Boğaziçi University

Introductory Phys Labs

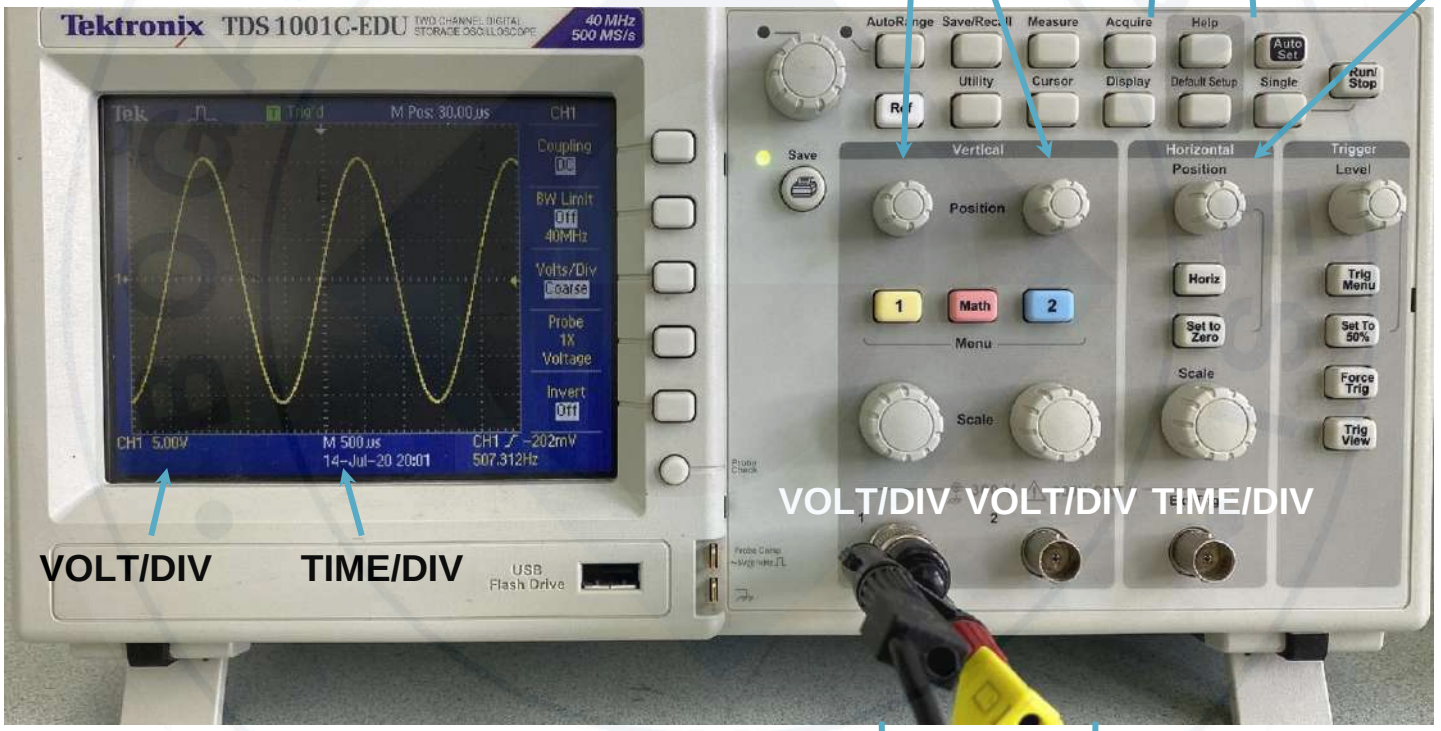
OSCILLOSCOPE

PHYL 201

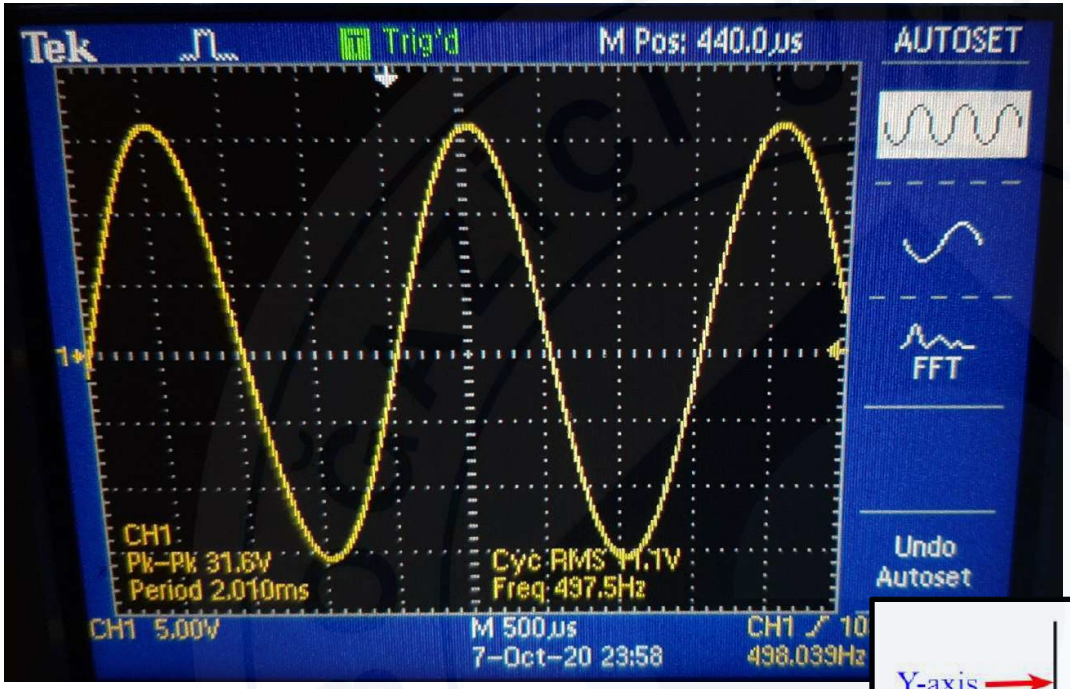
THEORY

OSCILLOSCOPE

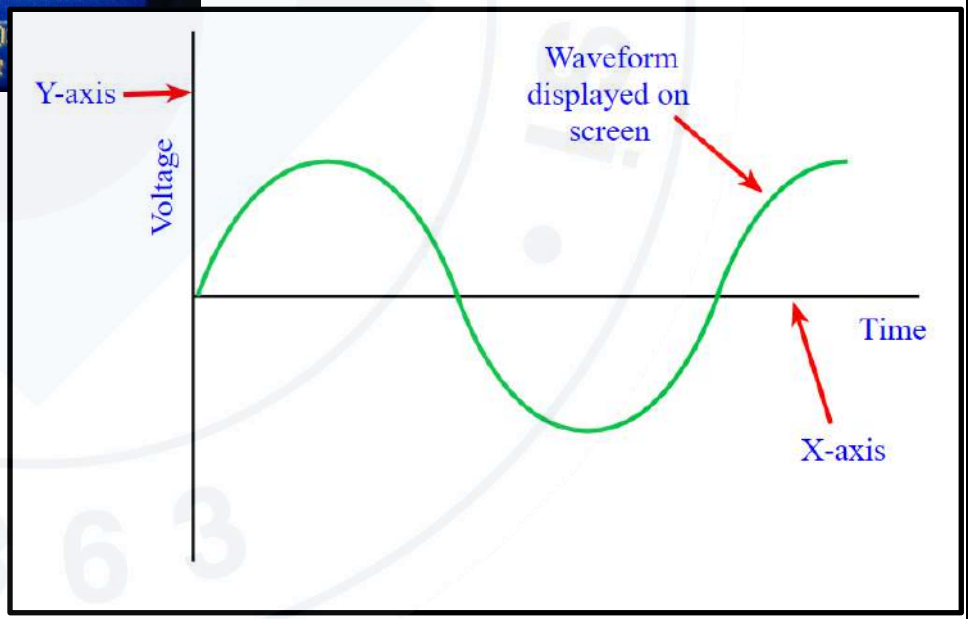
Oscilloscopes display the change of an electrical signal over time, with voltage and time as the Y- and X-axes, respectively, on a calibrated