Student Experiments

Manual

ULTRASONIC

P9160-4U

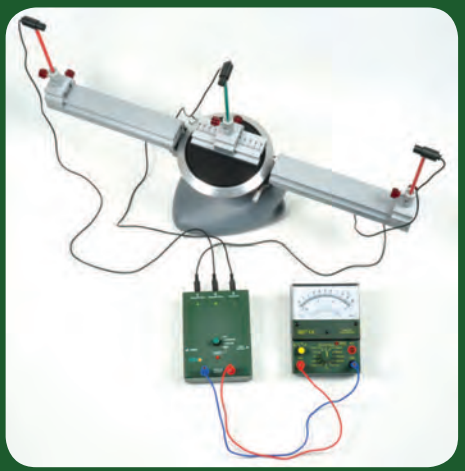

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TABLE OF CONTENTS

GONIOMETER - INTRODUCTION

US 00

The goniometer consists of a base with a rail mounted on it, as seen in the image on the right. In the middle of the base is a pivot axis, on which the left rail and angular scale are moved at the middle.

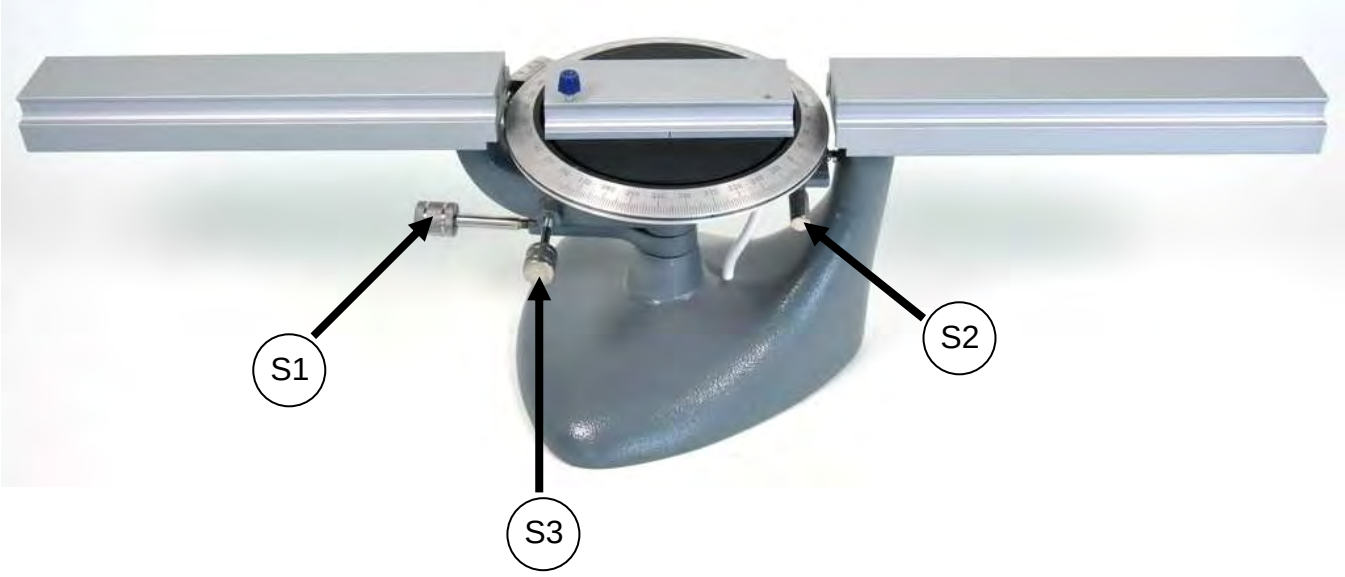
Function of the screws: the screw on the left side (**S1**) releases the movable arm with the rail, while the right front screw with the smaller diameter (**S2**) serves to fix the angular scale. The "big" front screw on the left (**S3**) allows for fine adjustment of the rail, but only when the other two screws have been tightened. Since the receiver does not have a narrow aperture, setting to a fraction of a degree is not necessary during ultrasound testing; i.e., the screw does not need to be used.

Basic setting:

1. Loosen the screws for the movable arm S1 and the angular scale S2.
2. Align the two rails with a long ruler, a long rail ... or "by sight". Then, secure it with screw S1.
3. Set the angular scale to 0° (the pointer of the vernier scale, which is connected to the arm, points to 0°).
4. Secure the angular scale with the right screw S2.

