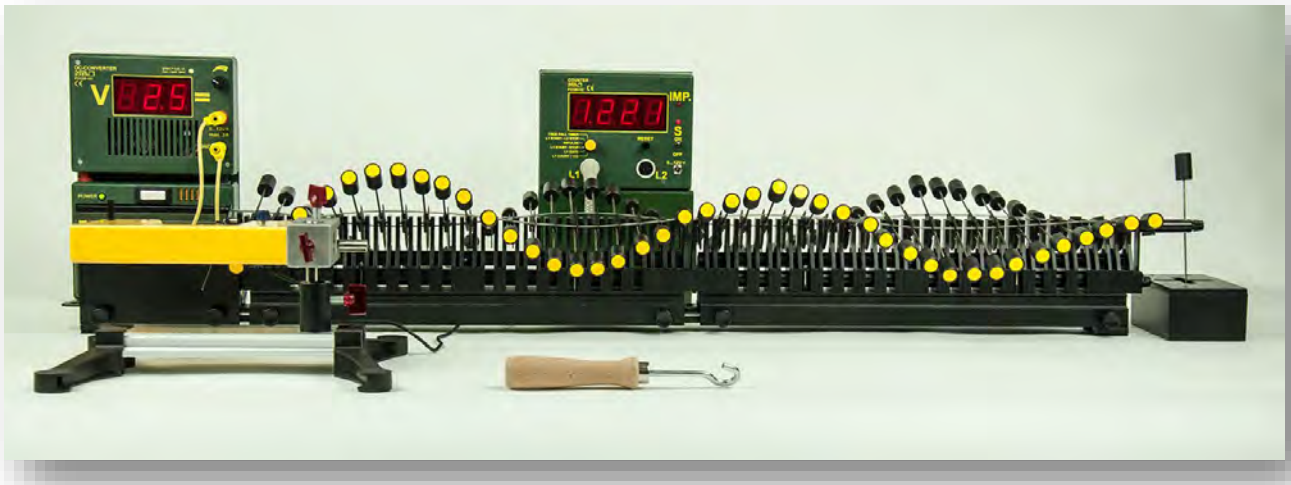
PARAMETERS OF A TRANSVERSE WAVE

SWD 03.05



Material:

Item Code	Qty	Description
DW405-1A	**1**	**Oscillation module 1 – set consisting of**
DW405-1A1	1	Oscillation module 1 with brake
P5312-1A	2	Little base with damping
DG205-1G	1	Hook metal, with handle
DW405-1E	**1**	**Wave demonstrator - Module II consisting of**
DW405-1E1	1	Oscillation module 2a with brake
P5310-1S	1	Rail bond SE, universal
DW405-3SL	2	Coupling spring 80 cm, for wave demonstrator
DW405-2A	**1**	**Wave demonstrator - Electrical driving unit consisting of**
DW405-2A1	1	Motor drive for wave demonstrator
P5310-1S	1	Rail bond SE, universal
	1	Pointer for driving unit
DW405-2D	**1**	**Wave demonstrator - Mechanical damping unit consisting of**
DW405-3P	1	Pendulum bearing for wave demonstrator
DW405-2DP	1	Pendulum for damping unit
DW405-2DW	1	Water trough for damping unit
P3120-1B	1	Rechargeable battery, "inno", 6V/10 Ah
P3120-1K	1	DC Converter "inno"
P3120-4A	1	L-shaped assembly platform
DG507-25	2	Safety connecting lead, 25 cm, yellow
P1100-1E	1	Measuring tape, L=300 cm
DS090-3K	1	Claw base "Sepp", 260 x 220 mm
DS201-10	2	Support rod, round, L=1000 mm, D=12 mm
DS095-3K	1	Boss head cross-pattern, demo 03
P1320-4A	1	Light gate "demo" 04
P3120-2Z	1	Universal timer "inno"
P3120-5B	1	S-shaped assembly platform

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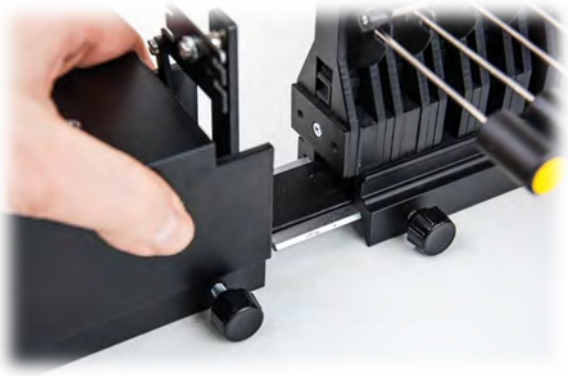
Purpose

So that we can analyse wave movements more precisely, a few terms must first be defined:
Oscillation period (T)
Frequency (f)
Wavelength (λ)
Speed of propagation (c)

