

# “Introduction to Oscilloscope, Function Generator, DMM”

## Function Generator: Wavetek model 81



### Waveforms:

- Sine wave
- Triangular wave
- Rectangular wave
- Positive pulses
- Negative pulses
- Positive ramp

Frequency range: 10mHz ÷ 50MHz

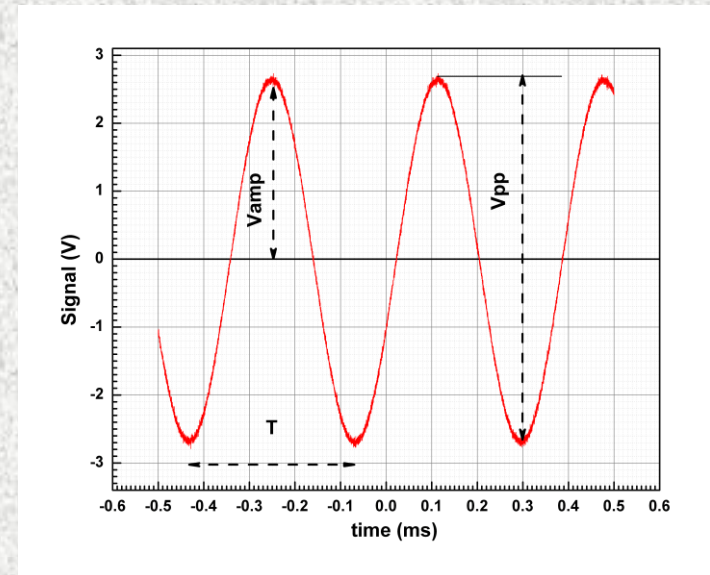
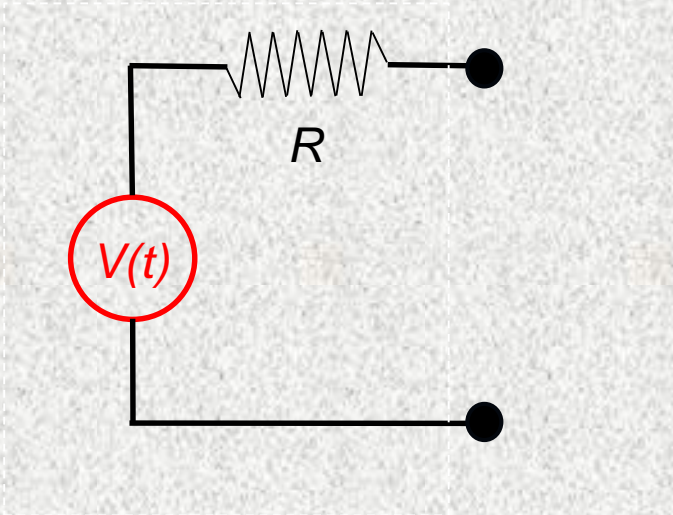
Output voltage: up to 16V (amplitude)

# “Introduction to Oscilloscope, Function Generator, DMM”

*The goal of the Lab is to get familiar with the these laboratory tools.*

## **Function Generator**

**Wave Function Generator; generates time dependent voltages  $V(t)$  as input for the study of electrical circuits or can be used as signal source in scientific experiment.**



# “Introduction to Oscilloscope, Function Generator, DMM”

**DMM – digital multimeter. (Agilent 34401A)**



**You can use DMM to measure:**

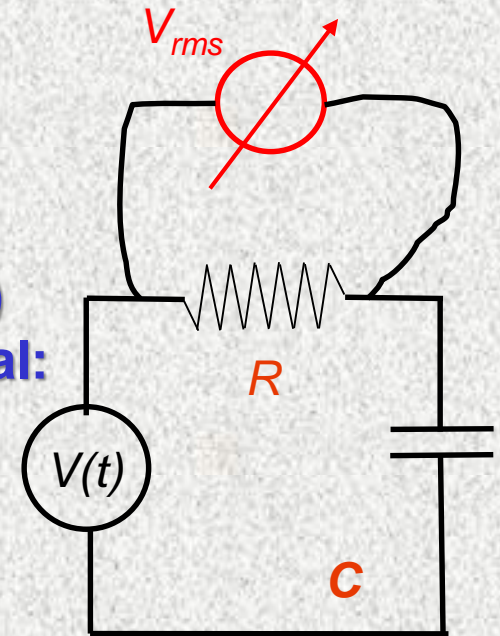
- AC/DC voltage
- AC/DC current
- Resistance
- Frequency
- Period