Now, when the left rail is moved, the arrow on the vernier scale shows the rotation angle (or we have to calculate the difference to the angle after alignment).

With the rail in the vertical position on the angular scale:
Set the pointer to 90° as in no. 3 above.



ULTRASOUND CONTROL UNIT

US 00

We always connect senders (red rod) to the outputs marked “TRANSMITTER” and the receiver (green rod) to the “RECEIVER” input.

We connect the meter to the ANALOG OUTPUT, making sure that the poles are correct.
On the meter, we first select the 1V range for direct current (DC). If required, a smaller DC voltage range can be selected.

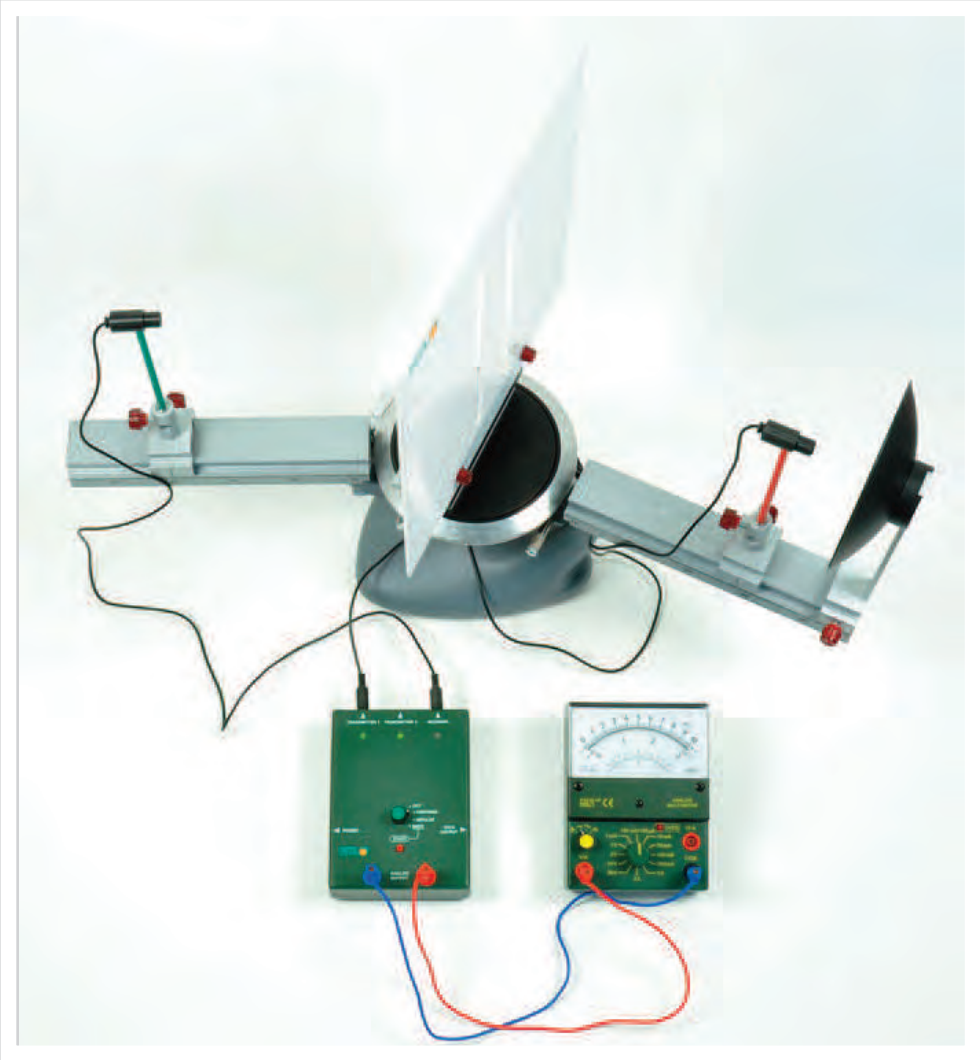
After setting up the experiment, we switch the control unit to CONTINUE. Now, sound waves are transmitted by connected senders and the receiver converts the received signal into a DC voltage, which we can read off the meter.

After completion of the experiment, we do not forget to switch off the control unit (OFF position).

