Labview Based Digital CRO For Electronic Measurement Techniques

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Abstract –
        This document gives LabVIEW is a graphical programming language that uses icons instead of lines of text to create applications. In LabVIEW, we build a user interface with a set of tools and objects. Electronic measurement technology is a basic course which has relations with electronic measurement principles and methods. The proposed system "Digital CRO in LabVIEW" operates as like as original CRO. This is the software version of the CRO hardware and the common typical electronic measurement instruments operating principles, performances and applications. It has such outstanding characteristics as theory has close relations with practices, outstanding practices and wide applications. We can purchase several add-on software toolsets for developing specialized applications & all the toolsets integrate seamlessly in LabVIEW. By using LabVIEW developing software which based on computer visual virtual instrumentation to program the Virtual Instruments with traditional instruments functions.
        So, the aim of this project to develop the software kit in LabVIEW which shows all the operation of CRO in short replaces CRO hardware by CRO software. Using graphical programming language we design this system. The proposed system has all the functions which are in a CRO. This is the application of Electronics Measurement technology with virtual instrumentation, and helpful for class course teaching.

Keywords— Electronic measurement technology; LabVIEW; Virtual Instrumentation; PowerPoint;

I.   INTRODUCTION

        An OSCILLOSCOPE is a device for recording and visualizing the instantaneous value of alternating voltage and is used in many professions and academic institutions. Oscilloscopes are well documented, but to study the theory is not enough to learn how to use these measuring instruments. Therefore it is natural to create a hands-on training that can be used by anyone interested in self-study.

The following chapter explains the work the subject and illuminated background of learning theory. In another chapter of the history and functions of an oscilloscope are presented. It leads to the creation of a new virtual oscilloscope. The end result is a functioning new virtual oscilloscope, and be for teachers through its interfaces to document and the ability to import own test signals easily into the system, a valuable tool can. But a real device can not replace it, and it should not.

What is an **Oscilloscope** ?

Oscilloscope is a measuring device which can show various waveforms & voltages, Frequency, time period, wavelength can be measured using Oscilloscope.

How does An **Oscilloscope** Work ?

An oscilloscope works by measuring the voltage signal as it travels through the object. It is used to help we find breaks in the circuits or shorts.

How to Use An **Oscilloscope** ?

The only way to use a oscilloscope is when dealing with electronics it will find and measure and find faulty electrical circuits on any electrical platform.

II.   Cathode-Ray Oscilloscope (CRO) Objective

- To introduce the basic structure of a cathode-ray Oscilloscope.
- To get familiar with the use of different control switches of the device.
- To visualize an ac signal, measure the amplitude and the frequency.

The device consists mainly of a vacuum tube which contains a cathode, anode, grid, X&Y-plates, and a fluorescent screen (see Figure below). When the cathode is heated (by applying a small potential difference across its terminals), it emits electrons. Having a potential difference between the cathode and the anode (electrodes), accelerate the emitted electrons towards the anode, forming an electron beam, which passes to fall on the screen. When the

fast electron beam strikes the fluorescent screen, a bright visible spot is produced. The grid, which is situated between the electrodes, controls the amount of electrons passing through it thereby controlling the intensity of the electron beam. The X&Y-plates, are responsible for deflecting the electron beam horizontally and vertically.
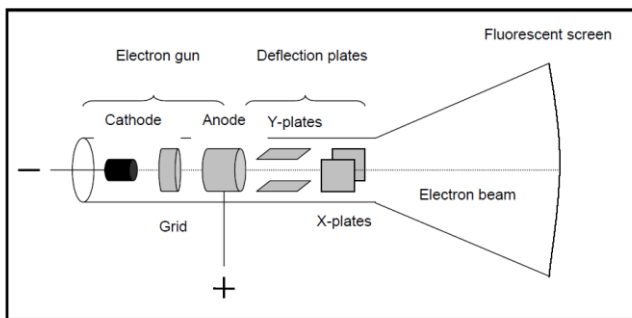

