The transmittance of information by a light conductor

(Item No.: P1402300)

Curricular Relevance

Area of Expertise: Interdisciplinary teaching

Education Level: Age 14-18

Topic: Natural phenomena and technical applications

Subtopic: Information technology, electronics

Experiment: The transmittance of information by a light conductor

Difficulty	Preparation Time	Execution Time	Recommended Group Size
Difficult	10 Minutes	20 Minutes	2 Students

Additional Requirements:

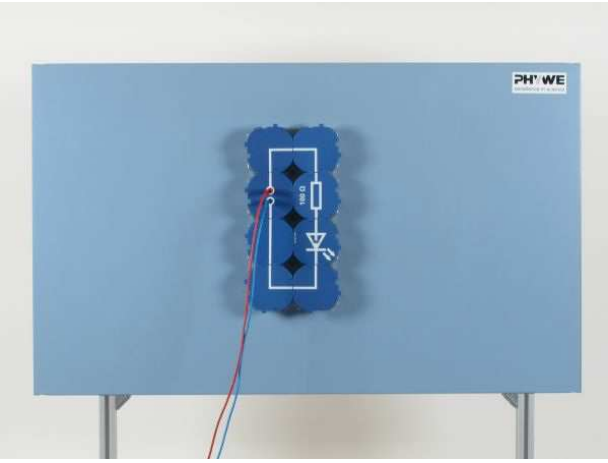
Experiment Variations:

Keywords:

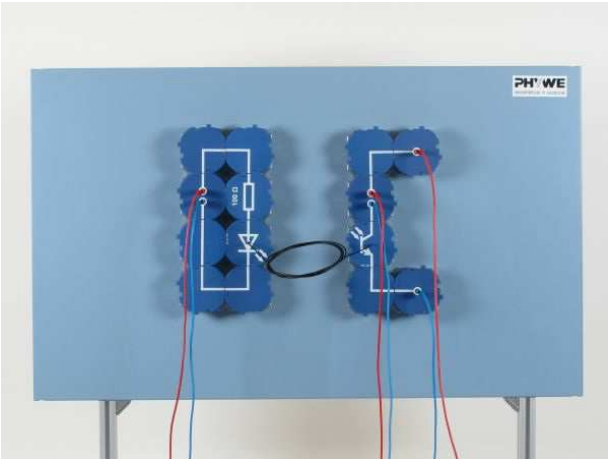
Principle and equipment

Principle

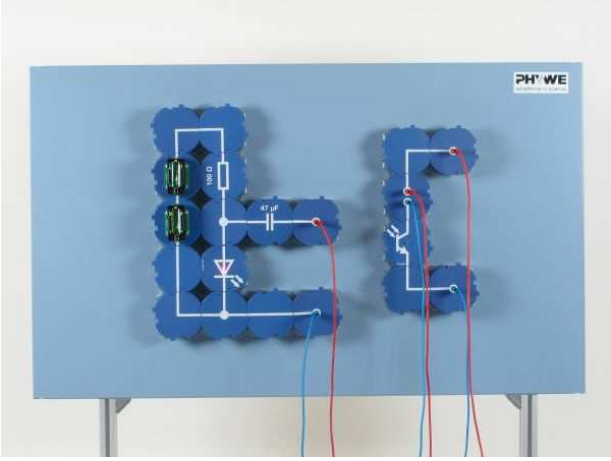
It is to be shown, that a light conductor can transmit digital and analog electrical signals.



Experimental set-up Part 1



Experimental set-up Part 2



Experimental set-up Part 3

Equipment

Position No.	Material	Order No.	Quantity
1	PHYWE Demo Physics board with stand	02150-00	1
2	Connector, straight, module DB	09401-01	2
3	Connector, angled, module DB	09401-02	6
4	Connector, T-shaped, module DB	09401-03	2
5	Connector interrupted, module DB	09401-04	4
6	Junction, module DB	09401-10	4
7	Battery holder module (C type), SB	05605-00	2
8	Resistor 100 Ohm,module DB	09413-10	1
9	Capacitor(ELKO)0.047 mF,module DB	09445-47	1
10	Transmitter f. opt. fiber,mod. DB	09461-00	1
11	Phototransistor, module DB	09458-00	1
12	Connecting cord, 32 A, 750 mm, red	07362-01	2
13	Connecting cord, 32 A, 1000 mm, red	07363-01	2
14	Connecting cord, 32 A, 1000 mm, blue	07363-04	2
15	Optical fiber, 2m	09461-02	1
16	Loudspeaker,8 Ohm/5 kOhm	13765-00	1
17	PHYWE power supply, universal DC: 0...18 V, 0...5 A / AC: 2/4/6/8/10/12/15 V, 5 A	13504-93	1
18	PHYWE Digital Function Generator, USB	13654-99	1
19	Electr.symbols f.demo-board,12pcs	02154-03	1
20	Battery cell, 1.5 V, baby size, type C	07922-01	2