**All DMM's measure AC signals (voltage or current) in rms (root mean square) units. For periodic signal:**

$$V_{rms} = \sqrt{\frac{1}{T} \int_0^T [V(t)]^2 dt}$$

**In case of sine wave**

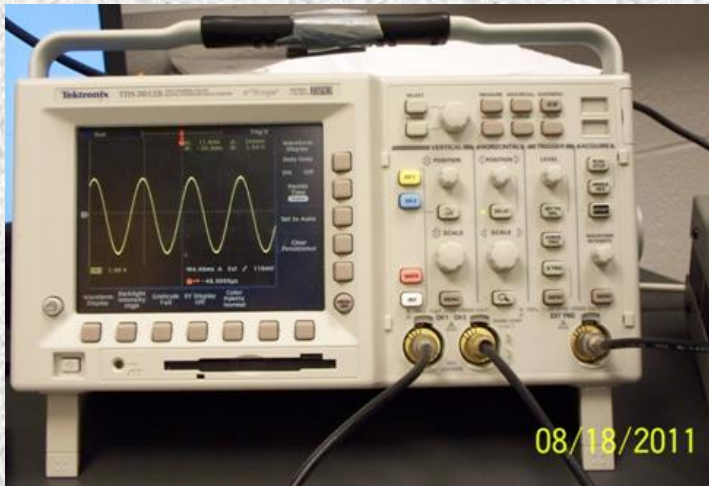
$$V_{rms} = \frac{V_{amp}}{\sqrt{2}} \approx 0.707 V_{amp}$$





# “Introduction to Oscilloscope, Function Generator, DMM”

## Digital Oscilloscope Tektronix TDS3012b



*The things you have learn and know about the scope:*

- *Inputs characteristics of the channels (input resistance, gain, bandwidth)*
- *Time base range*
- *Triggering*
- *Measurements of signal parameters*
- *Using cursors*
- *Averaging*
- *Using Math options*
- *Computer access to the image and data*
- *And much more ....*

### Higher Speeds Demand Greater Bandwidth

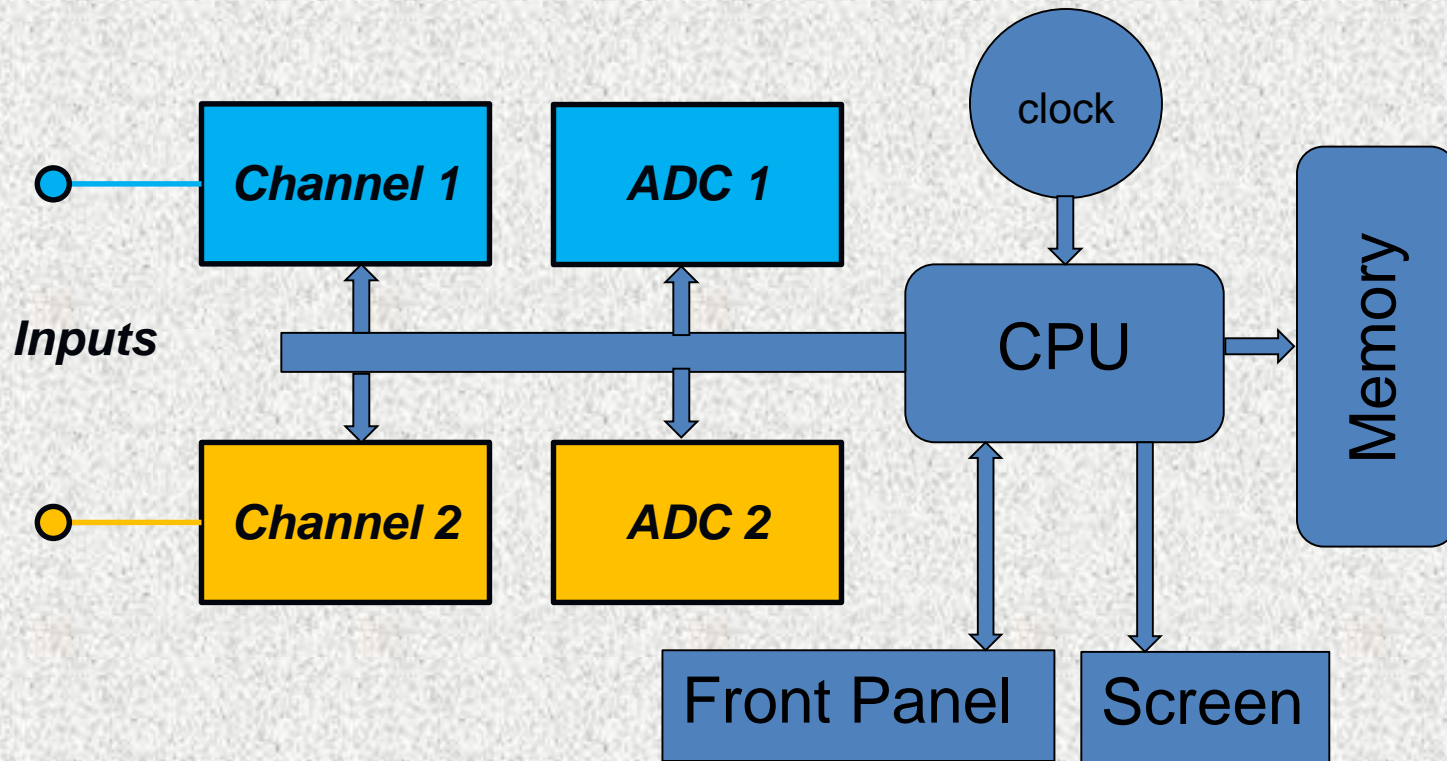
The TDS3000B DPOs offer bandwidths from 100 to 500 MHz to best suit the needs of your most demanding projects, so you can complete your tasks efficiently and confidently.