Setup

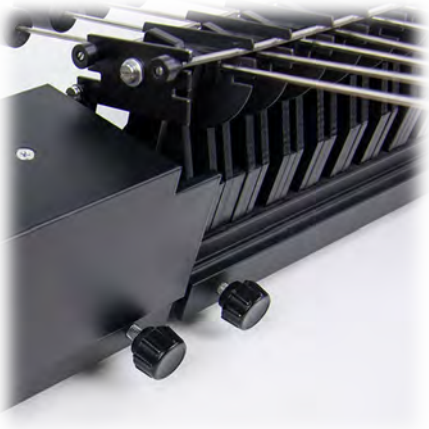
The two oscillation modules are coupled with the rail connector, thus we get a "wave machine" with a length of 80 cm

It should be noted that the two brake springs must also be coupled.
The pin of one spring must snap into the hole in the second spring.



The driving unit is mounted at the end with the long brake spring with the help of the rail connector.

At the end with the short brake spring, the second pendulum bearing (part of the damping unit) is mounted.



The two 80 cm long coupling springs are hooked into the upper slit of the pendulum.

The pendulum bearing and the driving unit are also included.

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The water trough of the damping unit is filled almost to the brim with water (filling quantity approx. 260 ml).

The lid of the water trough is put on and the water trough is pushed directly to the end of the vibration module 2a.

The pendulum of the damping unit is inserted into the pendulum bearing.

The pendulum plate is lowered into the trough so that it is completely under water.

Then the pendulum is screwed to the axis of the pendulum bearing.

Make sure that the pendulum can swing freely, if necessary the water trough must be moved accordingly.

The little bases are inserted and screwed tight at the outer ends of the wave machine.

The driving unit is supplied with an infinitely variable DC voltage (at least 0 - 6 V).

The 1000 mm support rod is mounted in the claw base "Sepp".

The boss head is then mounted at a height of 10 cm on the support rod.

With the help of the second 1000 mm support rod the light gate is mounted in a horizontal position.

The universal counter is attached to the assembly platform.
The light gate is connected to input "L1" of the universal counter.
The selector switch of the time counter is set to "L1 START - STOP".

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All pendulum rods are brought into a horizontal position.

The height of the pendulum rods is measured by the measuring tape.

The light gate is now adjusted with the stand material so that the light signal of the light gate (the two openings on the inside of the legs) is at the same height as the pendulum rods.

The height should be about 10 cm.

The thin metal pointer is screwed laterally into the slotted plate of the drive unit.

The pointer protrudes about 25 mm over the ends of the pendulum.

The claw base including the light gate is now adjusted so that the end of the metal pointer crosses the light signal of the fork.

Note:
The period of oscillation (T) is the duration of a whole oscillation.
In this way the light gate measures the duration of half an oscillation (i.e. T / 2).

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Series of Experiments:

The power supply is switched on and a voltage of 2.5 V is set.
The drive unit stimulates uniform vibration.

The timer is switched on, the "Reset" button is pressed and the first measured value is quickly read. Since the timer adds up the period values, the "Reset" button must be pressed several times in order to read off the duration of only half an oscillation.

If the light gate is not mounted exactly horizontally at the height of the self-aligning bearings, different time periods are obtained. To compensate for this, two upper and two lower half oscillations should be measured. The determined time periods are entered in the table:

Voltage (in V)	$\frac{T_{1\,up}}{2}$	$\frac{T_{2\,up}}{2}$	$\frac{T_{\varnothing\,up}}{2}$	$\frac{T_{3\,below}}{2}$	$\frac{T_{4\,below}}{2}$	$\frac{T_{\varnothing\,below}}{2}$	*Oscillation period T (in sek)*	*Fre-quency f*	*Wave-length λ (in m)*	*Speed of Propagation c (in m/s)*

The mean of the upper and lower half-periods is determined. The two mean values are added together, so we get the duration of a whole oscillation (T).
The period of oscillation (T) is the period of a whole oscillation.

The frequency is the reciprocal of the period of oscillation: $f = \frac{1}{T}$

The wavelength (λ) is the distance between two neighbouring points of the same phase (e.g. two neighbouring wave crests).

This can be determined by pressing the brake and measuring with the roll tape measure. The determined wavelength is entered in the table.

Note: Immediately after applying the brake, the drive unit should be switched off.

But how fast does the wave move "further" or does it spread? The speed of propagation (c) is calculated as the quotient of the wavelength and the period of oscillation.

$$c = \frac{\lambda}{T} = \lambda \times f$$

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The supply voltage of the drive unit is switched on again. The above parameters are also determined for supply voltages of 3.0 and 3.5, entered in the table and thus the speed of propagation is calculated.

Result:

A higher supply voltage results in a shorter period of oscillation, a higher frequency and a shorter wavelength. The speed of propagation of the wave remains almost the same.