

University of Applied Sciences Hamburg	DEPARTMENT OF INFORMATION ENGINEERING	Laboratory for Instrumentation and Measurement
Group No :	<h1>Test No. 2</h1>	L1: in charge of the report
Date:		Assistant A2:
Professor:		Assistant A3:
Advanced Scope Measurements		

History

Report 1		Date	Remarks
	received		
	checked		
	result	o.k.	
n.g.		→ 1. Correction → Term.....	
1. Correction		Date	Remarks
	received		Last chance!!
	checked		
	result	o.k.	
n.g.		→ 2. Correction → Term.....	
2. Correction		Date	Remarks
	received		
	checked		
	result	o.k.	
n.g.		→ not passed → back to L1.....	

Final decision:

o.k.

not passed

Prof.

Important

- no wiring before the presentation of a correct circuit diagram including all instruments
- maintain a log-book to document your experimental work

Objectives

- Understand the impact of AC coupling on the measured signal
- Capability to determine the time constants of a pulse
- Understand and apply the x-y-mode

Preparation

Note:

This homework is to be prepared as group work before the lab session starts and to be presented at the beginning of the lab session by the team leader.

1. Find information about AC and DC coupling of a scope and write down a short explanation of these functions and their benefit.
2. Find information about the terms fall time, rise time and pulse duration and make a sketch to illustrate these terms.
3. Describe in two sentences the function and purpose of a diode and plot the characteristic I-U-diagram of a silicium diode in the range between 0 and 800mV described by the following equation:

$$I = I_s \left(e^{\frac{U}{nU_T}} - 1 \right)$$

with the typical saturation current $I_s = 10\text{nA}$ and emission coefficient $n = 2$ for the 1A si diode 1N4007 used in the lab.

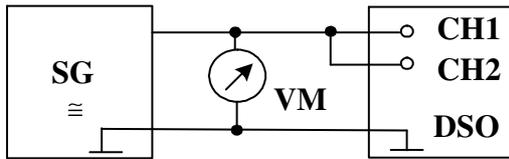
The thermic voltage U_T results to 26mV at room temperature.

Remember:

Use grid paper in the lab to make plots, circuit diagrams and calculations. Use logarithmic paper for Bode plots.

Make a plot of the wiring diagram including all necessary instruments and a list of all important items in use.

Experiment 1: Impact of DC/AC-coupling



Scope setup:

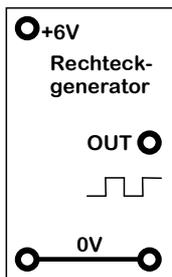
Channel 1: DC coupling
Channel 2: AC coupling

Signal generator setup: Sine, 6Vpp

- Set channel 1 to the DC coupling mode and channel 2 to the AC coupling mode in the channel menu. Let u_1 be the voltage displayed on channel 1 and u_2 the voltage on channel 2. Measure the ratio u_2/u_1 as function of the frequency in a range between 1 Hz and 50 Hz. Draw the amplitude response as Bode plot. Determine the cutoff frequency f_b .
- Switch off channel 2 and set the signal generator to a square wave signal between (low state = 0V, high state = 6V and a frequency of 10 Hz and check the result with channel 1 (still in the DC coupling mode). Re-activate channel 2 in AC coupling mode and investigate the impact of the AC coupling on the wave form. Take a screen shot of both channel 1 and channel 2. Explain the difference of the wave forms of channel 1 and channel 2.

Experiment 2: Measure rise-time, fall-time, and cycle duration of a pulse

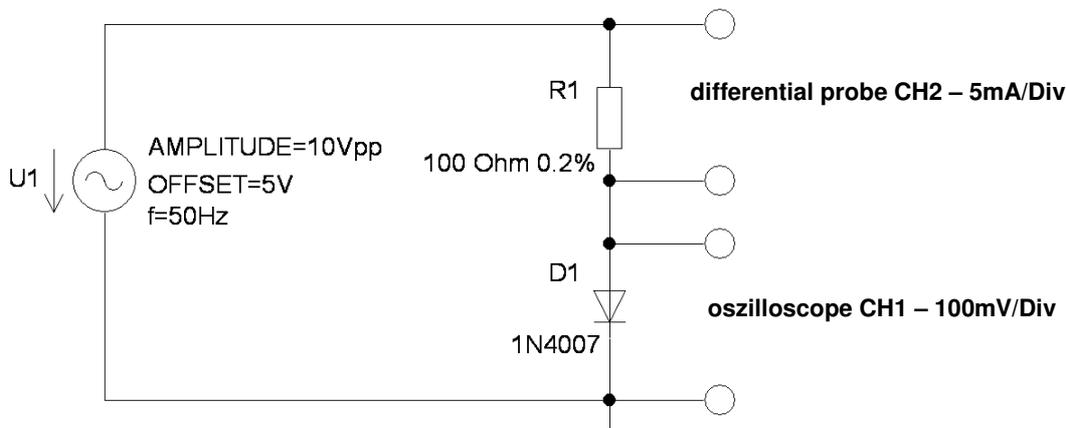
Pulsengenerator Box:



- Determine the rise-time t_R , fall-time t_F and cycle duration T_P of the signal at the output OUT. Make a screen shot of the signal.
- Determine the DC value of the output signal.

Experiment 3: x-y-mode

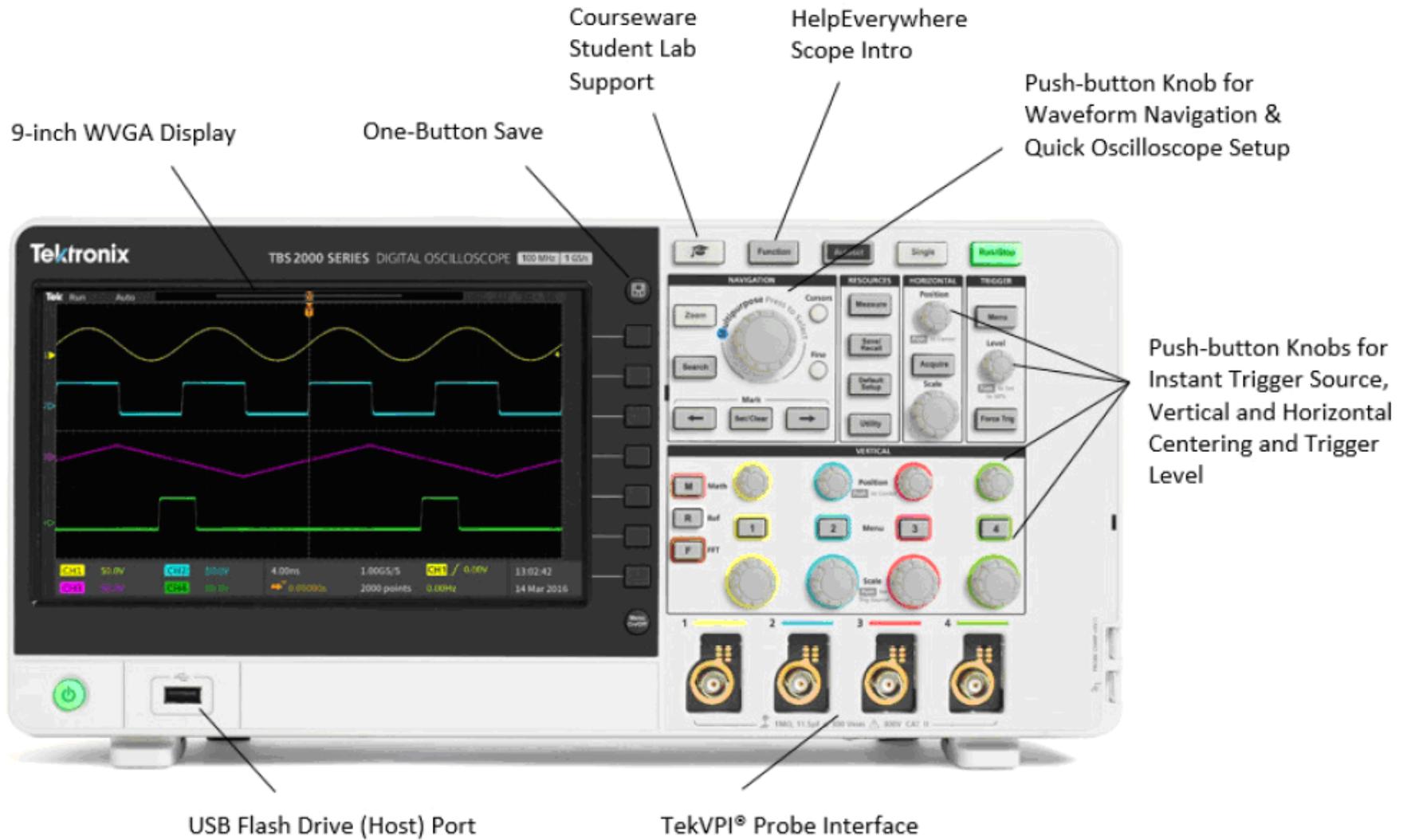
The objective of this experiment is the demonstration of the x-y- deflection of a scope in order to display the $u(i)$ -characteristic of a diode:



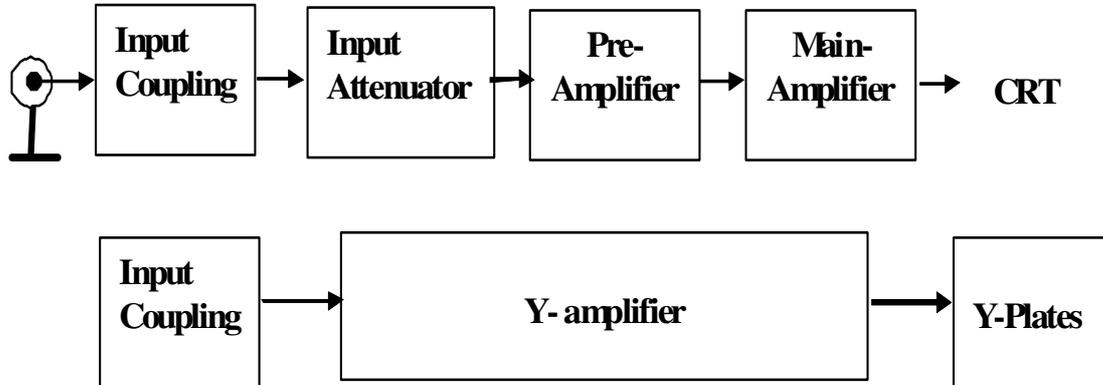
- Adjust the generator to a amplitude value of 10 Vpp with a DC-offset of 5V and a frequency of 50 Hz.
- Set up the circuit shown above (R_1 is a measurement resistance of 100 Ω).
- Make a screen shot, provide the correct scaling information and compare with the preparation.

Appendix 1
2104B

Digital Storage Oscilloscope Tektronix TDS



Appendix 2: Subsystems in a scope



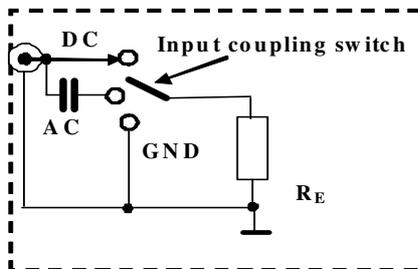
Vertical deflection system

Almost all amplifiers used in scopes are calibrated in terms of sensitivity rather than gain.

The actual attenuation or amplification is not important.

For special purposes and to give the scope more flexibility in the display of certain types of input signals an **input coupling selector** is provided for each channel:

Input coupling in a scope



In the **DC-position** (which is the most common one), the input signal goes straight to the vertical amplifier.

In the **AC-position**, a capacitor **C** blocks all dc and very-low-frequency signal components of the signal into the vertical amplifier. If for example an input signal consists of a DC component, U_{DC} , super-imposed onto an ac signal u_{ac} : $u(t) = U_{DC} + U_{AC}$ and only the AC component is of interest, then the AC-position is selected.

Warning! The DC signals blocked are not the only ones blocked. The input impedance [$R_E = 1\text{ M}\Omega$] forms a high pass filter with the capacitor **C**. The cut-off frequency is about 2-10 Hz depending on **C**.

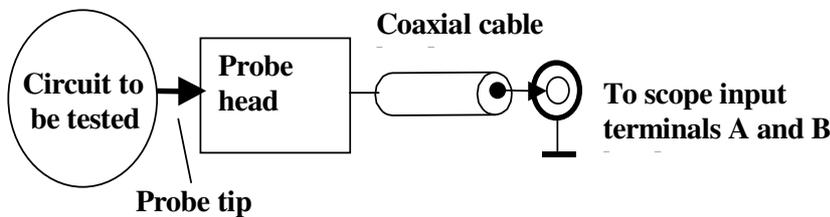
The **GND-position** of the input coupling switch grounds the internal circuitry of the amplifier. This is used to position the beam on the screen without having to remove the scope lead.