Model	Bandwidth	Channels	Sample Rate
TDS3054B	500 MHz	4 Ch	5 GS/s
TDS3052B	500 MHz	2 Ch	5 GS/s
TDS3044B	400 MHz	4 Ch	5 GS/s
TDS3034B	300 MHz	4 Ch	2.5 GS/s
TDS3032B	300 MHz	2 Ch	2.5 GS/s
TDS3024B	200 MHz	4 Ch	2.5 GS/s
TDS3014B	100 MHz	4 Ch	1.25 GS/s
TDS3012B	100 MHz	2 Ch	1.25 GS/s



# “Introduction to Oscilloscope, Function Generator, DMM”

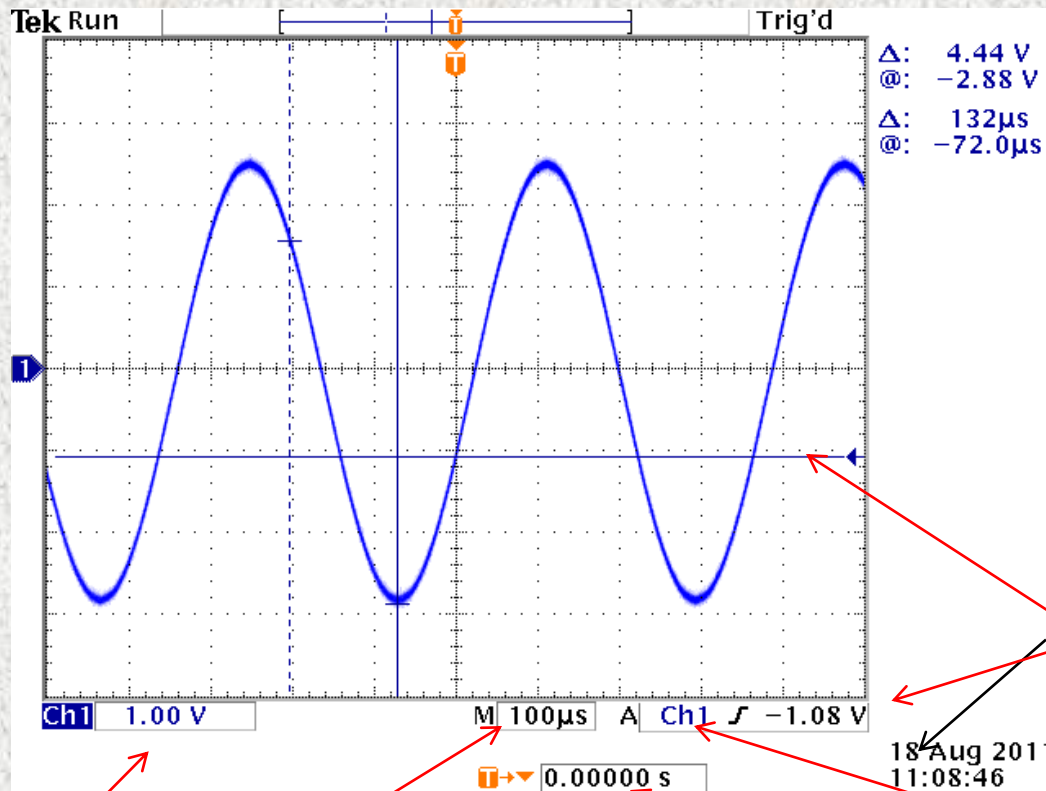
## Digital Oscilloscope Tektronix TDS3012b



*Simplified block diagram of two channels digital oscilloscope*

# “Introduction to Oscilloscope, Function Generator, DMM”

## Digital Oscilloscope Tektronix TDS3012b - Triggering



Vertical scale(V/div)

Horizontal scale(s/div)