DIFFRACTION AT A DOUBLE SLIT

US 11

Required Kit:
P9901-4U Ultrasonic



Material:
1x P1860-1B Ultrasonic control unit
1x P1860-1S Ultrasonic transmitter
1x P1860-1E Ultrasonic receiver
1x P1860-1G Ultrasonic goniometer
2x P1861-1R Slider with clamping post
1x P1865-BS Ultrasonics screens, set, with bracket
1x P1865-1P Ultrasonics parabolic mirror

Additionally required:
1x P3210-1P Multi-Multimeter, analogue

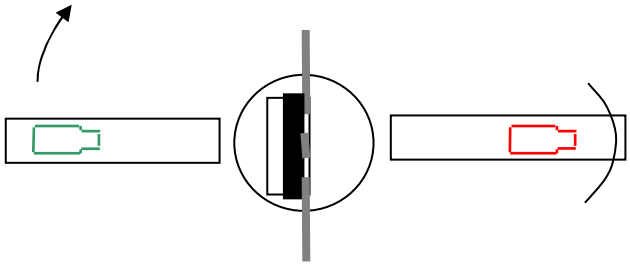
DIFFRACTION AT A DOUBLE SLIT

US 11

The classic double-slit experiment. If we let the waves pass through at only two places (slits), there is clearly mutual reinforcement of the diffracted waves, whereas the difference between their paths is a multiple of a wavelength.

Preparation:

In place of the single slit, we mount the double slit with a 5 cm gap in the screen bracket.



Experiment:

We rotate the arm and continually read the angle with the corresponding voltages at which minima and maxima occur.

If we have enough time, we also measure towards the left – among other reasons, because of a possible inaccurate alignment of the double slit.

We can represent the maxima and minima with their voltage levels at the corresponding angles, and we can join them with a curve.

To understand that the superposition of the waves, which are diffracted at both slits, actually causes the pronounced maxima and minima, we cover one slit, turn the arm with the receiver and observe the reading. At the narrow slit, nearly uniform diffraction occurs in all directions – only decreasing slightly at larger angles.

Results:

The waves which are diffracted at the two slits are superimposed such that well-defined maxima and minima are produced.
The size of the maxima decreases farther from the slits.

Note:

From the angle φ_n to the nth maximum, we can calculate the wavelength of the diffracted wave as $\sin \varphi_n = n*\lambda / a$, where a is the slit distance = 5 cm.