scale. The waveform can then be analyzed for properties such as amplitude, frequency, rise time, time interval, distortion, and others.



OSCILLOSCOPE

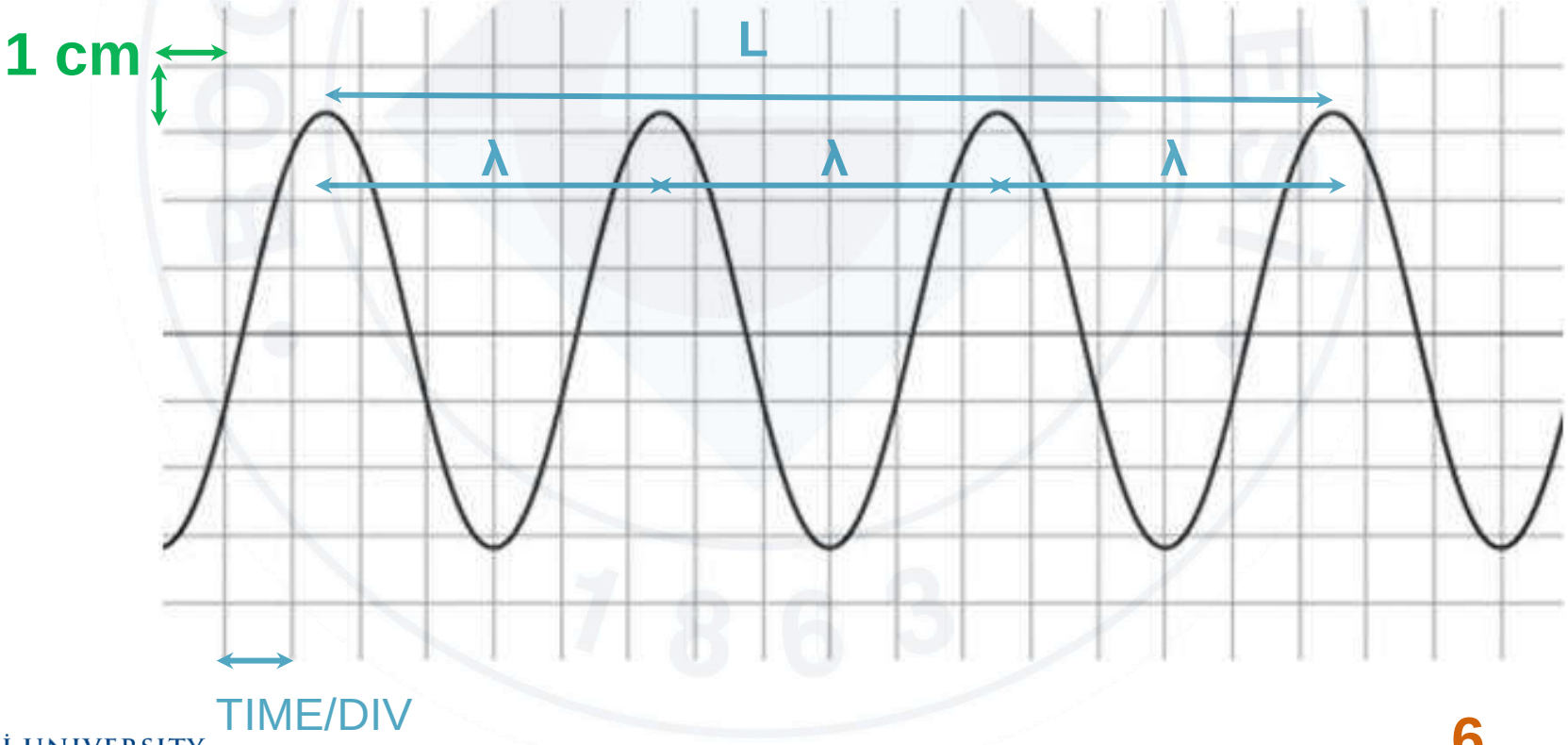


1.0 DIV = 1.0 cm

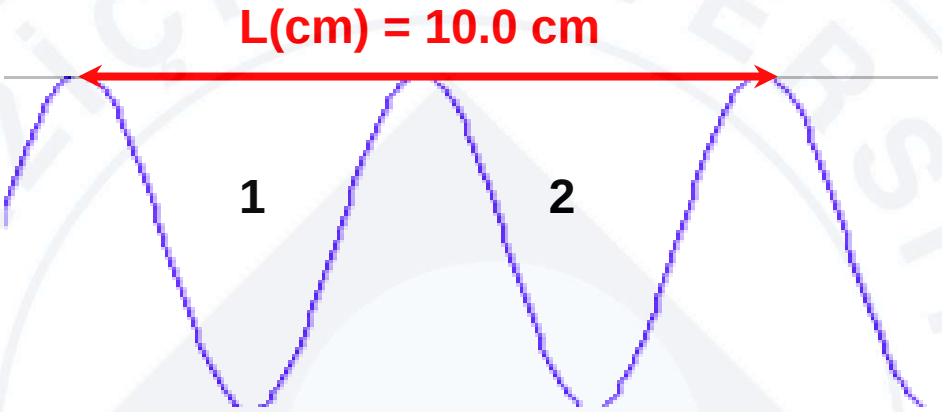


TIME MEASUREMENT

- λ(cm) = L(cm) / #of full cycle
- T(s) = λ(cm) x TIME/DIV (s/cm)
- f(Hz) = 1 / T(s)



