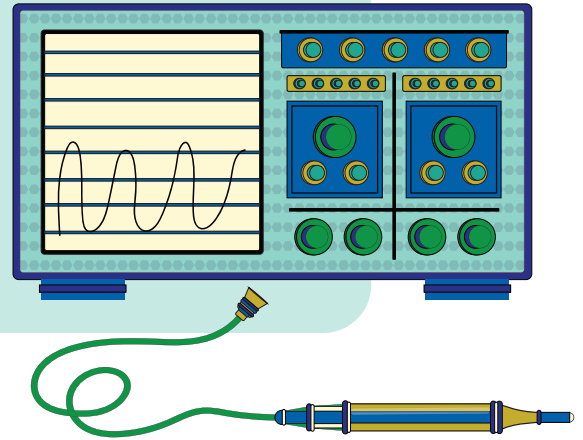


**CONCEPT** How do you test and troubleshoot complex electrical circuits when you need to monitor a signal over time? This is when you set aside your multimeter and pull out an oscilloscope!



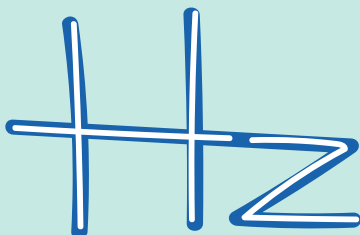
## BACKGROUND

Origins of today's oscilloscopes date back to the late 1890s. An oscilloscope is a type of electronic test instrument that allows you to visualize and analyze electrical signals. It displays a graph of an electrical signal as it varies over time, allowing you to see the shape, amplitude, and frequency of the signal.

An oscilloscope consists of a cathode ray tube (CRT) or a liquid crystal display (LCD) screen, a horizontal input for the signal to be measured, and vertical inputs for the reference signal. It also has controls for adjusting the display, such as brightness and contrast, as well as controls for adjusting the horizontal and vertical scales. Some oscilloscopes also have built-in functions such as spectrum analysis and logic analysis, which allow you to perform more advanced measurements and analyses.

## FORMULA

Some common values for constants that are associated with oscilloscopes include the bandwidth of the instrument (measured in Hz), the maximum input voltage that can be measured, the sample rate (measured in samples per second), and the vertical and horizontal resolution of the display. These values can vary depending on the specific model of the oscilloscope.



## EXAMPLES

There are many manufacturers of oscilloscopes, including both large multinational companies and smaller, specialized firms. Some of the major manufacturers of oscilloscopes include:

Tektronix  
Keysight Technologies  
Rohde & Schwarz  
National Instruments  
Yokogawa

## TERMINOLOGY

**VOLTAGE (V):** Voltage is a measure of the electrical potential difference between two points in a circuit. Oscilloscopes typically measure voltage in units of volts (V).

**TIME (T):** Time is a measure of the duration of an event or signal. Oscilloscopes typically display signals as a function of time, with time measured in units of seconds (s) or milliseconds (ms).

**FREQUENCY (F):** Frequency is a measure of the number of cycles per second in an alternating current (AC) signal. Oscilloscopes typically display the frequency of a signal as a numeric value in units of hertz (Hz) or kilohertz (kHz).

*Make sure it measures up*

**AMPLITUDE:** Amplitude is a measure of the strength or magnitude of a signal. Oscilloscopes typically display the amplitude of a signal as a numeric value in units of volts (V) or millivolts (mV).

**PERIOD (T):** Period is a measure of the time it takes for a signal to complete one full cycle. Oscilloscopes typically display the period of a signal as a numeric value in units of seconds (s) or milliseconds (ms).

**RISE TIME:** Rise time is a measure of how quickly a signal transitions from low to high voltage levels. Oscilloscopes typically measure rise time in units of seconds (s) or nanoseconds (ns).

## REAL WORLD CONNECTIONS

Oscilloscopes are used by a wide variety of professionals in many different fields. Some examples of people who may use oscilloscopes in their job include:

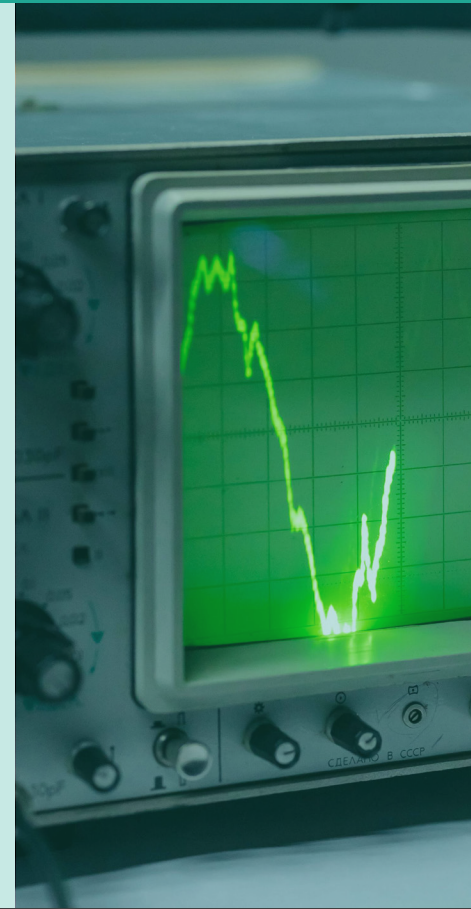
**ELECTRICAL ENGINEERS:** Electrical engineers use oscilloscopes to design, test and troubleshoot electronic circuits and systems. They may use oscilloscopes to measure the performance of circuits and to identify any problems or defects.

**TELECOMMUNICATIONS TECHNICIANS:** Telecommunications technicians use oscilloscopes to test and troubleshoot telecommunications equipment, such as phone systems, modems, and networking equipment.

**AUTOMOTIVE ENGINEERS:** Automotive engineers use oscilloscopes to test and debug the electronic systems in vehicles, such as the engine control system, the brake system, and the electrical system.

**COMPUTER TECHNICIANS:** Computer technicians use oscilloscopes to troubleshoot and repair computer hardware, such as motherboards, hard drives, and power supplies.

**SCIENTISTS:** Scientists in many different fields, such as physics, biology and chemistry, use oscilloscopes to measure and analyze electrical signals in a wide variety of research applications.



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