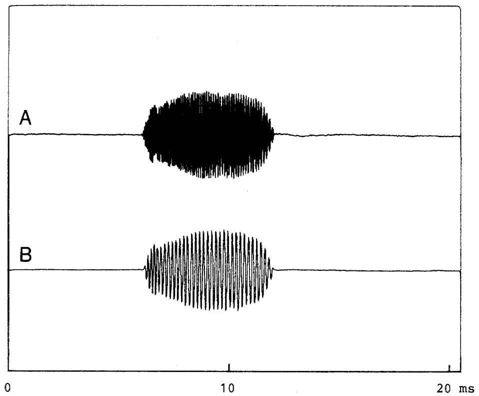
OUTPUTS

The two 3.5 mm sockets are used to connect a set of headphones or a tape recorder. The TAPE output is not affected by the setting of the volume control or the HET/DIV switch. When the COM switch is pressed, the frequency division output signal is temporarily replaced by the amplified microphone signal, enabling the reecording of spoken comments on the tape. The maximum length of any connected cable is 1 meter.

The PHONES socket may be used to connect a set of stereo headphones with a 3.5 mm plug.

Connecting a set of headphones will turn off the internal loudspeaker. For both output sockets, the heterodyne signal is available on the left channel and the frequency division signal on the right, regardless of the setting of the HET/DIV switch (see the figure below).

At the TAPE socket the transformed, audible signals (HET and DIV) are available (see the figure below). If the input impedance of the tape recorder is very low (lower than 5 kohms), the signal levels in the detector will be decreased, resulting in a weaker output to the loudspeaker or headphones. Any tape recorder connected to the TAPE output must be battery powered (not connected to the mains).



A - Original signal B - Frequency division output

Pettersson

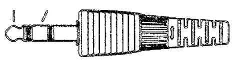
Elektronik AB

www.batsound.com

Tel: +46 18 303880

Fax: +46 18 303840

HET. DIV.



Technical specifications

Type:	Heterodyne and frequency division (÷10)
Frequency range:	10 - 120 kHz (min.)
Display accuracy:	+/- 0.15 kHz
Bandwidth (het.):	8 kHz (+/- 4 kHz), -6 dB
Battery:	1 x IEC 6LF22 (9V)
Quiescent current:	23 mA typ. including LCD backlight
Size:	119 x 60 x 25 mm
Weight:	160 g. including battery
Outputs:	2 x 3.5 mm jacks for headphones and tape recorder (350 mV_{rms} /3.3 kohm).
Comment switch:	Yes

Using the detector in intense electromagnetic fields may cause interference and/or temporary signal loss.

ULTRASOUND DETECTOR D 230

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