EXAMPLE #1



3 peaks, 2 full cycles

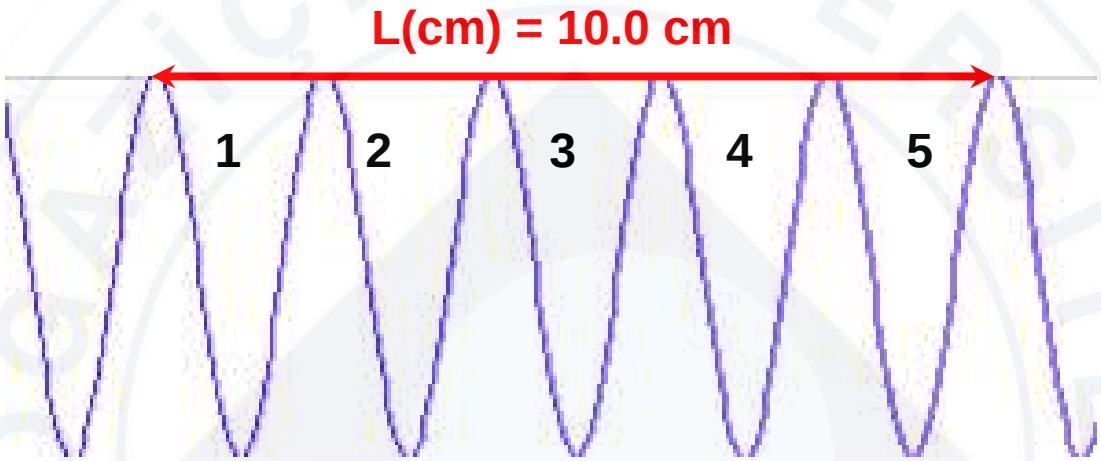
TIME/DIV = 10.0 μs/cm

$\lambda = 10.0/2 = 5.00$ cm

$T = \lambda \times \text{TIME/DIV} = 5.00 \text{ cm} \times 10.0 \mu s/cm = 50.0 \mu s$

$f = 1/50.0 \ (\mu s)^{-1} = 20.0 \times 10^3$ Hz

EXAMPLE #2



6 peaks, 5 full cycles

TIME/DIV = 25.0 μs/cm

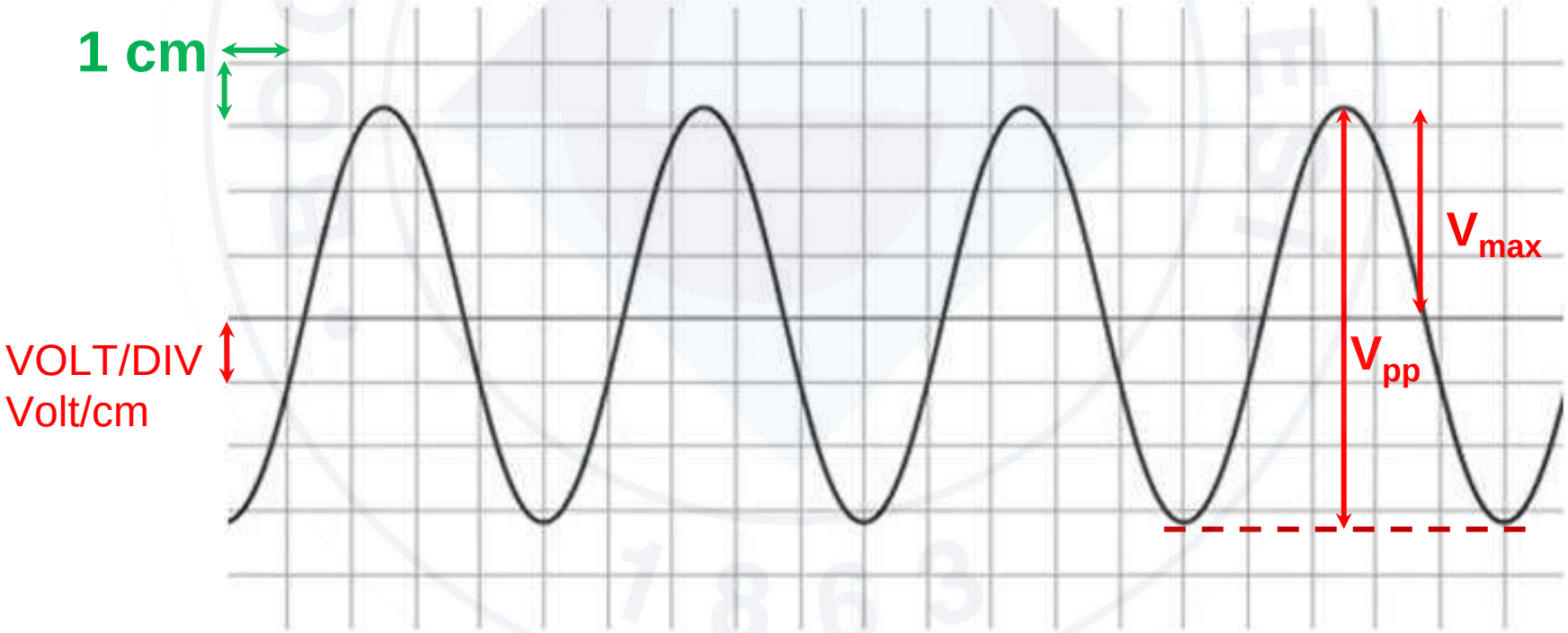
$\lambda = 10.0/5 = 2.00$ cm,

$T = 2.00 \times 25.0\ \mu s = 50.0\ \mu s$

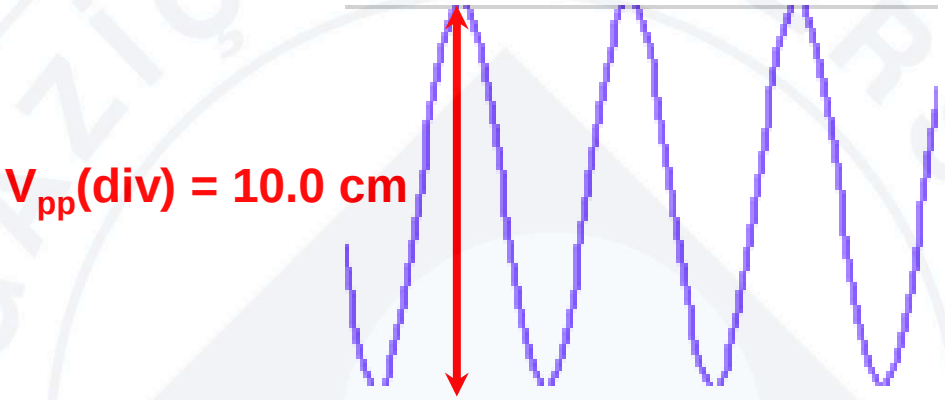
$f = 1/50.0\ (\mu s)^{-1} = 20.0 \times 10^3$ Hz