Fig 1. The basic structure of CRO

A sweep generator is connected to the X-plates, which moves the bright spot horizontally across the screen and repeats that at a certain frequency as the source of the signal. The voltage to be studied is applied to the Y-plates. The combined sweep and Y voltages produce a graph showing the variation of voltage with time, as shown in Fig. 2. *Front panel* of the *CRO*
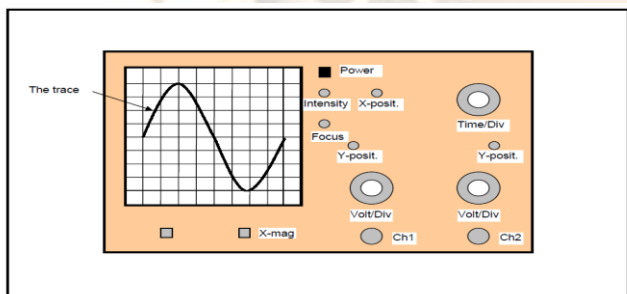

Fig 2. The Front Panel of CRO

An **oscilloscope** (also known as a **scope**, **CRO**, **DSO** or, an **O-scope**) is a type of electronic test instrument that allows observation of constantly varying signal voltages, usually as a two-dimensional graph of one or more electrical potential differences using the vertical or 'Y' axis, plotted as a function of time, (horizontal or 'x' axis). Although an oscilloscope displays voltage on its vertical axis, any other quantity that can be converted to a voltage can be displayed as well. In most instances, oscilloscopes show events that repeat with either no change, or change slowly [1]. Oscilloscopes are commonly used to observe the exact wave shape of an electrical signal. In addition to the amplitude of the signal, an oscilloscope can show

distortion, the time between two events (such as pulse width, period, or rise time) and relative timing of two related signals.

III. Introduction To Theoretical Virtual Learning Labview

An oscilloscope is a device for recording and visualizing the instantaneous value of AC voltages. It is a versatile instrument that is used by many professions and sciences. The need to know about the use and operation of the instrument to convey is understandable. But on the one hand, the manufacturer provides an instruction manual to an oscilloscope, on the other hand, stacking books in the libraries of books that explain everything there is to know about oscilloscopes. Why do we need then a teaching and learning software for virtual laboratories? This chapter interprets the theme of the work and discusses the benefits of educational software than printed educational materials have. It provides a typology of educational software and relates them to learning paradigms. Finally, the use of multimedia elements in the virtual teaching is illuminated. At the end of the chapter, the aim of this work is reformulated.

LabVIEW is a graphical programming language that uses icons instead of lines of text to create applications. In contrast to text-based programming languages, where instructions determine program execution, LabVIEW uses dataflow programming, where the flow of data determines execution. In LabVIEW, we build a user interface with a set of tools and objects. The user interface is known as the front panel. We then add code using graphical representations of functions to control the front panel objects. The block diagram contains this code. In some ways, the block diagram resembles a flowchart. We can purchase several add-on software toolsets for developing specialized applications. All the toolsets integrate seamlessly in LabVIEW. Refer to the National Instruments Web site at ni.com for more information about these toolsets.

IV. Interpretation Of The Theme

Actual vs. workspaces.

Virtual Laboratories "... where reaching the more likely are the highest level, where it is because the real overthrow, it is called virtual. "Whether something is called a real or virtual depends on the stimulus density, with which it is detected by the nerves, perceptions, and then processed into ideas. The denser and more accurate perceptions are, the more real they seem, says Flusser Villem. Flusser cites the example of a chair, the only "is a bunch of swirling particles", but is perceived as real, because we can see and touch him and. The density of the

point stimuli is gathered more than they could resolve the central nervous system. This is something really really Virtual.

Actually, virtual laboratories are therefore "real work spaces." This work is not concerned with creating teaching and learning software for a fictional, not real space, but a teaching and learning program that reflects a real system realistically possible in a perceived as a virtual system. The focus is on the realistic play, not on the system, in which they are playing, with the exception that the playback system may not have the required density to be considered as real. Otherwise, it would correspond to the real system, and when it does this is either the real system or a copy unnecessary. Currently there is no danger, however, the reality can be confused with virtuality, because the playback systems of virtual worlds are not developed far enough to replace the reality.

Teaching and learning software thus makes sense only if it is not as good as the reality. Teaching and learning software can not replace the real teaching, but only support: The oscilloscope developed in this study is not a "real scope", but it is at exactly the point where it topples into the real, or at least prepares the way for this. This is the main novelty of this project compared to the "Existing virtual oscilloscope" featured teaching and learning software.

We can purchase several add-on software toolsets for developing specialized applications. All the toolsets integrate seamlessly in LabVIEW. Refer to the National Instruments Web site at ni.com for more information about these toolsets.