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Set-up and procedure

1st. Experiment

- First set up part 1 of the circuit as in Fig. 1; do not yet use the light conductor
- Set the function generator to a square voltage of frequency from 1 Hz to 1 0 Hz and a voltage of 2 V; observe the light-emitting diode
- Fit the light conductor to the light-emitting diode and observe the light at the end of the light conductor
- Gradually increase the signal frequency of the function generator and observe the light at the end of the light conductor; move the end of the light conductor quickly and observe the light (1)
- Turn back the voltage on the function generator

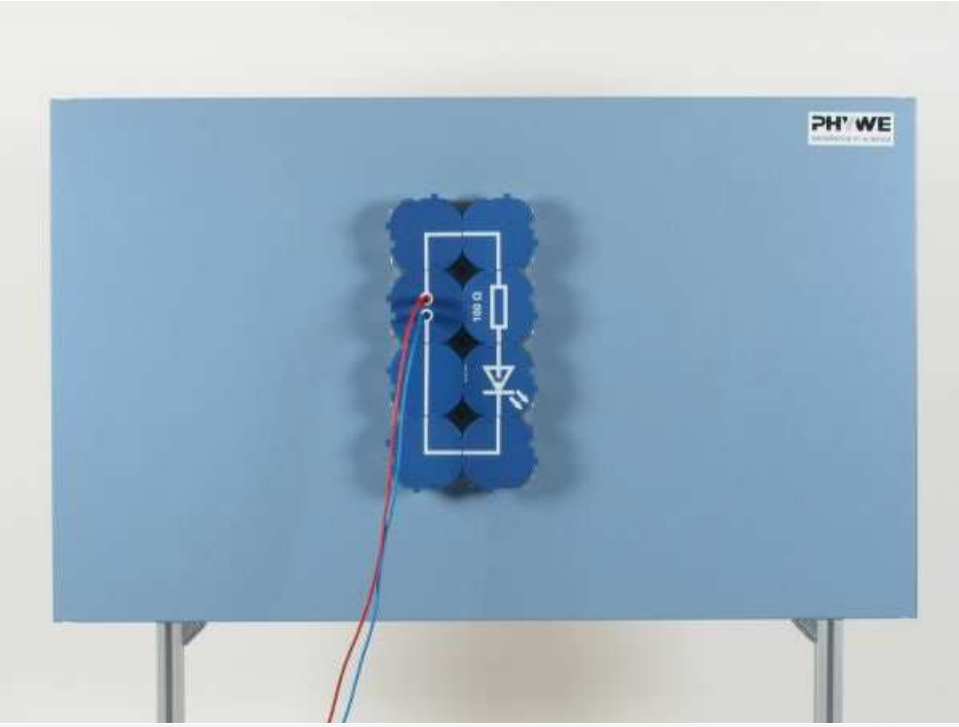

Fig. 1

2nd. Experiment

- Expand the experimental set up to that in part 2 of Fig. 2; use the 5 kΩ loudspeaker connection (interrupted connector above the phototransistor); set a direct voltage of 10 V for the phototransistor (both single junction connection modules); ensure correct polarity; fit the light conductor to the lightemitting diode
- At first, set a frequency of 400 Hz on the function generator and increase the signal voltage of the function generator until a sound is to be heard from the loudspeaker, but do not exceed the maximum value of 2 V
- Change the frequency of the signal voltage of the function generator; pay attention ot the pitch of the sound (2)
- Detach and reattach the light conductor to the lightemitting diode.
- Switch off the power supply and function generator

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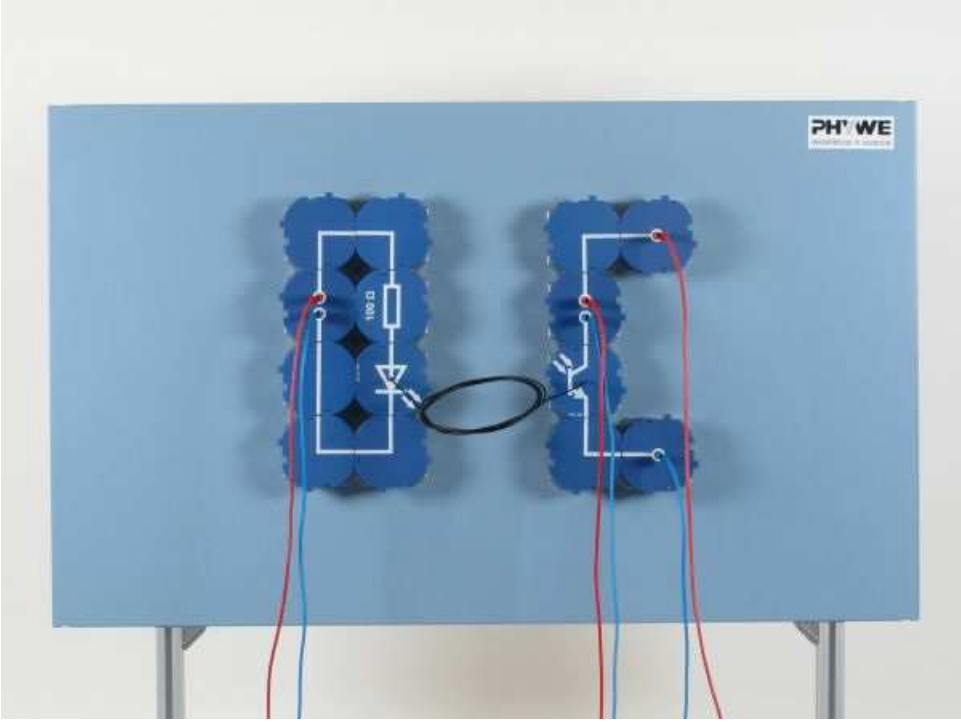