VOLTAGE MEASUREMENT

- $V_{pp}(Volt) = V_{pp}(cm)$ x VOLT/DIV
- $V_{max}\ (Volt) = V_{pp}(Volt) / 2$
- $V_{rms}(Volt) = V_{max} / \sqrt{2}$



EXAMPLE #2



VOLT/DIV = 5.00 Volt/cm

V_{pp}(Volt) = V_{pp}(div) x VOLT/DIV = 10.0 x 5.00 = 50.0 V

V_{max} (Volt) = V_{pp}(Volt) / 2 = 50.0 / 2 = 25.0 V

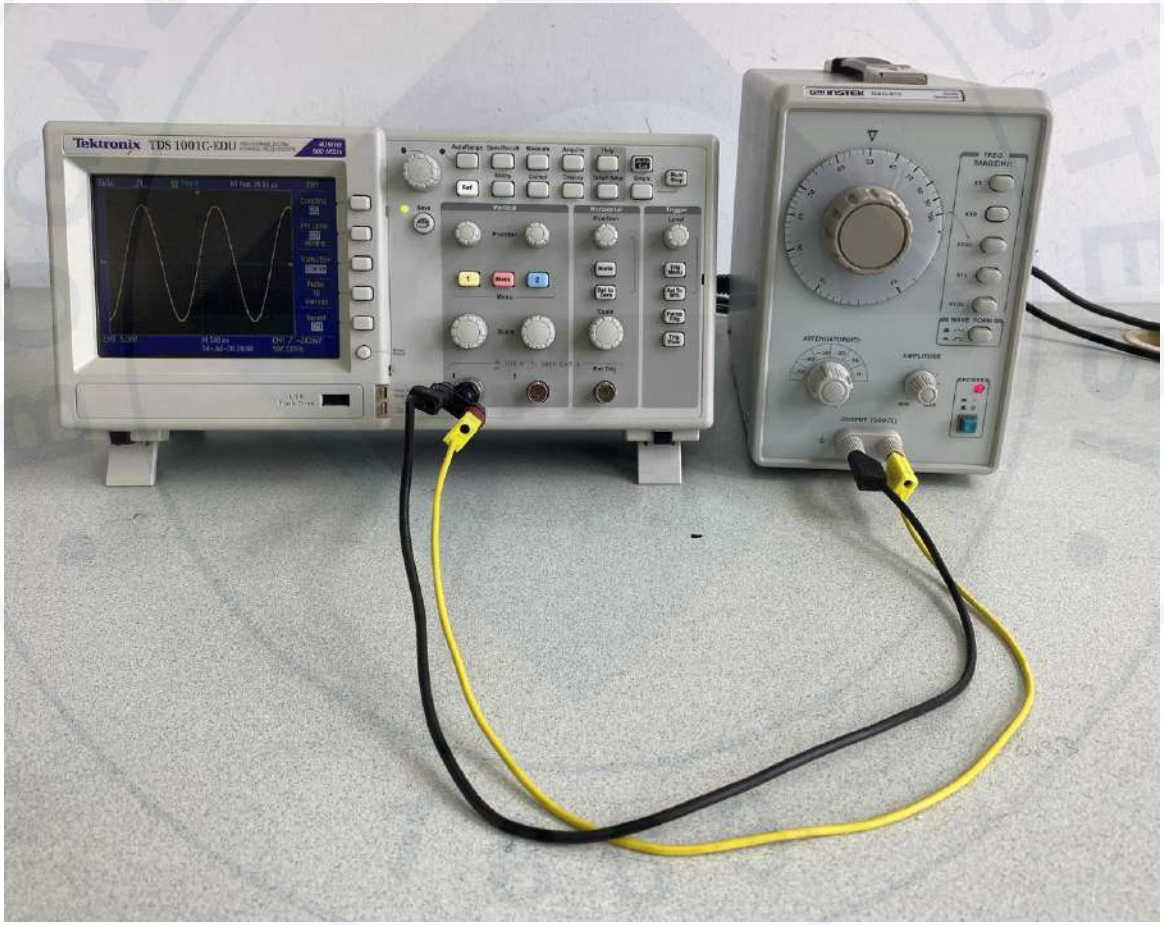
V_{rms}(Volt) = V_{max} / $\sqrt{2}$ = 17.7 V

EXPERIMENT SETUP

OSCILLOSCOPE

Oscillator generates sinusoidal waves (adjustable between 10 Hz – 10 MHz).

Oscilloscope is connected to oscillator to observe to generated signal.



OSCILLOSCOPE

Oscillator(Power supply) is set to 50x10 = 500 Hz

Current signal frequency indicator

Frequency tuning knob

Frequency multipliers

Sine vs Square Wave button

Voltage knob

DATA-TAKING

PART 1: Given f_{TV} with 2 different Time/div settings. You will take 2 measurements of frequency, 1 measurement of voltage.

PART 2: Given f_{TV} (3rd) with 1 Time/div settings. You will take 1 measurement of frequency.