V.   Waveform Generation in CRO using LabVIEW

The current systems are using electronic device. Two types are CRO are available, analog and digital CROs. These two systems are very costly. They are using to measure various parameters. For this, many controls are available which are described as shown below.

The controls on a scope can be divided into four groups.
(1) Hold/Control   (on/off, brightness, focus)
(2)   Horizontal   (X   position,   X   amplitude, time/division)
(3)   Vertical   (Y position, Y amplitude, Invert, Volts/division)
(4)   Trigger/synchronisation   (level, +/-, external, ac/dc)
Set any controls marked "calibrate" to the correct position.

Adjust the housekeeping controls to obtain a trace (display). Adjust the vertical and horizontal controls

to display a few cycles of a waveform.Adjust the trigger/synch controls to make the display stationary. It is best to display about two cycles and make them as large in height as possible. Measure the amplitude and periodic time (time of one cycle). See below.

calculate the frequency.
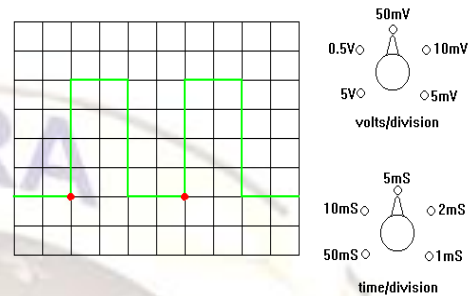
In the diagram the waveform is 4 divisions high. The volts/ division switch is set to 50 mV/division. The amplitude is therefore 4 x 50 mV = 200 mV. The width of one cycle (indicated between the two red dots) is 4 divisions. The time/division switch is set to 5 mS/division. The periodic time is 4 x 5 mS = 20 mS.

Note that one cycle is the time between the start of a waveform and the point where it starts to repeat itself. Frequency can be calculated by dividing 1 second by the periodic time. Note that if the periodic time is in mS then 1 second has to be expressed as 1000 mS. 1000mS/20mS = 50 Hz The pattern of squares is called a GRATICULE.

Frequency and Period

If a signal repeats, it has a *frequency*. The frequency is measured in Hertz (Hz) and equals the number of times the signal repeats itself in one second (the cycles per second). A repeating signal also has a *period* - this is the amount of time it takes the signal to complete one cycle. Period and frequency are reciprocals of each other, so that 1/period equals the frequency and 1/frequency equals the period. So, for example, the sine wave in Figure has a frequency of 3 Hz and a period of 1/3 second.
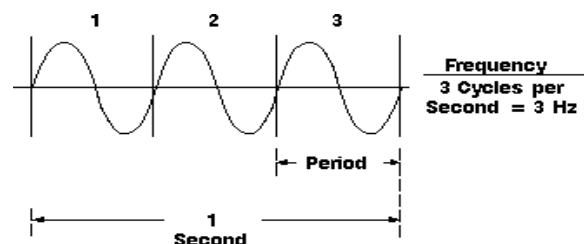

Fig 3: Frequency and Period

Voltage

Voltage is the amount of electric potential (a kind of signal strength) between two points in a circuit. Usually one of these points is ground (zero volts) but not always - we may want to measure the voltage from the maximum peak to the minimum peak of a waveform, referred to at the peak-to-peak voltage. The word amplitude commonly refers to the maximum voltage of a signal measured from ground or zero volts. The waveform shown has an amplitude of one volt and a peak-to-peak voltage of two volts.

Phase

Phase is best explained by looking at a sine wave. Sine waves are based on circular motion and a circle has 360 degrees. One cycle of a sine wave has 360 degrees, as shown in Figure . Using degrees, we can refer to the phase angle of a sine wave when we want to describe how much of the period has elapsed.
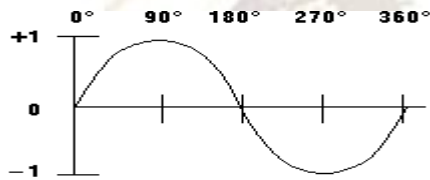
VI.   Studying Characteristic Curves with LabVIEW

OBJECTIVES
-Use LabVIEW to measure DC current.
-Write LabVIEW programs to display the characteristic curves of resistors, diodes, and transistors studied in electronics courses.