Triggering level

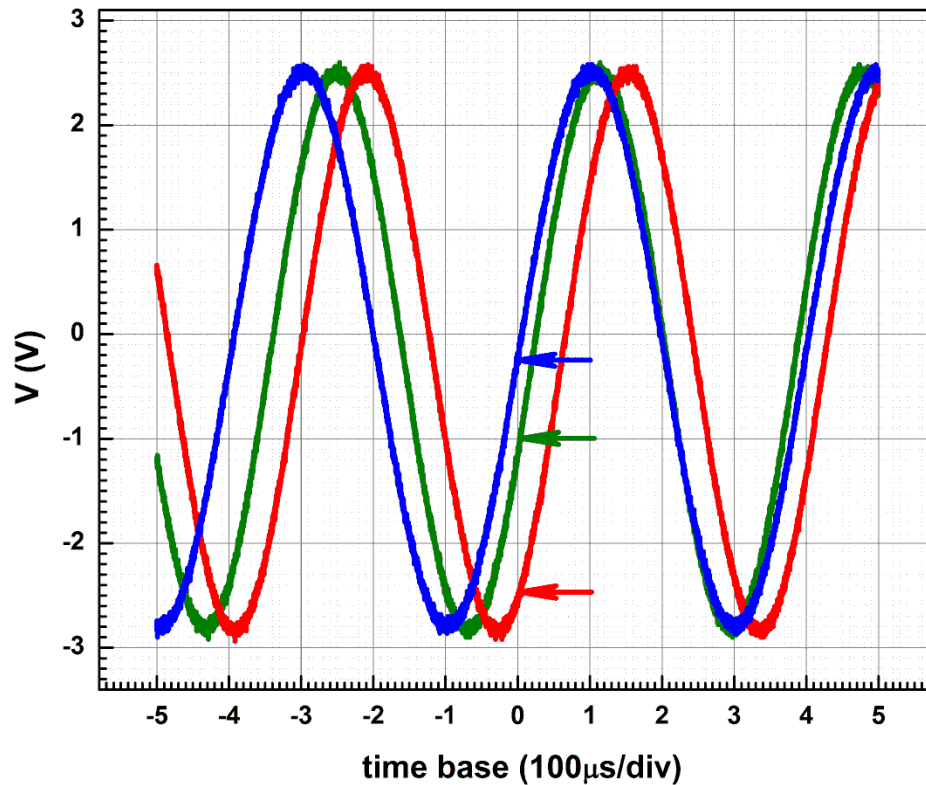
Triggering source

Triggering delay



# ***“Introduction to Oscilloscope, Function Generator, DMM”***

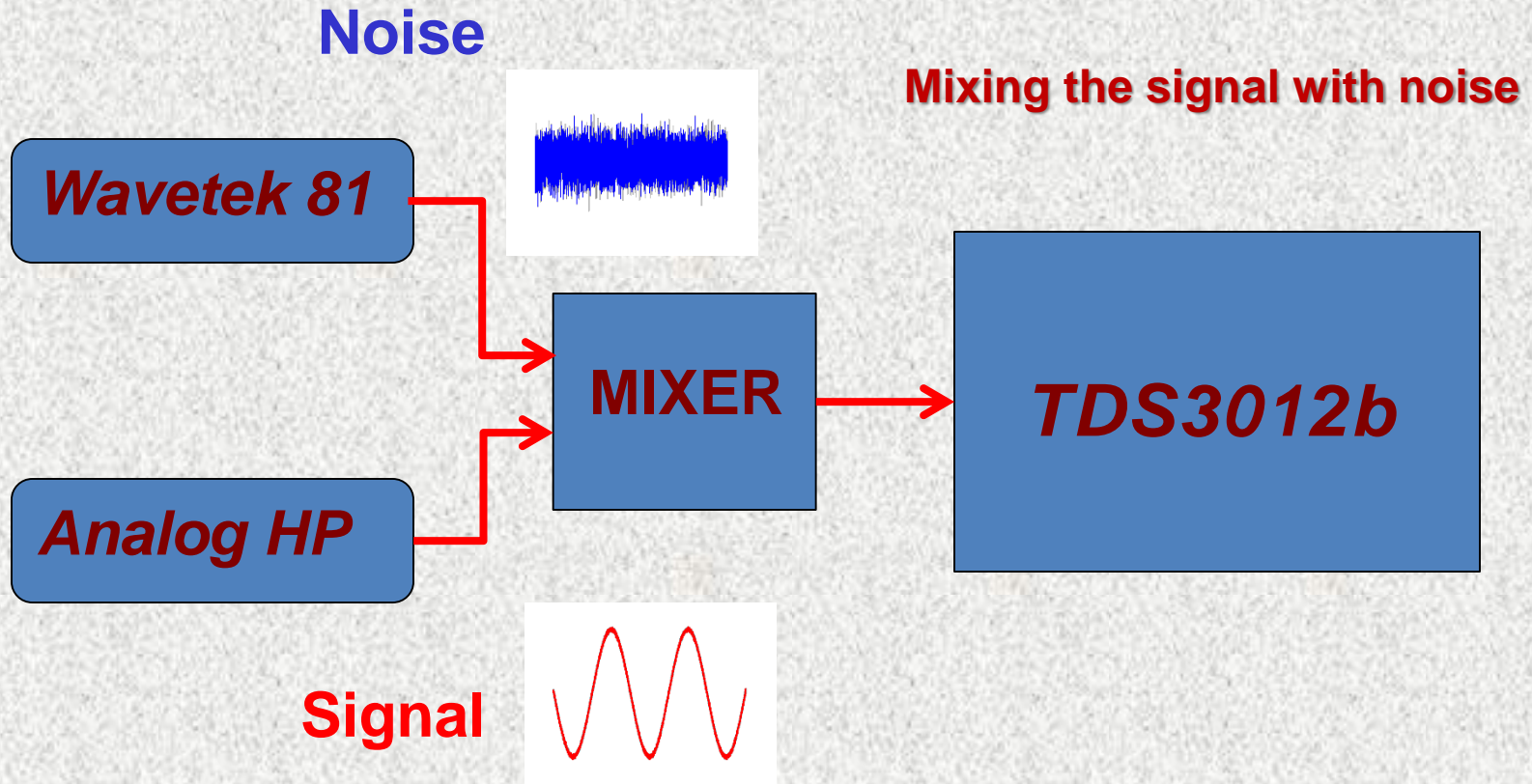
## ***Digital Oscilloscope Tektronix TDS3012b - Triggering***