Fig. 2

3rd. Experiment

- Change the experimental set-up to that shown in Fig. 3
- Do not yet switch on the function generator; observe the light at the end of the light conductor
- Switch the function generator to sinusoid voltage and set a frequency of 1 Hz and a voltage of 2 V; observe the light at the end of the light conductor; slowly increase the frequency
- Fit the light conductor to the phototransistor, switch on the power supply and demonstrate signal transmission at different signal frequencies (3)

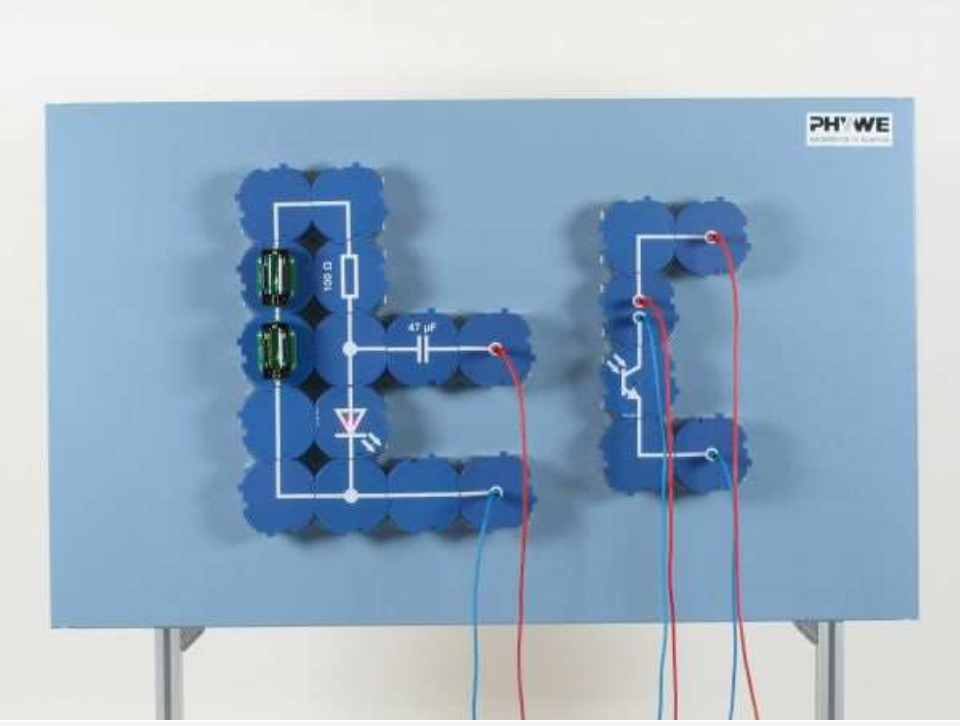

Fig. 3

Observation and Evaluation

Observation

1. When a square voltage of low frequency is applied to the light-emitting diode, then the light-emitting diode generates flashes of light with the signal frequency. At higher frequencies of the square voltage, the variation in the brightness is no longer recognisable. When the light conductor is moved, however, then it can be seen that there is a periodic change in the brightness.
2. When the light-emitting diode and the phototransistor are connected by means of the light conductor, then the loudspeaker emits a tone, the height of which depends upon the frequency of the square voltage of the function generator.
3. When only the voltage from the battery is applied to the light-emitting diode, then the light-emitting diode lights up with constant brightness. When the battery voltage is overlayed with a sinusoid alternating voltage, the brightness of the light changes periodically. The light is amplitude modulated. The signal voltage of the function generator is transmitted by the light.

Evaluation

The first experiment demonstrates the process of digital transmission of information by the light conductor, as is exclusively used in message transmission. For this, the image or sound signal to be transmitted is converted to digital signals which cause a laser, used as light-emitting diode, to be switched at a high frequency. For the transmission of analog signals, as demonstrated in the third experiment, a direct voltage causes the lightemitting diode to generate light without a signal. The overlayed signal voltage modulate the brightness of the light. At too high amplitudes of the signal voltage, or without a direct voltage, the signal is greatly distorted. A light-emitting diode enables light to be transmitted over large distances. Because of the high frequency of the light, numerous image and sound signals can be transmitted simultaneously. The diferent forms of the signal in digital and analog transmission can be demonstrated, when the collector voltage is observed using the Cobra3 Basic Unit or an oscilloscope.

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