INTRODUCTION

Some of the most important information about an electrical or electronic component is contained in the component's V-I curve or characteristic curve, which is a graph plotting the component's current (on the vertical axis) versus the component's voltage (on the horizontal axis).
LabVIEW can easily vary the voltage across a component and then measure the component's current, we can use LabVIEW to automate this process and quickly plot a device's characteristic curve. Such a process is similar to the way that LabVIEW is used in research-and-development labs to study the properties of devices and circuits.

Part 1. Using LabVIEW to Measure Current

Up to now in this course, we have used LabVIEW to measure voltage, but not current. In fact, the DAQ card in computer is inherently a voltage-measuring device, and cannot **directly** measure current. But we'll use a standard trick to make **indirect** current measurements. The trick is simply to insert a small resistor of known value into our circuit, then measure the voltage across the resistor, and then use Ohm's law ($I = V \div R$) to compute the current. This new resistor
is often called a *sensing resistor*.
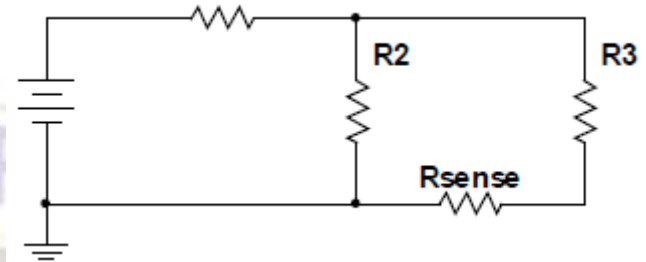
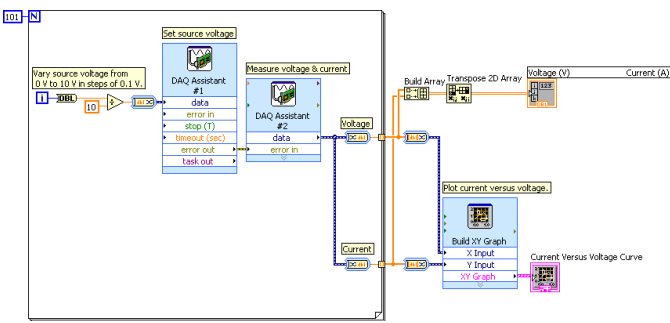### Part 2. Characteristic Curves of Passive Linear Components

How to use LabVIEW to measure current as well as voltage, we're ready to plot some characteristic curves. In DC Circuits and AC Circuits courses, we studied the three passive linear devices: resistor, capacitor, and inductor.
• These devices are called **passive** because, unlike transistors and other active devices, they cannot amplify power in a circuit.
• The devices are called **linear** because the current through them is proportional to the voltage across them. (For resistors, this statement is true in both DC and AC circuits. For capacitors and inductors, this statement is true in AC circuits, which is where capacitors and resistors are primarily used.) This behavior contrasts with the behavior of diodes and other non-linear devices, in which current is **not** proportional to voltage.

LabVIEW program:

Create a new VI whose front panel contains a 2-D array of numeric indicators and an Express XY Graph. Resize the array and make its vertical scrollbar visible, as shown below. Also change the labels on the array and graph to match the ones shown below.
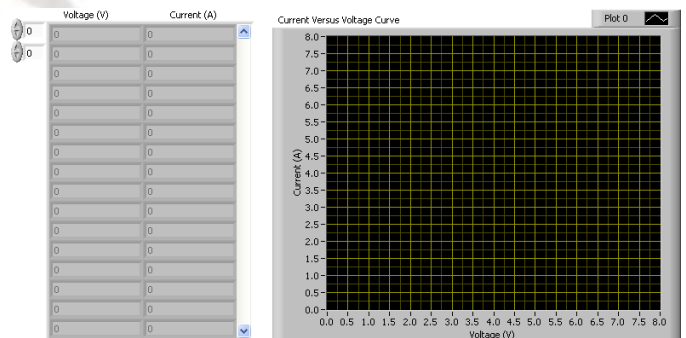
Part 3. Characteristic Curves of Diodes

