The Half-Wave Rectifier

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In a half-wave rectifier, only one half-wave of the AC voltage is rectified; the other half-wave is not used. Such a rectifier consists only of a single diode. During the half-period in which the diode is operated in forward direction, a voltage is built up at the output (s. figure 1). In the second half-period, the diode is operated in reverse direction. If the diode is operated in reverse direction, no current can flow because the diode does not become conductive. As a result, no current can flow through the resistor. Thus, the entire negative voltage of the second half-wave lies across the diode and not across the resistor.
Disadvantages of half-wave rectification are the comparatively large ripple on the DC side and the poor efficiency. In addition, the upstream transformer becomes magnetized because it is only traversed by current in one direction.

Fig. 1: Principle of a half-wave rectifier

Measurements on the Half-Wave Rectifier with the Oscilloscope

Build the half-wave rectifier circuit shown in figure 2 with the diode and the load resistor. Take the transformer output voltage $u_{\rm Sec}$ from the variable low-voltage terminals (**L1** and **N** at your table). The voltages $u_{\rm Sec}$ and $u_{\rm R}$ are to be measured with the oscilloscope. Draw the connection between the circuit and the oscilloscope in figure 2.

Fig. 2: Half-wave rectifier circuit

Sketch the oscilloscope display with the voltages $u_{\rm Sec}$ and $u_{\rm R}$ in the screen image figure 3.
Also document the settings of the channels used, the time base and the GND line on the left side of the screen image.

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Fig. 3

Channel 1: $ \frac{V}{\rm DIV} = $

Channel 2: $ \frac{V}{\rm DIV} = $

Time basis: $ \frac{T}{\rm DIV} = $

Switch now a capacitor (electrolytic capacitor) with 100 µF in parallel to the resistor $R_{\rm L}$ and sketch the voltage curve of $u_{\rm Sec}$ and $u_{\rm R}$ again.
Warning: When using an electrolytic capacitor, observe the correct polarity!

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Fig. 4

Channel 1: $ \frac{V}{\rm DIV} = $

Channel 2: $ \frac{V}{\rm DIV} = $

Time basis: $ \frac{T}{\rm DIV} = $

Measure the following values with the help of the oscilloscope and enter the results in table 1 (C = 100 µF):

- Secondary-side voltage of the transformer $û_{\rm Sec}$
- Frequency of the secondary transformer voltage $f_{\rm Sec}$
- Peak-to-peak ripple voltage $u_{\rm PP-ripple}$
- Ripple frequency $f_{\rm Ripple}$
- Average value of the rectified voltage $|ū_{\rm R}|$
- Peak value of the rectified voltage $u_{\rm R,~max}$

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Tab. 1: Rectifier

Consider a measure with which the ripple voltage can be reduced. Sketch the circuit with your solution in figure 5 and measure the voltages $u_{\rm Sec}$ and $u_{\rm R}$. Enter these **with another color** into the screen image shown above figure 4.

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Fig. 5

Carry out the corresponding measurements – as above – again on the half-wave rectifier. These were the secondary-side voltage of the transformer $û_{\rm Sec}$, the frequency of the secondary transformer voltage $f_{\rm Sec}$, the peak-to-peak value of the ripple voltage $u_{\rm PP-ripple}$, the ripple frequency $f_{\rm Ripple}$, the average value of the rectified voltage $|ū_{\rm R}|$ and the peak value of the rectified voltage $u_{\rm R,~max}$. Enter the results in the second free line of table 1.