

► Test and Measurement Fundamentals

A Quick Guide to Oscilloscopes and Probes

DIGITAL DESIGN

TDS1000 Series
Digital Storage
Oscilloscopes

TDS2000 Series
Digital Storage
Oscilloscopes

TDS3000B Series
Digital Phosphor
Oscilloscopes

**Operator
Training Kit**

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THE ABCs OF PROBES	
Active Probe A probe containing transistors or other active circuits that normally uses an external power source.	Probe Power Power that's supplied to the probe from some source such as the oscilloscope, a probe amplifier, or the circuit under test.
Attenuator Probe A probe that attenuates the input signal, to increase the input range of an oscilloscope.	Reactance An impedance element that reacts to an AC signal by restricting its current flow based on the signal's frequency.
Circuit Loading Distortion of the circuit by the interaction of the probe and oscilloscope with the circuit being tested.	Ringings Signal oscillations that result when a circuit resonates.
Compensation An adjustment made to a probe that balances its capacitance with that of the oscilloscope.	Shielding A grounded conductive sheet of material placed between a circuit and external noise sources to intercept and conduct away noise.
Impedance The process of impeding or restricting AC signal flow.	SNR (signal-to-noise ratio) The ratio of signal amplitude to noise amplitude; usually expressed in dB: $SNR = 20 \log (V_{\text{signal}}/V_{\text{noise}})$.
Loading The process whereby a load applied to a source draws current from the source.	Source The origination point or element of a signal voltage or current.
Passive Probe A probe whose network equivalent consists only of resistive (R), inductive (L), or capacitive (C) elements.	Source Impedance The impedance seen when looking back into a source.
Probe An input device for transmitting the signal to the oscilloscope.	

THE XYZs OF OSCILLOSCOPES

AC (Alternating Current) A signal in which the current and voltage vary over time.	Holdoff A specified amount of time that must elapse before the trigger circuit generates another trigger signal. Holdoff helps ensure a stable display.
AC Coupling Useful for observing an AC signal riding on a DC signal, as the DC component is blocked while the AC signal passes through.	Interpolation A "connect-the-dots" processing technique to build a waveform based on a few sampled points.
Acquisition The process of sampling signals that digitizes signal samples into data points then assembles the data points into a waveform record.	Noise An unwanted voltage or current in an electrical circuit.
ADC (Analog-to-Digital Converter) An electronic component that converts a signal into discrete binary values.	Normal Trigger Mode A mode where the oscilloscope acquires a waveform providing a specific trigger event occurs.
Aliasing This phenomenon can occur when an oscilloscope digitizes at a sampling rate that is too low to reproduce the input signal accurately. The oscilloscope may then display the waveform at a lower frequency than the actual input signal.	Nyquist Rate The minimum at which a signal can be sampled to avoid aliasing and ensure accurate representation. It is twice the input signal frequency.
ART (Analogous Real-Time) Oscilloscope The input signals drive a CRT in real-time to show a signal's behaviour over time. ARTs cannot store, analyse or manipulate the signal data and are limited by the writing speed of the CRT and sample triggering.	Oscilloscope An instrument used to analyse a signal over time. "Oscilloscope" comes from "oscillate", since oscilloscopes are often used to measure oscillating voltages.
Attenuation A decrease in signal voltage during transmission.	Peak Detect An acquisition mode that captures spikes and glitches that may occur between sample points.
Averaging A signal processing technique used by digital oscilloscopes to eliminate noise in a signal.	Period The amount of time it takes a signal to complete one cycle. The period equals $1/\text{frequency}$.
Bandwidth The continuous band of frequencies that a network or circuit passes without diminishing in power more than 3-dB from the mid-band power.	Persistence The natural decay of waveform points on a CRT.
Cursors Markers that you can move across the oscilloscope screen. The oscilloscope displays the waveform values (expressed in volts, amps, time, frequency, VA, etc.) at the point(s) the marker(s) cross the waveform(s) or calculates values based on comparing different cursor locations.	Phase A means of expressing (in degrees) the time-related positions of different signals.
DC (Direct Current) A signal with a constant voltage and current.	Pre-trigger A specified portion of the waveform record that contains data acquired before the trigger event.
DC Coupling A mode that passes both AC and DC signal components to the circuit.	Pulse A common waveform shape that has a fast rising edge, a width, and a fast falling edge.
Digital Real-Time Digitising A digitising technique that samples the input signal with a sample frequency of four to five times the oscilloscope bandwidth. Combined with sinix interpolation, all frequency components of the input up to the bandwidth are accurately displayed.	Real-time Bandwidth The maximum frequency a DSO can acquire, when sampling the entire input waveform in one pass, to reconstruct the waveform accurately. This is the sample rate divided by 2.5.
DPO (Digital Phosphor Oscilloscope) Digital oscilloscopes that display, store and analyse complex signals in real time, using three dimensions of signal information - amplitude, time and amplitude over time. Displayed points vary in intensity depending on the frequency of their acquisition and decay as if the oscilloscope had an analogue CRT.	Real-time Sampling A sampling mode in which the oscilloscope collects as many samples as it can as the signal occurs.
DSO (Digital Storage Oscilloscope) Input signals are converted into digital data and displayed on screen (CRT or LCD). The digital nature of this data allows storage, analysis and sophisticated triggering. DSOs are limited by sample rates and aliasing.	Record Length The number of waveform samples stored at any time.
Envelope The outline of a signal's highest and lowest points.	Rise Time The time taken for the leading edge of a pulse to rise from its minimum to its maximum value (typically measured from 10% to 90% of these values).
Equivalent-time Sampling A sampling mode in which the oscilloscope constructs a waveform by capturing a sample of information from each signal repetition. Accurate waveform reconstruction requires a repetitive signal and multiple triggering.	Roll Mode A display mode to view the waveform as it is acquired point by point.
FFT (Fast Fourier Transform) A method of calculating the frequency components of a periodic waveform - often called harmonic analysis.	Sample Rate The rate at which the analogue input signal is sampled for conversion into a digital value.
Floating Measurements Voltage measurements where the voltage reference is not earth ground.	Sampling The process of capturing an analogue input, such as voltage, at a discrete point in time so that it can be converted into digital data.
Frequency The number of times a signal repeats in one second, measured in Hertz (cycles per second). The frequency equals $1/\text{period}$.	Single Shot Triggering of an oscilloscope to take one record length of data only.
Glitch An intermittent error.	Time Base The time base defines the time and horizontal axis of the display.
Ground 1. A conducting connection by which a circuit is connected to the earth to establish and maintain a reference voltage level. 2. The voltage reference point in a circuit.	Trigger The circuit that drives the capture of signal information. Different types of trigger can be used such as edge, video, pulse, width, logic, etc.
	Trigger Holdoff A control that inhibits the trigger circuit from looking for data for some specified time after the last captured event.
	Trigger Level The level that the signal must reach before the trigger circuit starts data conversion.
	Voltage The difference in electric potential, expressed in volts, between two points.
	Waveform (Trace) A graphic representation of a signal varying over time.
	XY Format A display mode used for studying the phase relationship of two signals.
	YT Format The conventional oscilloscope display format. It shows signal behaviour (on the vertical axis) as it varies over time (on the horizontal axis).