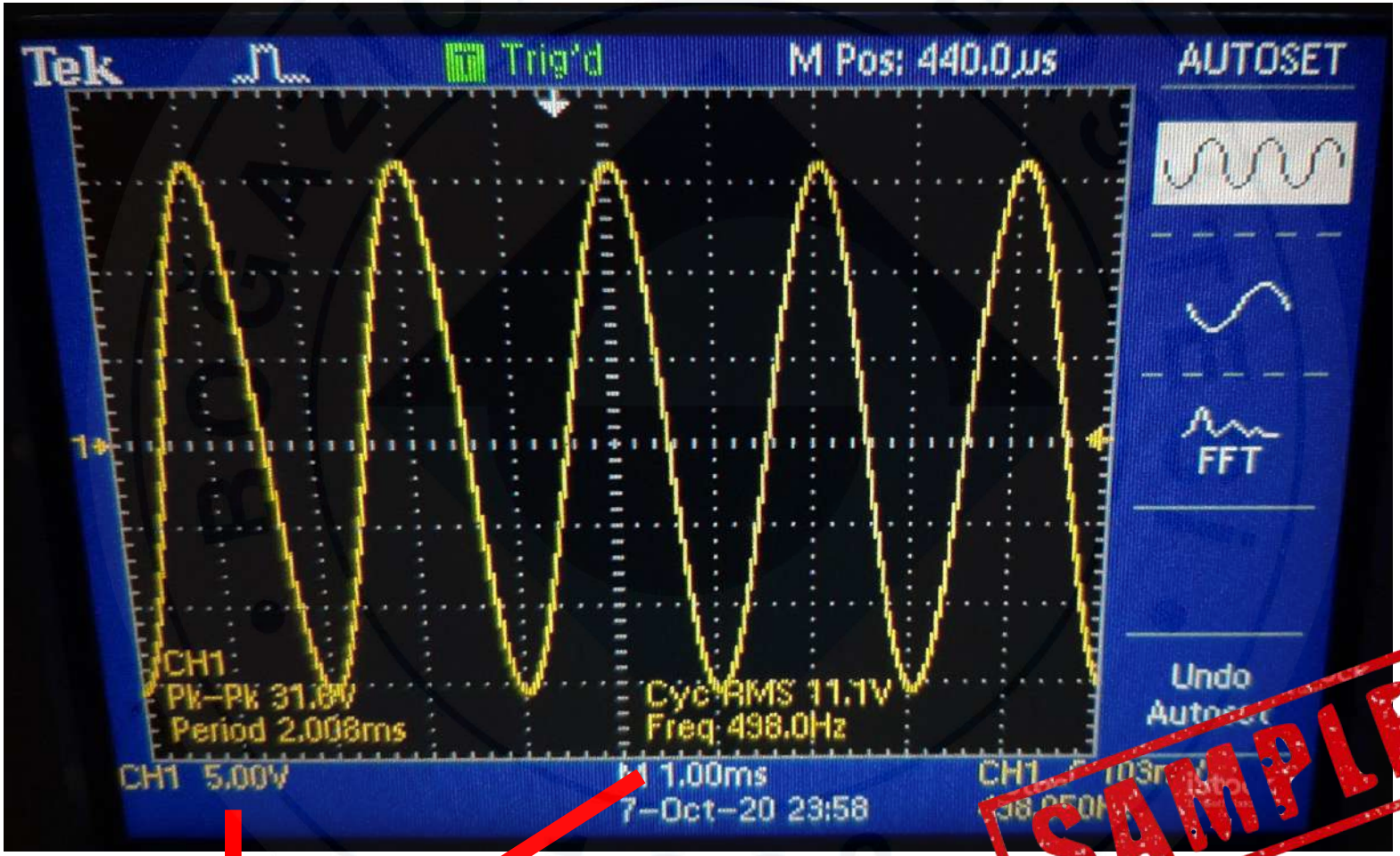
UNKNOWN FREQUENCY: Given f_{unknow} and with 1 Time/div settings. You will take 1 measurement of frequency and voltage.

PART 1,2

Read the Frequency of the Oscillator.

OSCILLOSCOPE

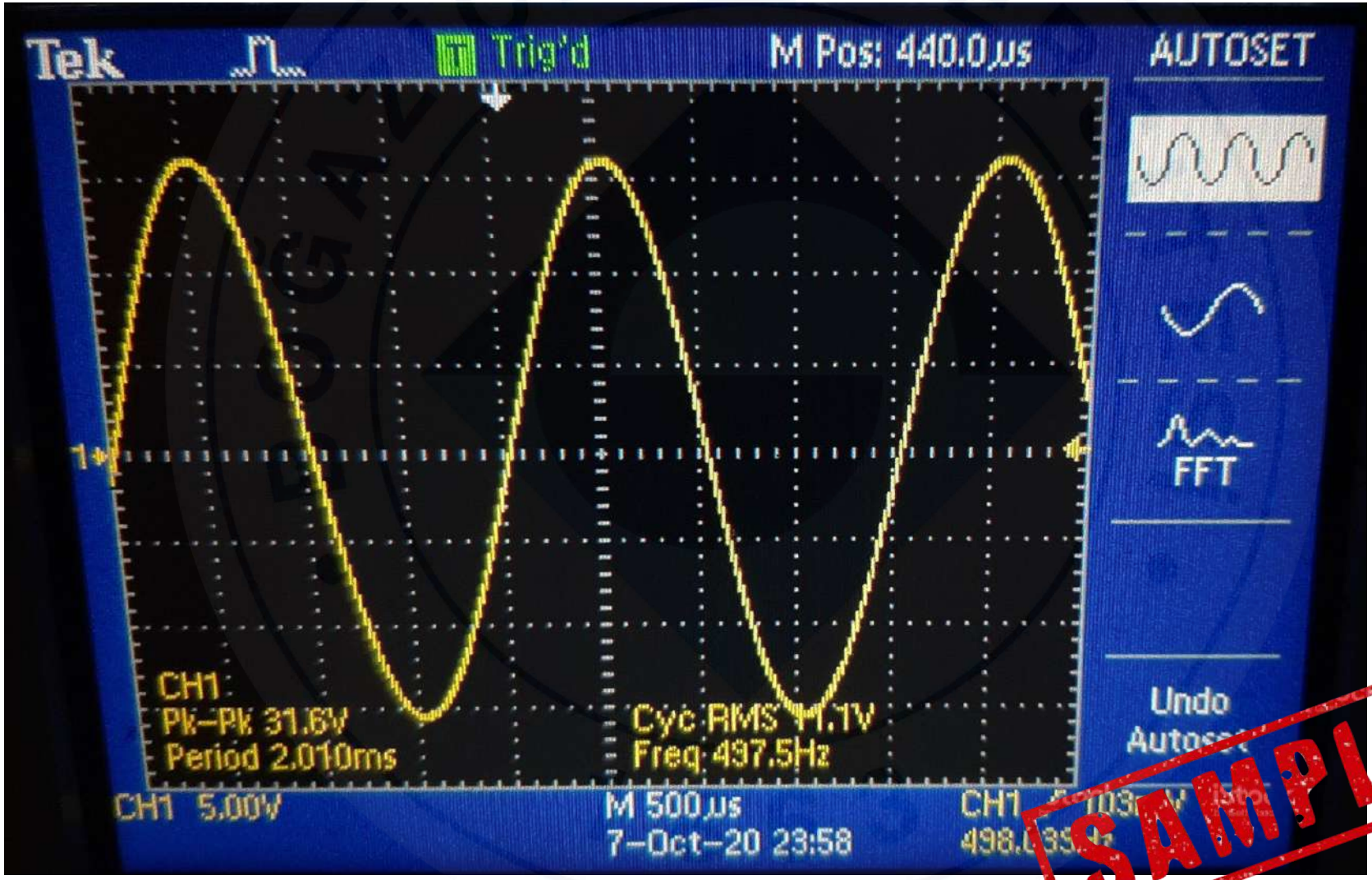
Read Time/Div-1 & Volt/Div. Determine λ, T, f and V_{PP}, V_{max}, V_{RMS}



ALL DIGITS ARE SIGNIFICANT!