As we know, a diode is a non-linear device, so its characteristic curve is not a straight line like the one we just obtained for a resistor. Fortunately, the LabVIEW program that wrote for resistors can also be used to plot a diode's characteristic curve. In fact, with a minor modification that we'll make below, this program can be used to plot the characteristic curve of any two-terminal device.
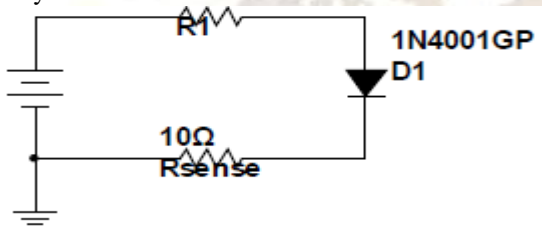

Part 4. Characteristic Curves of Transistors

Before modify program to draw transistor characteristic curves, how such a program will have to differ. The main difference is that in existing program, there's only one voltage that we need to vary: namely, the voltage across the entire series circuit. So we needed one DAQ Assistant to produce this varying voltage, and another DAQ Assistant to measure the current and voltage values that we plotted as the characteristic curve.

To plot a transistor's characteristic curves, we need to vary **two** voltages independently of each other: the transistor's base supply voltage VBB and its collector supply voltage VCC. This is clear from the figure below, which shows that VBB and VCC are both variable voltage supplies.
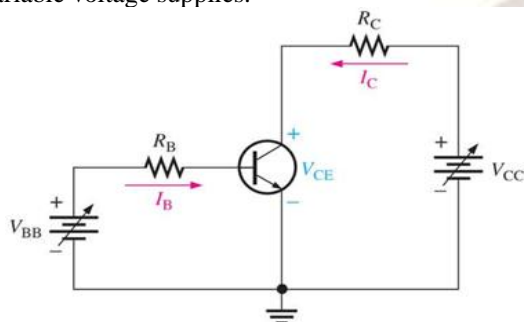
(a) Circuit
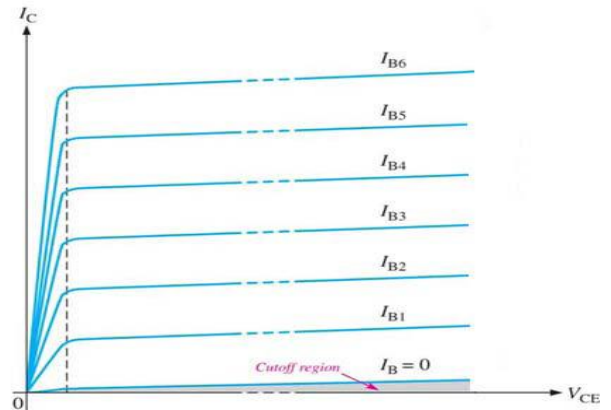
(b) Family of I_C versus V_{CE} curves for several values of I_B
($I_{B1}< I_{B2}< I_{B3}$, etc.)

VII.   CONCLUSION & FUTURE WORK

In this simulation project, we can also generate a waveform by giving amplitude and frequency values. We can also select the type of waveform like,

- Sine wave
- Cosine wave
- Rectangular wave
- Triangular wave
- Saw tooth wave

Filter which is used to filter out the noise signal from the input signal. There are so many types of filters available which is of two forms either in analog form or digital form. We can use any type of filter for filtering the unwanted signal from the source.

In this project where we have used the filters for filtering out the noise signal from the input signal from the source. After filtering we can analyze the signal in the spectrum and moreover we can also calculate the total harmonic distortion which is present in the input signal.
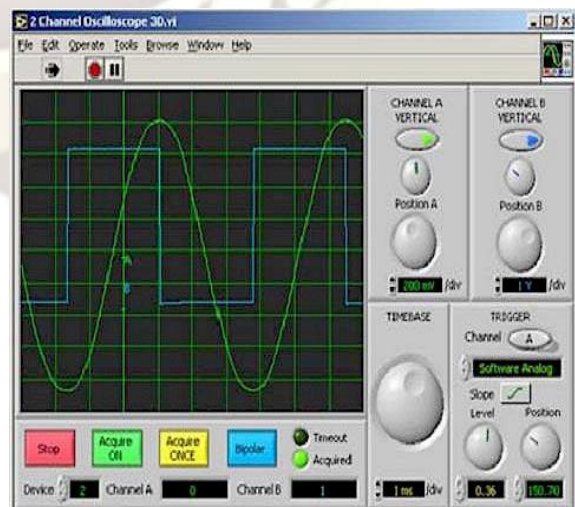

Fig 4. Future View of Digital CRO.

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