Other subsystems in a scope:

1) Dual trace features

It is often advantageous to be able to display two or more signals simultaneously on the screen. This can be accomplished by electronic switching of the input signals to produce separate traces. There are two possible modes:

the **ALTERNATE** mode, and the **CHOPPED** mode.



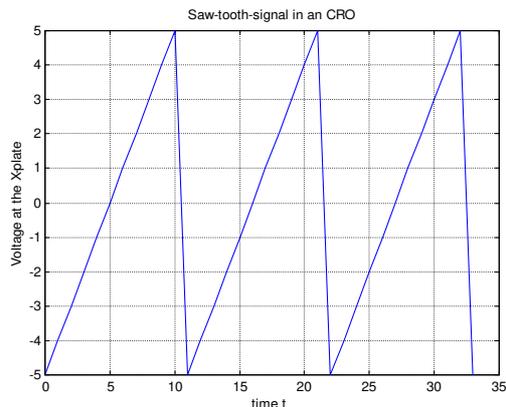
2) Oscilloscope probes

Oscilloscope probes should perform the simple task of sensing signals at their source and transferring them to the input of a scope without loading or disturbing the circuit under test. The simplest types of probes could be simply lengths of wire.

However, this type of probe is usually unsuitable because they pick up unwanted noise which is transferred to the scope input. A common probe is a passive voltage probe with no attenuation which consists of a co-axial cable. This type is capable of transmitting high frequency signals without distortion and external interference.

Basically oscilloscope measure voltages between the scopes input and ground and thus they can load the circuits to which they are connected. The typical input impedance of a scope is as shown: $R_E = 1.0 \text{ M}\Omega$

Appendix 3: Time-base and Triggering system

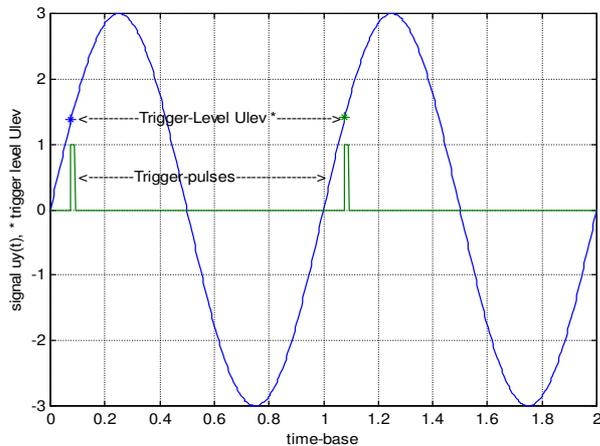


The most common use of the scope is to display a signal against time (**Y-t mode**).

To generate this type of display, a ramp voltage that causes a linear deflection of the beam must be applied to the X-plates. Additionally this voltage has to be repetitively applied to the horizontal plates and it must be synchronised with the periodic signal being displayed, in such a way that the a steady image appears on the screen.

This is the function of the **time-base circuit** which produces a sweep waveform (saw-tooth) starting at t_0 . In practice, the left edge of the screen corresponds to a negative voltage U_{min} and the right edge of the screen corresponds to a maximum saw-tooth of U_{max} , so that the middle line of the display corresponds to a sweep level of zero Volts.

Triggering level U_{LEV} and –slope in a DSO



The **TIME/DIV** control on the front panel of the scope determines how much time it takes for the sweep waveform to move the spot by one division. During the short time needed for the spot to be returned from the right edge of the screen to the starting position, the beam has to be shut off (retrace blanking). This is achieved by additional circuitry manipulating the beam intensity.

To achieve a stable display for the swept waveform it is necessary to start at the same point of the signal waveform.

This is achieved by the a triggering signal.

Each time a triggering signal meets a pre-selected **SLOPE** or a voltage **LEVEL** (U_{LEV}) condition, the pulse generator emits a pulse to start the sweep generator.

The point on the triggering signal at which the pulse generator emits a pulse is controlled by the **Trigger Slope** and **Trigger Level** switches on the scope.

The trigger slope switch allows one to choose whether the slope of the triggering signal should be **positive** or **negative** when the pulse generator emits a pulse.

Similarly the trigger level switch determines the value (sign and magnitude) of the triggering voltage at which a pulse is generated.

When a sweep is triggered an LED is lit on the front panel. For different applications different trigger couplings are requested.