*This data was taken from scope in ASCII format and plotted using Origin. Color arrows indicate the triggering levels for each trace*

# ***“Introduction to Oscilloscope, Function Generator, DMM”***

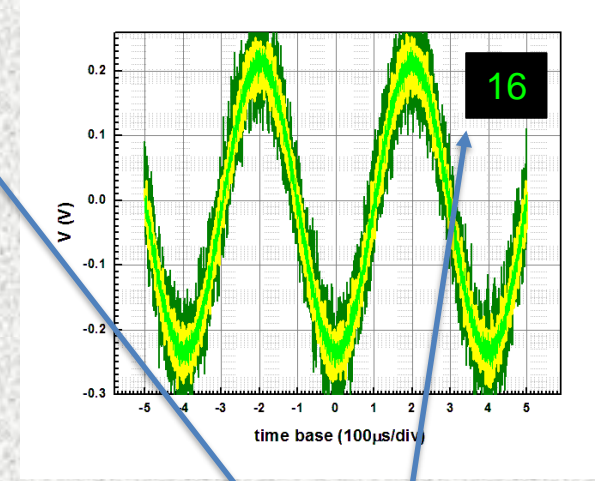
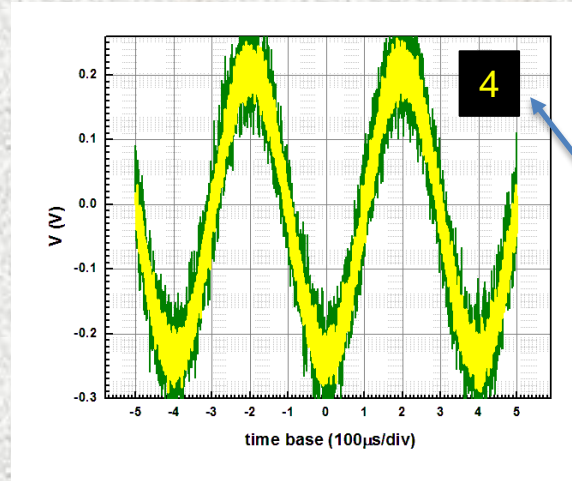
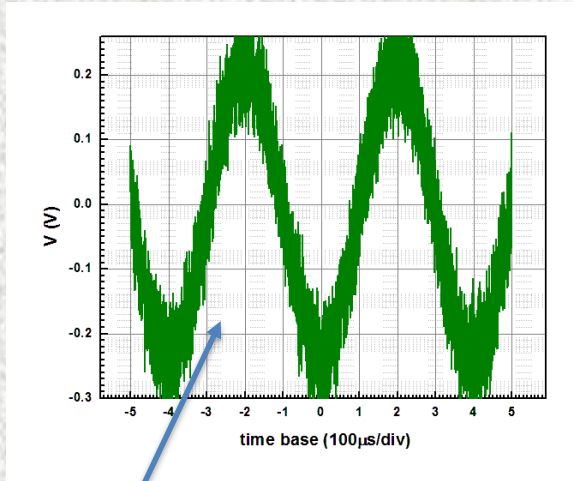
***Digital Oscilloscope Tektronix TDS3012b – Averaging***



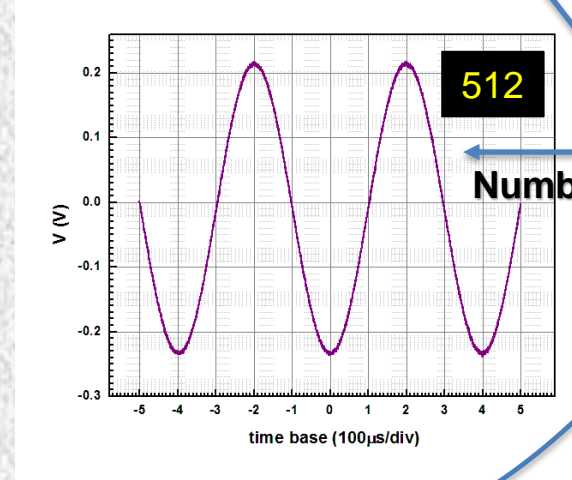
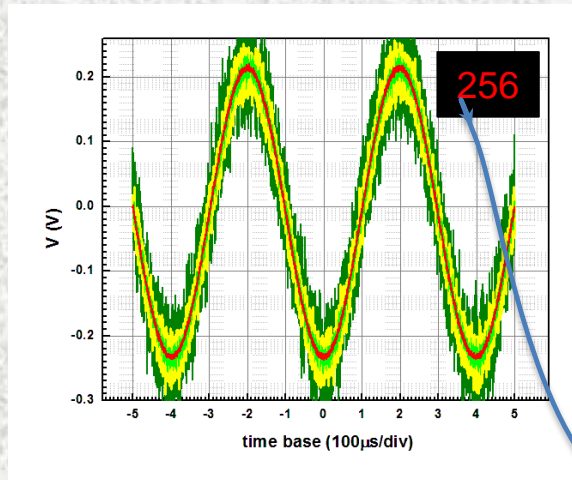


