

# PROTOCOL

to exercise

## *Standing Waves*

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## *Standing Waves*

### Used Devices

Nr.	Device	Manufacturer	Type	
1.	Oscilloscope	-		
2.	Function generator	-		
3.	Spectrum Analyser			

## **1 Inhalt**

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<b>2</b>	<b>TASKS .....</b>	<b>3</b>
2.1	GENERAL INFORMATION .....	3
2.2	GIVEN EXERCISES .....	3
<b>3</b>	<b>MEASURING OF THE FREQUENCY.....</b>	<b>4</b>
<b>4</b>	<b>MEASURING OF THE WAVELENGTH .....</b>	<b>5</b>
<b>5</b>	<b>PROPAGATION SPEED.....</b>	<b>5</b>
<b>6</b>	<b>COMPARISON WITH THE SPEED OF LIGHT .....</b>	<b>5</b>
6.1	SHORTENING FACTOR.....	5
<b>7</b>	<b>LIST OF FIGURES .....</b>	<b>7</b>

## 2 Tasks

### 2.1 General Information

A configuration with two parallel lines to measure standing waves and their wavelength is also called lecher-line. At one end of the lecher-line a high frequency signal is feed into the line. On the other End of the lecher-line a short circuit was made.

The maximas of the current are always located at the distance of  $\lambda/2$  and  $\lambda$ , measured from the short circuited lecher-line end. In addition a current maxima is also located at each end of the lecher-line.

This effect causes the possibility to measure the wavelength of a periodic signal with a lecher-line.

The practical uses of this is to measure propagation speeds of electromagnetic signals.

### 2.2 Given Exercises

- Measuring of the wavelength of a radio signal using the lecher-line.
- Measuring of the frequency of the radio signal.
- Calculating of the propagation speed of the signal on the lecher-line.
- Comparison with the measured propagation speed and the speed of light in vacuum.
- Calculating of the shortening factor ( $k$ ).

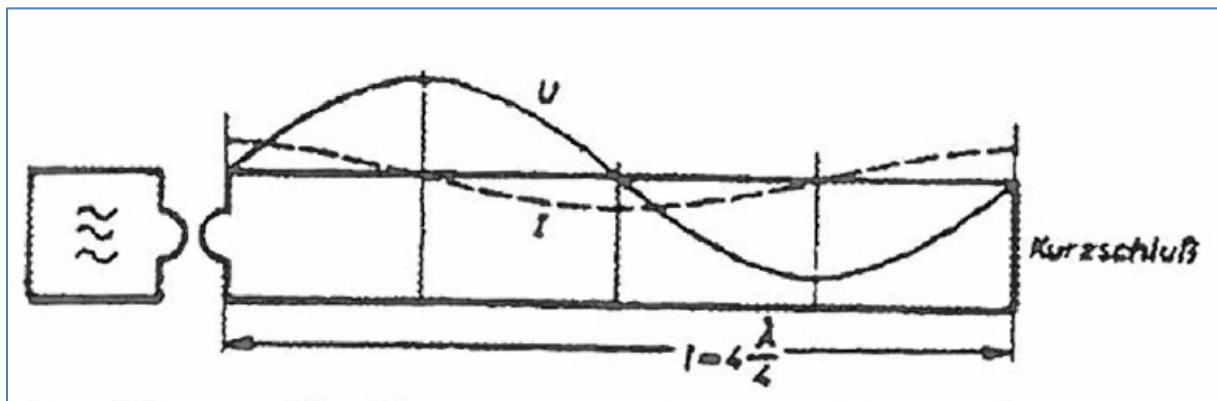


Figure 1. – Idea of the lecher-line

The given lecher-line was driven by a generator und built up on a wood-bar. Therefore the propagation speed is way smaller as the one from light.