Phys Labs

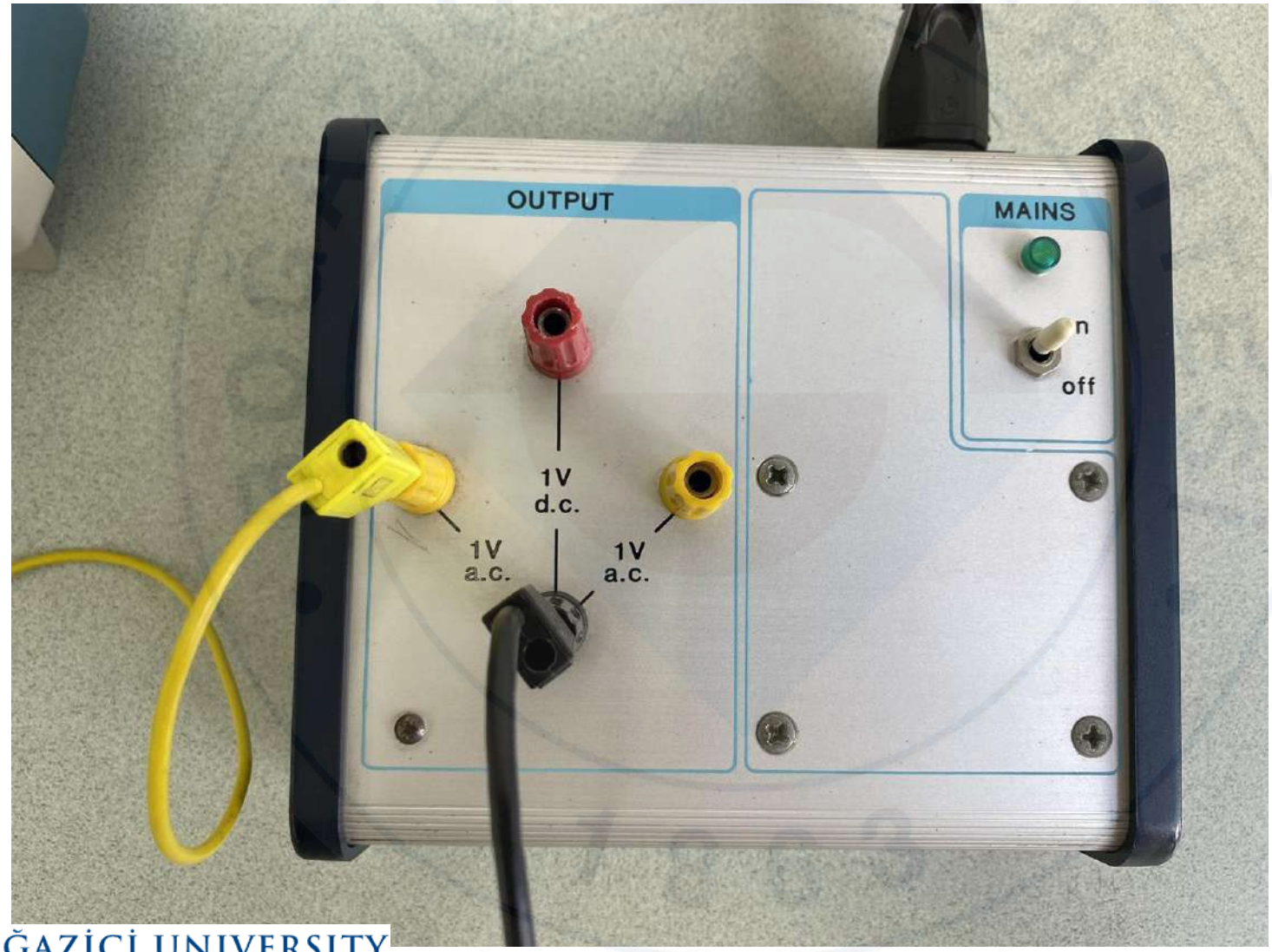
Read Time/Div-2. Determine λ, T and f.