# “Introduction to Oscilloscope, Function Generator, DMM”

## Digital Oscilloscope Tektronix TDS3012b – Averaging



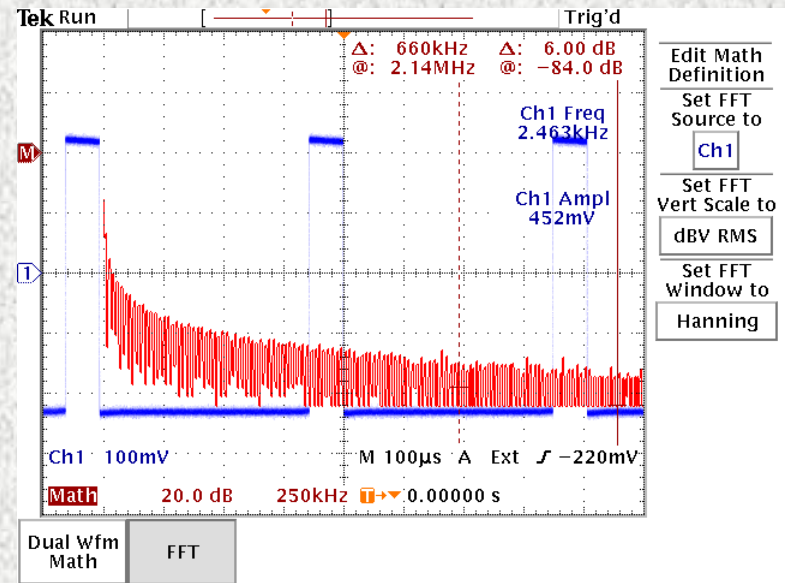
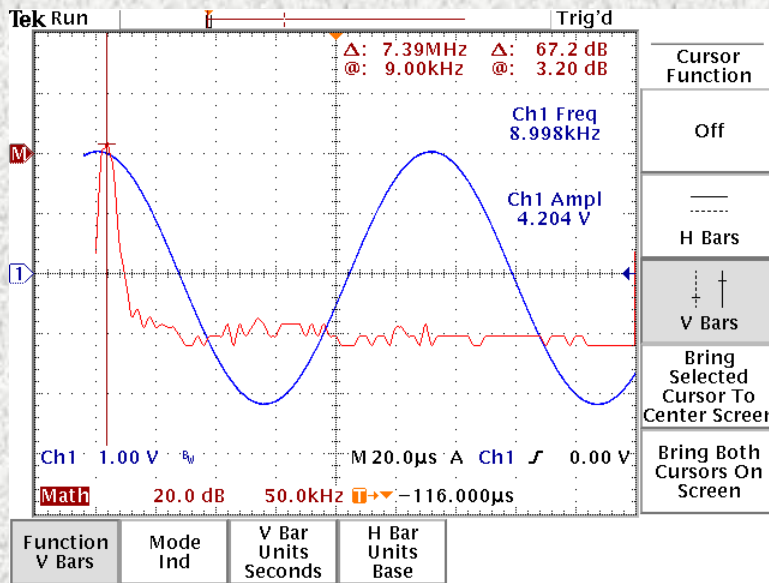
Noisy signal



Numbers of averaging

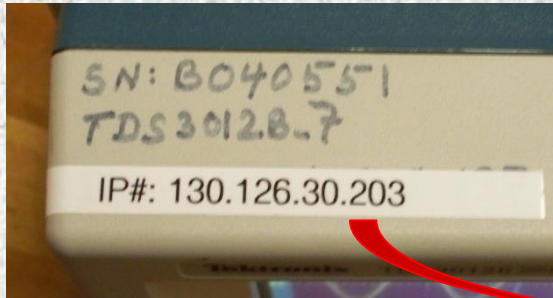
# “Introduction to Oscilloscope, Function Generator, DMM”