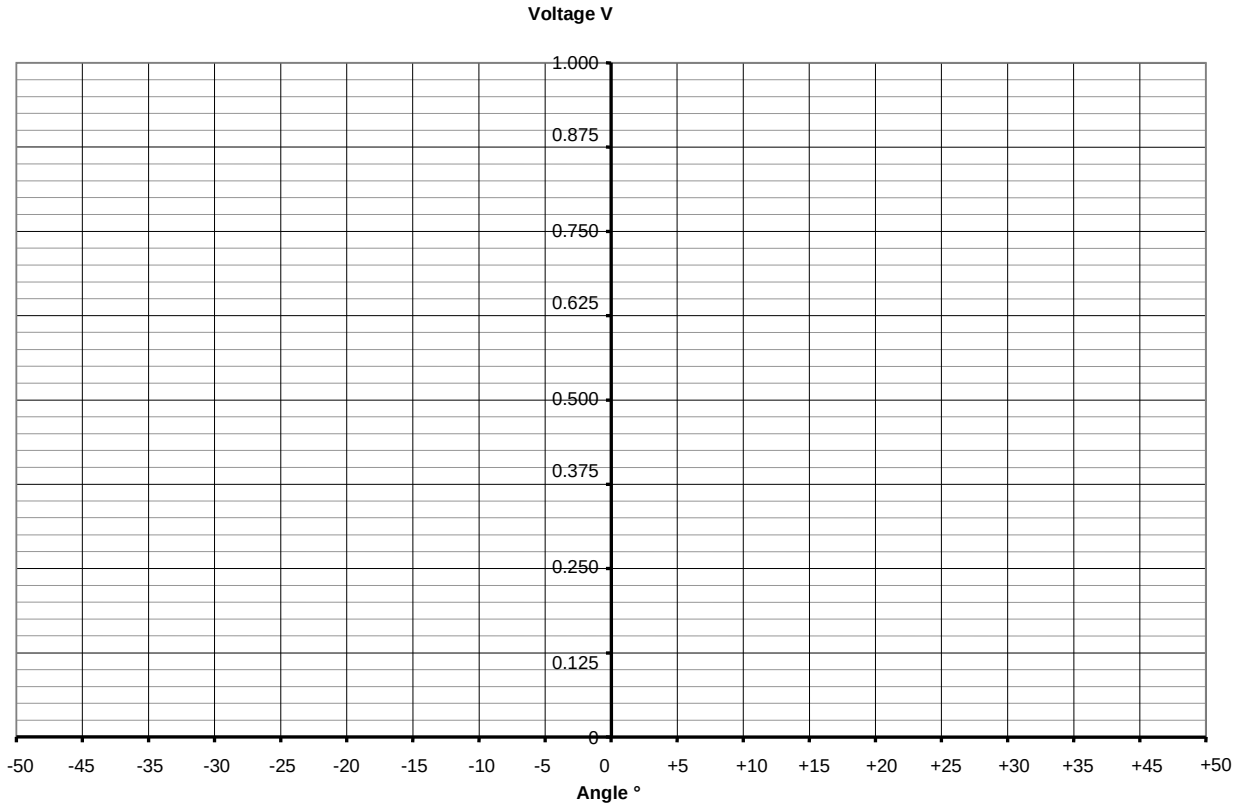
DIFFRACTION AT A DOUBLE SLIT

US 11

Recording of measured values of the minima and maxima

Rotate to the left											
Angle in °											
Voltage (V)											
Rotate to the right											
Angle in °											
Voltage (V)											

After completing the table, plot the readings on a graph:



DIFFRACTION AT A DOUBLE SLIT

US 11

Readings: Width of slit = 1 cm Wavelength (λ) = 0,85

Theory Gap (a) = 5

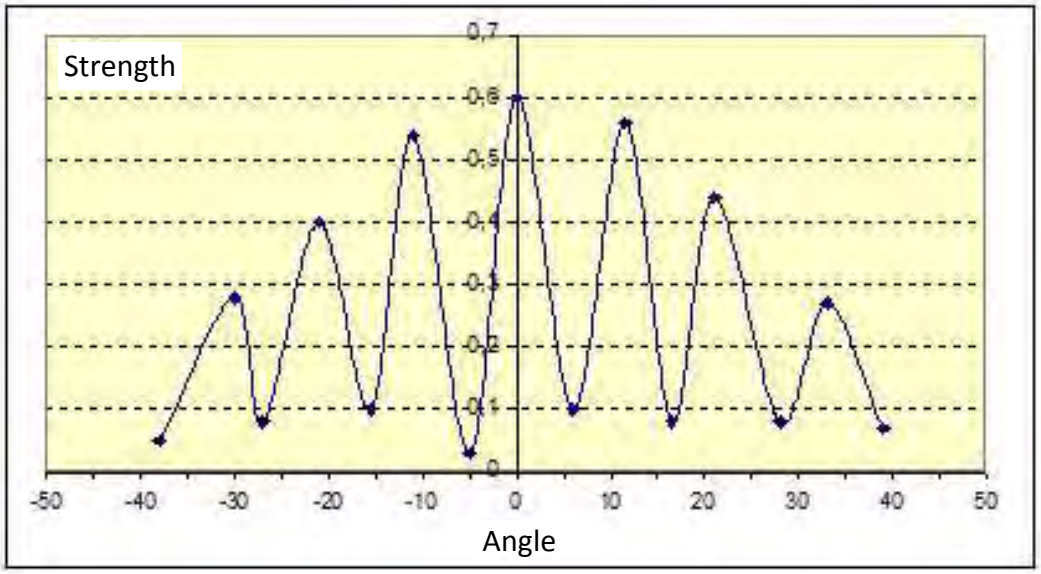
Maxima occur when: $\sin\varphi = n^{*} \lambda/a$

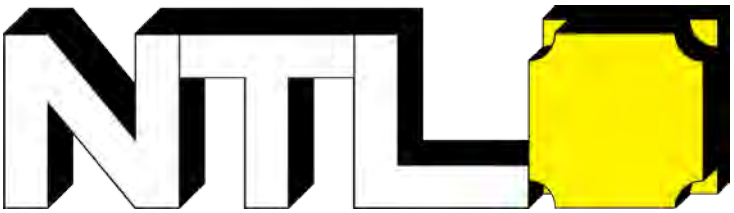
φ1 = 9,79 φ2 = 19,9 φ2 = 30,7

Measurements

Direction: Left Right

Angle	-38	-30	-27	-21	-16	-11	-5	0	6	11,5	16,5	21	28	33	39
Voltage	0,05	0,28	0,08	0,4	0,1	0,54	0,03	0,6	0,1	0,56	0,08	0,44	0,08	0,27	0,07





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