### 3 Measuring of the frequency

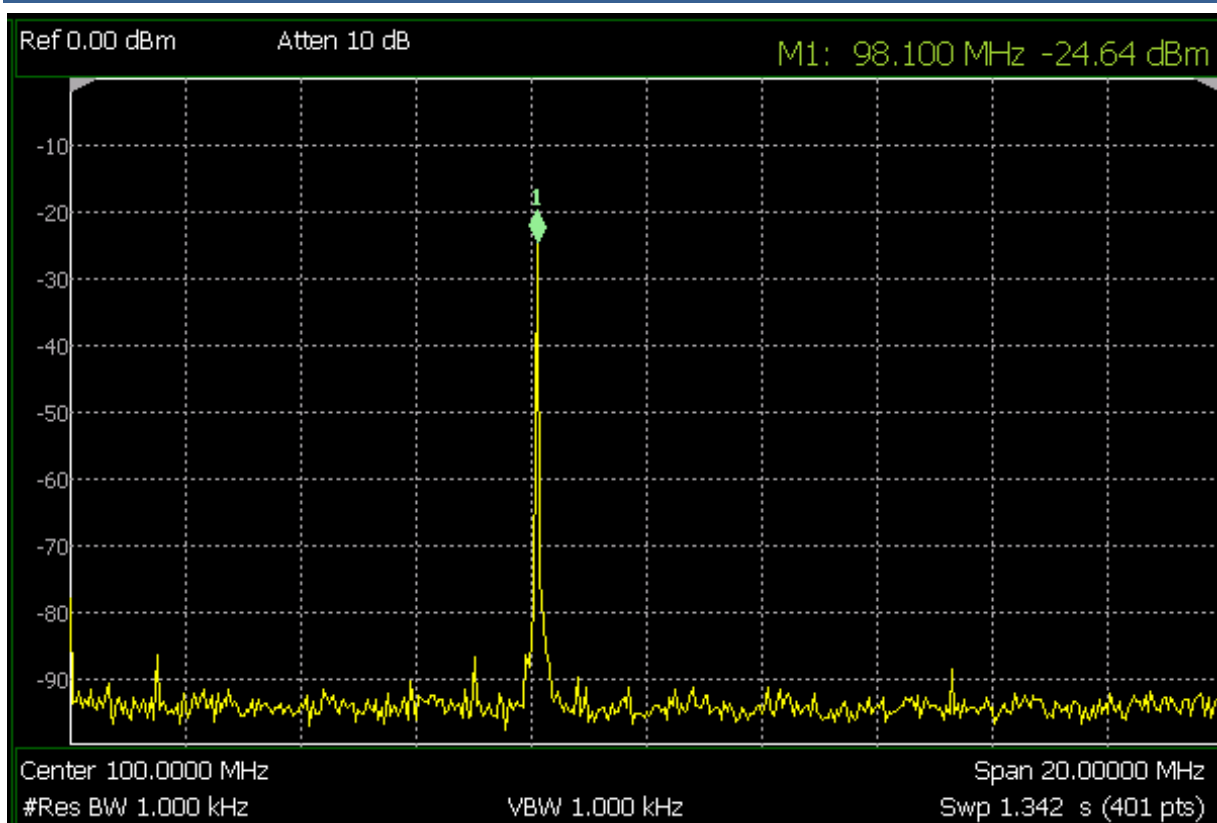


Figure 2. – Measured spectrum of the generator

The generated signal was measured on a Spectrum RF Analyser. Based on above spectrum it is shown that the generator has an output of about 100 MHz (exactly 98 MHz).

$$f = 98 \text{ MHz}$$

Measuring the signal with an oscilloscope was logically resulting in the same frequency value.

## 4 Measuring of the wavelength

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The distance between the maxima was 2,55 m. This value was measured with a light bulb connected to both lines of the lecher-line which indicated the maxima.

$$\lambda/2 = 1,275 \text{ m}$$

$$\lambda = 2,55 \text{ m}$$

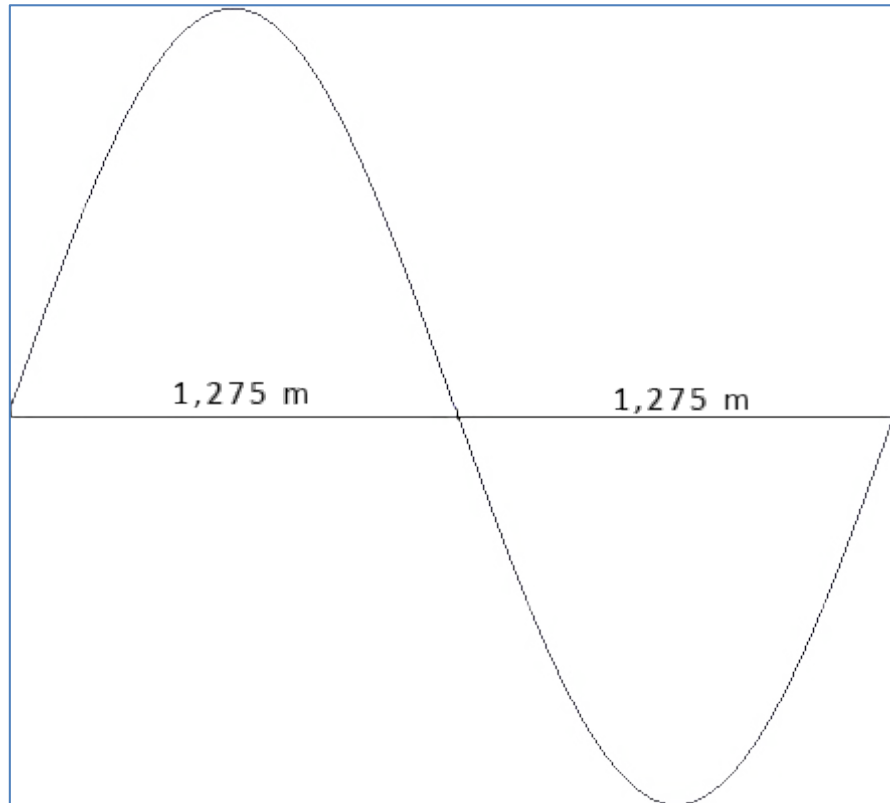


Figure 3. – Signal wavelength

## 5 Propagation Speed

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Based on both above measured values the propagation speed ( $v$ ) was calculated.

$$v = \lambda * f = 2,55 \text{ m} * 98 \text{ MHz}$$

$$v = 255\,000 \text{ km/s}$$

## 6 Comparison with the speed of light

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The speed of light is about 3 000 000 km/s the measured speed with 255 000 km/s was therefore only 85 % of the speed of light.

### 6.1 Shortening factor

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Based on the measured propagation speed and the speed of the light the following calculation was made.

$$k = \frac{v}{c} = \frac{255\,000 \text{ km/s}}{3\,000\,000 \text{ km/s}} = 0,85$$



## 7 List of figures

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Figure 1. – Idea of the lecher-line .....	3
Figure 2. – Measured spectrum of the generator .....	4
Figure 3. – Signal wavelength .....	5