## Digital Oscilloscope Tektronix TDS3012b – Math

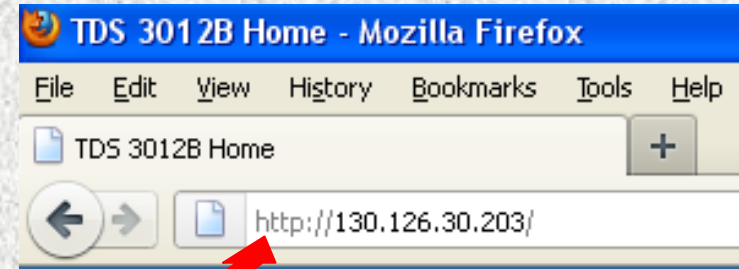


# “Introduction to Oscilloscope, Function Generator, DMM”

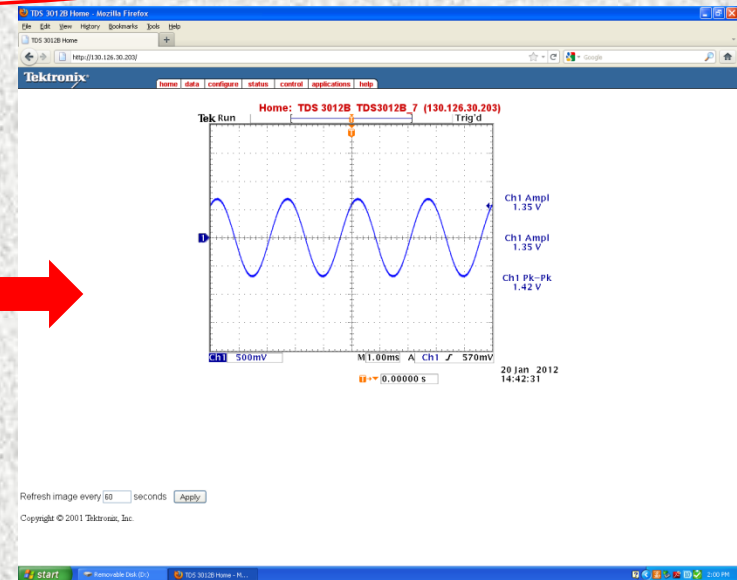
Retrieving the data from scope. All scopes in the Lab are connected to network



Find IP address of the scope on the top of its case and type it in the browser window



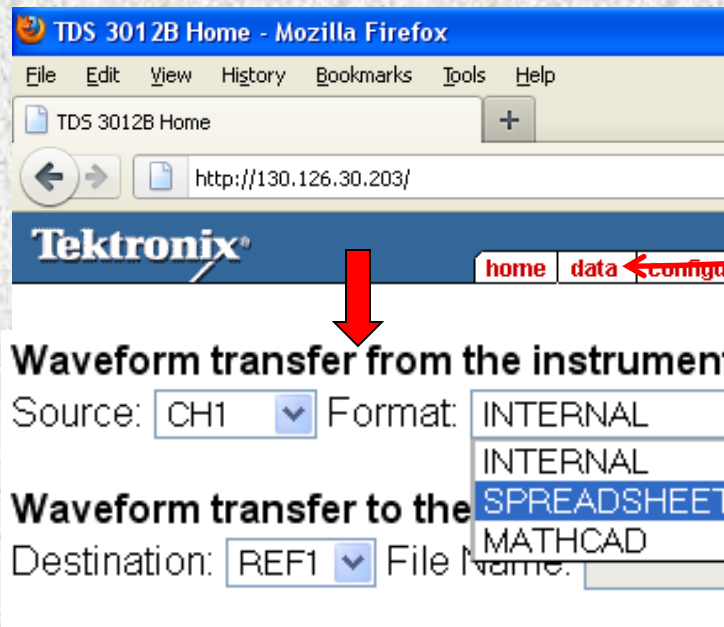
You will have access to the scope screen image and data stored in scope memory from computer





# “Introduction to Oscilloscope, Function Generator, DMM”

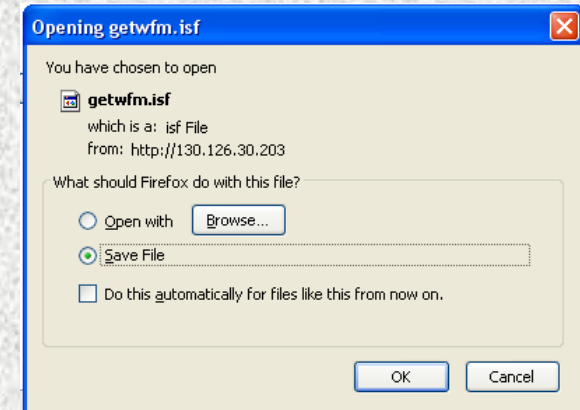
## Retrieving the data from scope.



The screenshot shows a Mozilla Firefox browser window titled "TDS 3012B Home". The address bar shows the URL "http://130.126.30.203/". The page header features the Tektronix logo and navigation links for "home", "data", and "configu". Below the header, there are two sections for waveform transfer. The first section, "Waveform transfer from the instrument:", has "Source" set to "CH1" and "Format" set to "INTERNAL". A "Get" button is visible. The second section, "Waveform transfer to the", has "Destination" set to "REF1" and "File Name" set to " ". A dropdown menu for the "Format" field is open, showing options: "INTERNAL", "SPREADSHEET" (highlighted), and "MATHCAD". A red arrow points from the "data" link in the header to the "Get" button.

