

Amplitude modulation of decimeter waves

Objects of the experiments

- Assembling a transmission line for the transmission of audio signals with the UHF transmitter.

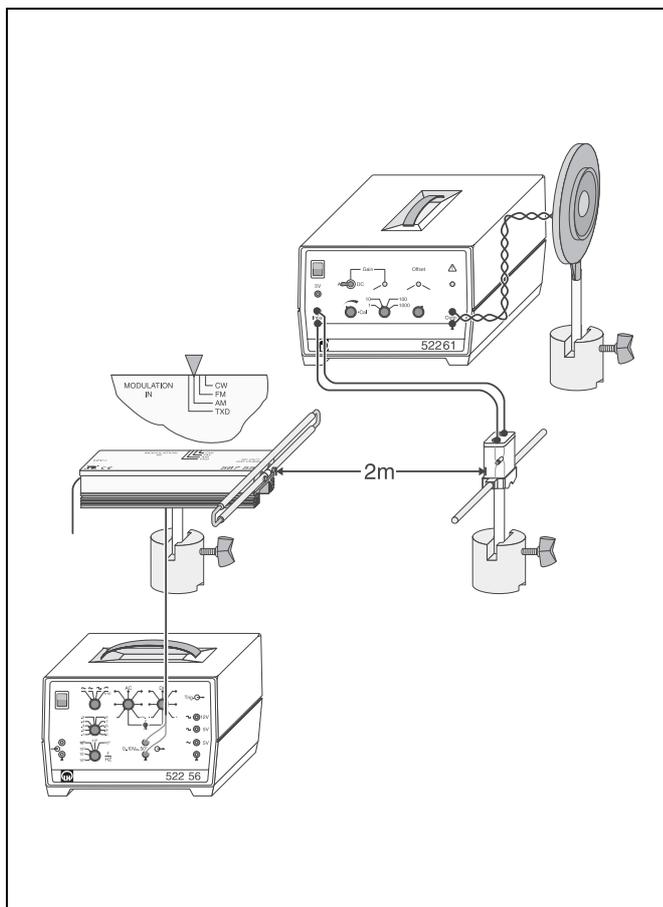


Fig. 1 Experimental setup for the transmission of audio signals with the UHF transmitter

Principles

By means of the UHF transmitter, audio signals in the frequency range from 100 Hz to 10 kHz can be transmitted by amplitude modulation of the signal

$$E(t) = E_0 \cdot \cos(2\pi \cdot \nu_0 \cdot t) \quad (I)$$

$\nu_0 = 433.92$ MHz: transmitting frequency

emitted by the UHF transmitter with the audio signal $u(t)$. The modulated signal then has the form

$$E_{AM}(t) = E_0 \cdot (1 + k_{AM} \cdot u(t)) \cdot \cos(2\pi \cdot \nu_0 \cdot t) \quad (II)$$

k_{AM} : coefficient of coupling

A receiver dipole with a high-frequency rectifier serves as a receiver which filters the high-frequency part out, while letting only the low-frequency audio signal through. The audio signal is amplified and supplied to a broad-band speaker.

Setup

The experimental setup is illustrated in Fig. 1.

- Clamp the UHF transmitter in the saddle base and connect the loop dipole to the antenna output of the UHF transmitter.
- Clamp the mounting rod for receiver dipoles in a saddle base, screw the receiver dipole with the diode on, and place it at a distance of about 1 m from the UHF transmitter.
- Align the receiver dipole parallel to the loop dipole.
- Use the screened cable BNC/4 mm to connect the modulation input of the UHF transmitter to the output of the function generator P.

Apparatus

1 UHF transmitter	587 55
1 plug-in unit 230 V AC / 12 V AC	562 791
1 function generator P, 100 MHz – 100 kHz	52256
1 AC/DC-amplifier, 30 W	52261
1 broad-band speaker	58708
3 saddle bases	30011
1 screened cable BNC/4 mm	57524
4 connection leads, 100 cm z.B.	50133

- Switch the function generator P on.

function: sine
 coarse attenuator: $\times 0.1$
 regulator DC: left stop

- Connect the input of the AC/DC-amplifier to the receiver dipole and the output of the AC/DC-amplifier to the broad-band speaker with twisted connection leads.

- Switch the AC/DC-amplifier on.

mode: AC
 amplification: $\times 10$

Offset compensation at the AC/DC-amplifier:

- Set the regulator AC of the function generator and the continuous attenuator of the AC/DC-amplifier to the left stop, and adjust the offset potentiometer so that the green LED lights up.

Carrying out the experiment

- Put the UHF transmitter into operation by plugging in the plug-in unit, and choose the AM mode.
- Set the regulator for the AC amplitude of the function generator P to the right stop (max.).
- Turn the continuous attenuator of the AC/DC-amplifier to the right until the speaker can be well heard.
- Vary the frequency at the function generator P between 100 Hz and 10 kHz.
- Vary the distance between the UHF transmitter and the receiver dipole with diode; get a barrier into the transmission line (e.g. a metal plate).

Evaluation

When the frequency of the function generator P is varied, the pitch of the speaker signal changes correspondingly.

When the distance between the UHF transmitter and the receiver dipole is changed, the volume of the speaker signal varies.

A barrier between the UHF transmitter and the receiver dipole reduces or even interrupts the transmission. However, a total interruption is often hindered due to reflection of the transmitted signal off nearby objects. The connection leads which conduct the signal from the receiver dipole to the amplifier can also, depending on their alignment, influence the received strength.

Results

Audio signals in the frequency range from 100 Hz to 10 kHz can be transmitted to a receiver by means of a UHF transmitter. After demodulation of the amplitude modulated signal of the UHF transmitter and its amplification, the audio signal can then be made audible with a speaker.

Safety notes

The UHF transmitter may not always conform to the limit values of class A (Group 2 of standard EN 55011). It may cause interference in other devices in the experimental room of a school or educational institution. Moreover, radio interference can occur up to a distance of several hundred meters. It is the responsibility of the user to take all precautions to ensure that devices installed outside of the experiment room can continue to work properly.

- Observe the notes in the instruction sheet of the UHF transmitter.
- Do not operate the transmitter longer than is necessary to conduct the experiment. Deactivate the transmitter immediately when the experiment is finished by switching off the plug-in supply unit.