DIGITAL STORAGE OSCILLOSCOPE I. PREPARATION ON THE PRACTICAL EXERCISE, BASIC SETUPS AND MEASUREMENTS

THEORY: Principle of DSO, oscilloscopic probes and their compensation, vertical channel of DSO and its functions, time base and its modes, zoom, oscilloscope synchronization (edge synchronization), synchronization setting and control, DSO input coupling and synchronization sources.

Notes: All states of oscilloscope's screen can be saved as a file on a FAT32 USB flash drive. Insert the flash drive into the front USB port, press "Save / Recall" > Storage > Select the desired format (signal, image, or device settings) and try to find out for yourself how to proceed to store image from the screen. Oscilloscope DSO1004A has a built-in help. Click "Help" and press the button function of which you want to know.

Exercises:

1. Prepare oscilloscope for the measurement. Connect the probes to the input 1 and 2 of the oscilloscope DSO1004A. Set the correct probe type in the input channel menu (10x). Check whether probes are properly compensated for LF signal (output of the calibrator "Probe Comp", adjusting screw on the probe, the displayed signal as close as possible to rectangular shape of 3Vpp). Proper catching and displaying of basic signals can be achieved by the pressing "default setup" and „autoscale".

2. Get acquainted with the "Trigger" function of the oscilloscope. Check the "Edge" mode setting. What is the function of trigger and how does the "Edge" mode work? Check out slope, sweep, coupling… settings, what do they do?

3. Generate harmonic signal with an amplitude of 1V and frequency 15kHz. Connect the output of the generator to the input 1 of the oscilloscope. Catch cca. 3 periodes of the input signal on the oscilloscope screen. Change the output waveforms of the generator and note changes on the DSO screen. Change signal frequency and by the adjusting the time base always try to catch cca. 3 periods. Change the input signal amplitude and by the adjusting the vertical channel sensitivity try to display whole waveform at cca. 80 % of the full scale range. Notice marks on the screen borders (V/, ms/, trigger marks, zero), how are they changing?

4. Hold the sensitive part of the probe between your fingers. Observe the signal on the screen. Try to change the synchronization level ("Trig.Level") and signal edge ("Slope"). How do those functions influence the signal on the screen? Change the "Sync" menu (Trigger) "Source option" on the "AC line". Does the signal stop? Is the signal "running" along the screen (triggering is not synchronized with the signal) ? What can be concluded about this signal, where does it originate?. To check, calculate the length of the period using time scale and convert it to frequency. Return to the original trigger source selection.

5. Reading waveform parameters can be done smarter on a DSO. You can measure Peak/Peak value, Frequency, Periode and maximal value using "Cursors". Try them on arbitrary waveforms from task 3. Measure the same using "Measure" functions and compare the results. Which of these two methods is more precise? Try different modes of the cursors (mainly mode "Manual" a "Track") and note the results. Try the "Zoom" function as well.

6. Set zero trace position on the screen (GND on the control control, triggering mode "Auto"). Display an arbitrary waveform containing a step change (discontinuity). Set synchronization level to cca. -0.5V and AC input coupling mode. Slowly increase Offset of the output signal at the generator up to 1V. Do you observe any change on the screen of the oscilloscope? Read the peak value of the signal using "Cursor". How does it differ from the value measured in task 5? Change the "Synchronization mode" to DC. What happens with the image displayed on the screen and why? Synchronize the image on the screen by new setting of synchronization level. Change the channel coupling mode to "AC". What happened with the signal on the oscilloscope screen? What happened physically with the Channel of the Oscilloscope and how has the connection been changed? What is the peak value of the signal now?

7. Try the mode “Normal” of the oscilloscope. Generate any signal from point 3 and catch it on the screen. Change the selection “Sweep” from the “Trigger” menu into “Normal”. What has changed on DSO screen? What happens if you set the trigger level outside the signal range? Set run mode back to auto. What does DSO do now? Set the trigger level back to signal range. What is the difference between Auto and Normal sweep mode?.

8. Displaying single-shot waveforms. Generate an arbitrary signal from task 3. Display the waveform on the DSO screen. Set sweep mode to normal. Turn off the generator output and set DSO run mode to single. What is the DSO doing now? Turn the generator output on. What has been caught on the screen? Repeat this for different trigger level and edge. What changes on DSO screen?

9. Noise of a DSO vs. noise of an analog oscilloscope. Verify the statement : “Digital oscilloscopes are noisier- (the signal on the disconnected input is more noisy - wider trace) - as it was on the old analog oscilloscopes”. Disconnect probe from the DSO input. Set the sensitivity of this channel to maximum, “Auto” mode. Observe how wide the trace is – it implicates the noise level. Set “BW limit” in the vertical channel setinngs. Has the trace width changed? Why? What does BW limit do? Think about the quoted statement, is it true?

10. Generate a rectangular waveform (square) with 2MHz frequency and 2V amplitude. Capture this waveform with and without BW limit and measure rise and fall time. Repeat the same at 20MHz. How are measured times changing with full and limited BW – explain.

11. Generate 500Hz harmonic waveform with 2V amplitude. Measure the amplitude by DSO with a compensated probe. Repeat this measurement at 20MHz. Are measured amplitudes the same? Try to compensate the probe for 20MHz and repeat both measurements.

Manuals of the instruments:

Oscilloscope Agilent DSO1004A
Generator Agilent 33220A