To get the data from scope – click on *data* button in Tektronix window

In data window choose the proper channel and format and click “Get”. Spreadsheet format corresponds to ASCII



Downloading the data

# “Introduction to Oscilloscope, Function Generator, DMM”

Choose the scope channel and time scale

time scale (s/div)  
1m

Delay time (s)  
5m

Channel  
MATH

START

Amplitude

Frequency

SAVE

Mag (dB)

Trace1

frequency (Hz)

Text Input  
Enter IP:  
130.126.30.213  
OK Cancel

Last time modified at  
2 July 2012  
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EXIT

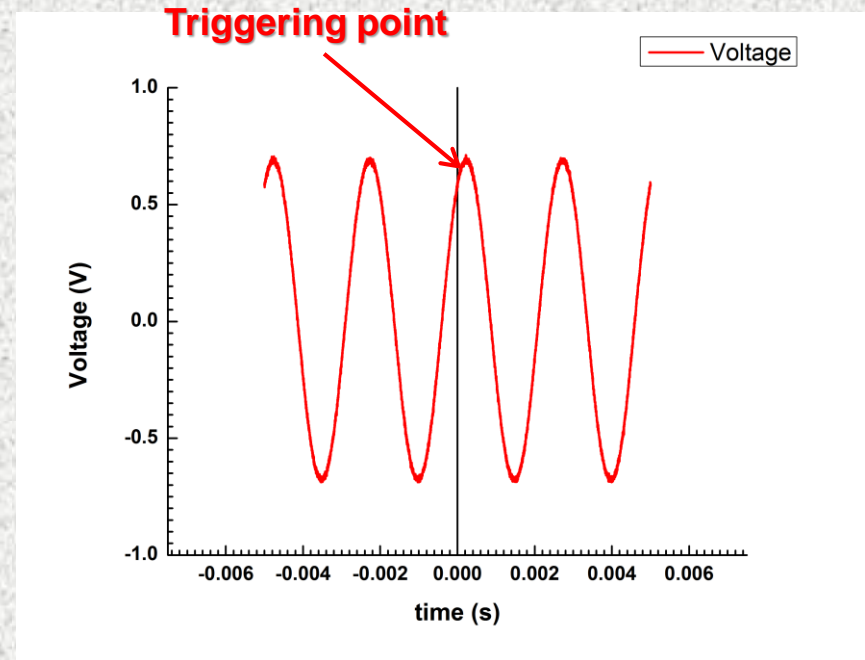
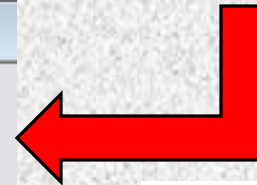
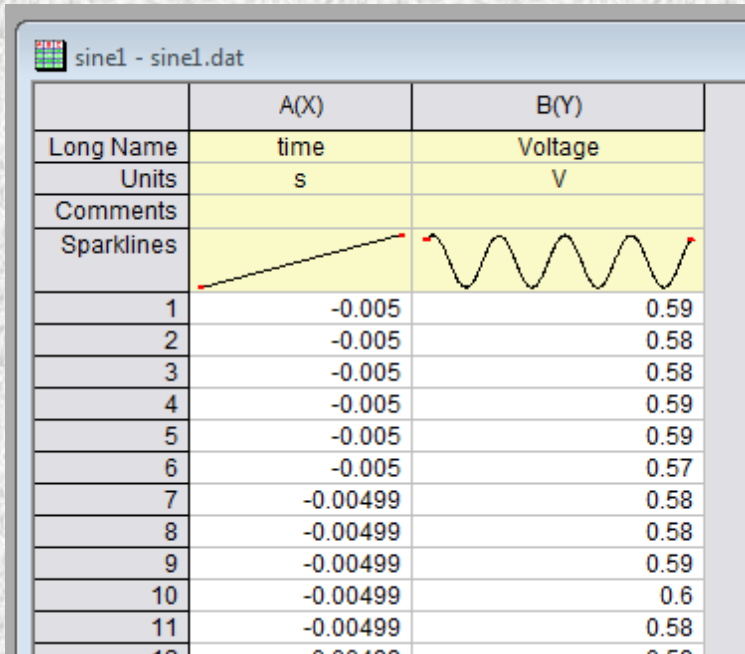
Reading data from  
TDS 3012B

This program will help you to take data much faster than using Tektronix site.

# “Introduction to Oscilloscope, Function Generator, DMM”

Retrieving the data from scope.

Now we import the data in Origin, Excel



The first column represent time in sec accounted from triggering event. The second – voltage applied to corresponding channel



# ***“Introduction to Oscilloscope, Function Generator, DMM”***

## ***The most important things which you have learn from Lab1:***

- ***Function generator.*** Manipulating with wave form, frequency, amplitude of the signal. What is the output resistance of the generator.
- ***DMM.*** Input resistance of DMM. Measuring AC signals. What is rms and how to calculate it.
- ***Oscilloscope.*** Triggering. Time base. Input sensitivity. Input resistance. Averaging. Simple math operations. Using computer for downloading the images and data from scope. Plotting this data on computer (Origin).
- ***General.*** Access to the Lab portal. Create a personal folder in “Students” area.