LAST PART: FINDING THE UNKNOWN FREQUENCY

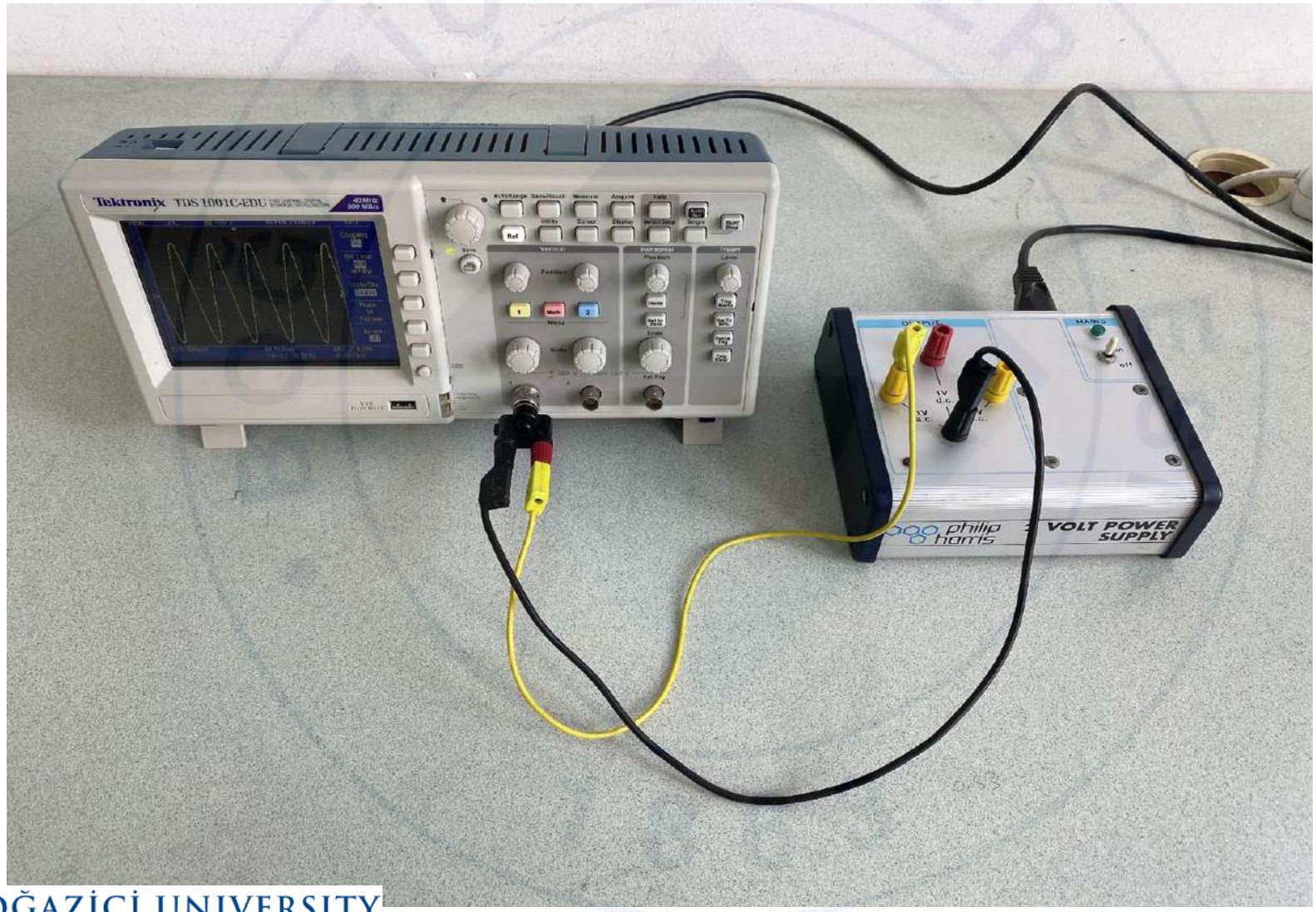
OSCILLOSCOPE

Unknown Frequency:

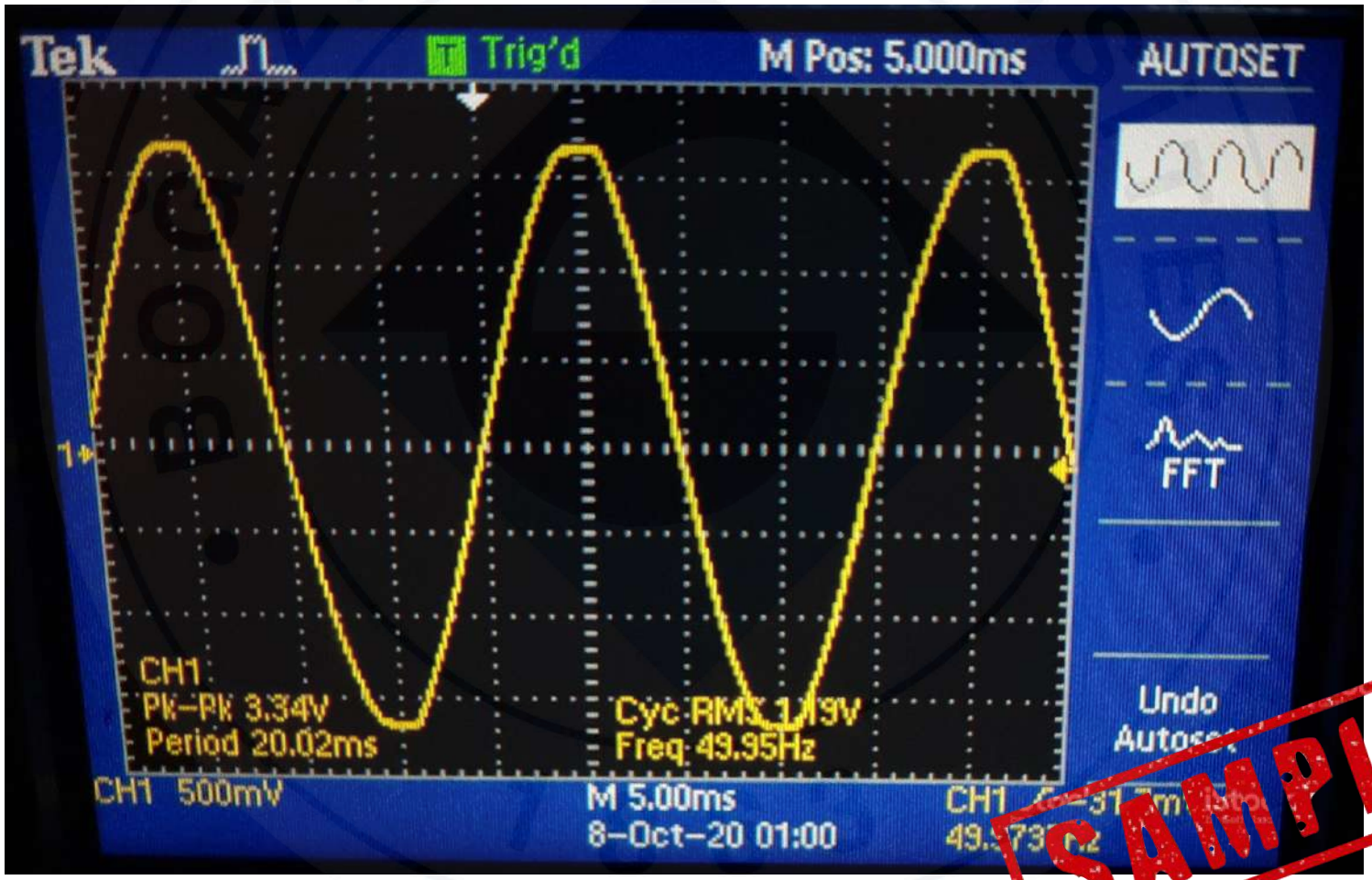


OSCILLOSCOPE

Unknown Frequency:



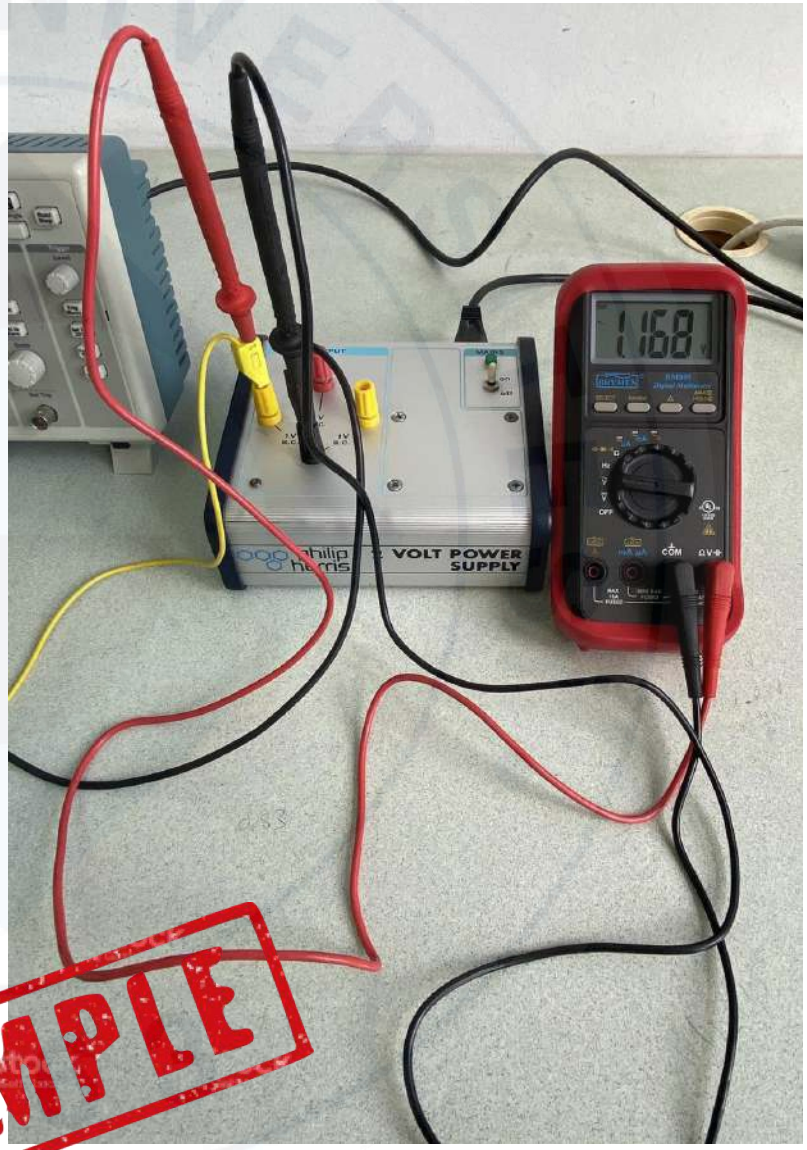
Read Time/Div and Volt/Div for Unknown Frequency. Determine λ, T, f and V_{PP}, V_{max}, V_{RMS}



OSCILLOSCOPE

Read V_{app} of unknown source.

Compare with V_{RMS}



SAMPLE

Length of one wave (λ) = ... $\frac{L}{\#\ of\ waves}$ ...

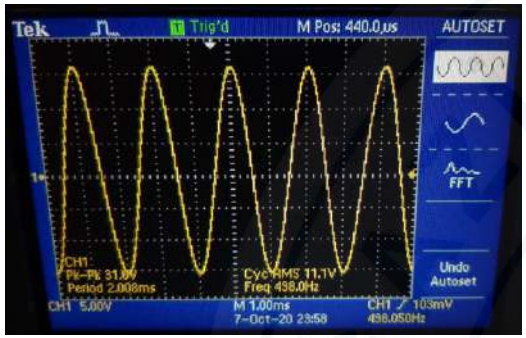
Period (T) = ... $\lambda\ x\ \frac{Time}{Div}$ .....

Frequency (f) = ... $\frac{1}{T}$ .....

V_{pp} (Volt) = ... $V_{pp}(div)\ x\ \frac{Volt}{Div}$.

V_{max} = ... $\frac{V_{pp}(Volt)}{2}$ ...

V_{rms} = ... $\frac{V_{max}}{\sqrt{2}}$ .....

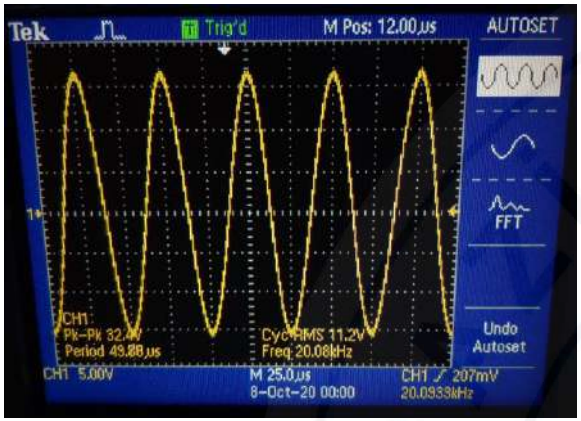


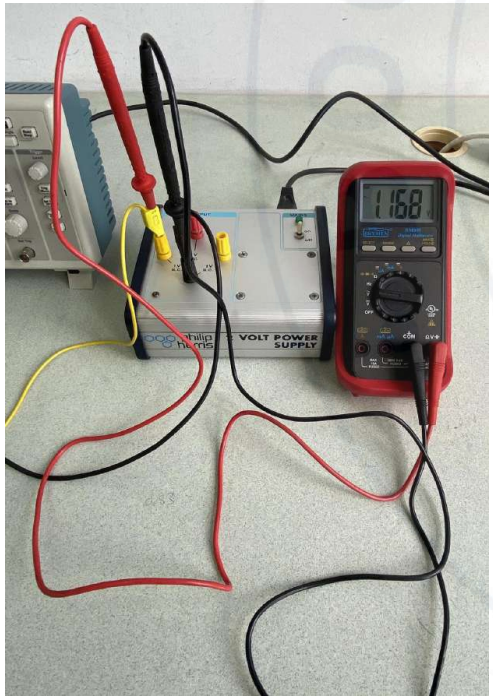
f_{TV}	500 Hz.

TIME MESAUREMENTS		
1st Reading	[TIME / DIV]$_1$	
	L_1	
	# of waves$_1$ in L_1	
	Length of the wave, λ_1	
	Period, T_1	
	Frequency, $f_{EV\text{-}1}$	
2nd Reading	[TIME / DIV]$_2$	
	L_2	
	# of waves$_2$ in L_2	
	Length of the wave, λ_2	
	Period, T_2	
	Frequency, $f_{EV\text{-}2}$	
	$f_{EV} = (f_{EV\text{-}1} + f_{EV\text{-}2})/2$	

% Error for f:

VOLTAGE MEASUREMENT	
[VOLT / DIV]	
V_{pp} (div)	
V_{pp} (Volt)	
$V_{max} = V_{pp} / 2$	
$V_{rms} = V_{max} / \sqrt{2}$	





f_{TV}	20,000 Hz.

TIME MESAUREMENTS	
[TIME / DIV]	
L	
# of waves in L	
Length of the wave, λ	
Period, T	
Frequency, f_{EV}	

% Error for f:

UNKNOWN FREQUENCY:

$V_{measured} = V_{TV}$	

TIME MESAUREMENTS	
[TIME / DIV]	
L	
# of waves in L	
Length of the wave, λ	
Period, T	
Frequency, f_{EV}	

VOLTAGE MEASUREMENT	
[VOLT / DIV]	
V_{pp} (div)	
V_{pp} (Volt)	
$V_{max} = V_{pp} / 2$	
$V_{rms} = V_{max} / \sqrt{2}$	

% Error for V_{rms} :