Acquisition Time: In a sample-and-hold or track-and-hold circuit, the time required after the sample or track command for the output to slew through a full-scale voltage change and settle to its final value within a specified error band.

ACSN: auto-correlation signal-to-noise

ADC: analog-to-digital converter.

Aliasing: Whenever a dynamic signal is synchronously sampled, a possibility of misunderstanding its frequency content exists. This difficulty is termed "aliasing" and occurs whenever the sampling rate is less than twice the highest frequency component in the signal being measured.

AND: Logical designation or circuit function meaning that all inputs must be in the TRUE state for a TRUE output.

Aperture Jitter: In a sample-hold or ADC, the jitter between the time of the sample (or convert) command pulse and the time the input signal is actually sampled. This jitter is usually due to thermal noise. It leads to an uncertainty in the sampled amplitude equal to delta t* dV/dt, where delta t is the aperture jitter, and dV/dt is the rate of change of the input voltage at the time of sampling. The terms "aperture jitter" and "aperture uncertainty" are often used interchangeably.

Aperture Uncertainty: In a sample-hold or ADC, the total uncertainty in the time of the sample (or convert) command pulse and the time the input signal is actually sampled, due to all causes including noise, signal amplitude-dependent delay variation (as in a flash ADC), temperature, etc. Often used interchangeably with "aperture jitter," but "aperture uncertainty" is the more inclusive term.

Area: In a time domain DSO waveform measurement, area is the sum of the sampled values between the cursors times the duration of a sample.

Artifact Rejection: Used in summed averaging to exclude waveforms that have exceeded the dynamic range of the recording system.

Automatic Setup: In an oscilloscope, automatic scaling of the timebase, trigger, and sensitivity settings. Provides a stable display of repetitive input signals.

Average: See Mean Value, Summed Averaging and Continuous Averaging.

AWG: arbitrary wave generator

Bandwidth: In normal use, the frequency range over which the gain of an amplifier or other circuit does not vary by more than 3 dB.

BER: See Bit Error Rate.

Binning: A technique for combining points in a histogram to be compatible with the resolution of the display device.

Bit: An abbreviation of "binary digit," one of the two numbers, 0 and 1, used to encode data. A bit is often expressed by a high or low electrical voltage.

Bit Error Rate: Ratio of the number of bits of a message incorrectly received to the total number received.
CCD: Charge Coupled Device. An integrated circuit that allows the transfer of a variable amount of charge through a series of cells; an analog shift register.

CCTM: clock certification test module

Channel: A path through an arrangement of components (modules and electrical or optical cabling or both) along which signals can be sent.

Clamping: Holding a circuit point to some reference level (frequently ground) by means of a low-impedance element such as a saturated transistor, FET, forward-biased diode, relay, etc.

Coherent Gain: The normalized coherent gain of a filter corresponding to each window function is 1.0 (0 dB) for the rectangular window and less than 1.0 for other windows. It defines the loss of signal energy due to the multiplication by the window function.

Common Mode Range: The maximum range (usually voltage) within which differential inputs can operate without a loss of accuracy.

Common Mode Rejection Ratio: The ratio of the common-mode input voltage to the output voltage expressed in dB. The extent to which a differential amplifier does not provide an output voltage when the same signal is applied to both inputs.

Common Mode Signal (Noise): The signal (usually noise) that appears equally and in phase on each of the differential signal conductors to ground. See Differential Input.

Continuous Averaging: Sometimes called "exponential averaging," the technique consists of the repeated addition, with unequal weight, of successive source waveforms. Each new waveform is added to the accumulated average according to the formula: S(i,new) = N / (N+1) * [S(i,old) + 1/ (N+1) * W(i)] where i = index over all data points of the waveforms; W(i) = newly acquired wave form;S(i,old) = old accumulated average; S(i,new) = new accumulated average; N = weighting factor (1,3,7...).

Conversion Cycle: Entire sequence involved in changing data from one form to another, e.g.,digitizing an analog quantity, changing binary data to BCD, etc.

Crosstalk: Unwanted coupling of a signal from one channel to another.

Cursor: A visible marker that identifies a horizontal or vertical position, or both, on an oscilloscope display. LeCroy DSOs offer "waveform riding" cursors that conveniently give both the horizontal and vertical values without selecting one or the other.

DAC: digital-to-analog converter

Data Logger: An instrument that accepts input signals (usually slow analog), digitizes them, and stores the results in memory for later readout. The digital equivalent of a strip-chart recorder.

DC: Direct current. Normally means a voltage or current that remains constant.

DC Level Shift: A change in the nominal DC voltage level present in a circuit.

DC Offset: See DC Level Shift. This term may imply that the shift is intentional, for example, adjustable by a control knob.

DC Overload: An overload signal of long duration compared to the normal input pulse width or duty ratio of a circuit.

Dead Time: In a digital oscilloscope, the dead time is the time from the end of one acquisition of data to the start of the next acquisition.

Decimation: The process of reconstructing a source waveform with a reduced number of data points by using only every nth data point, where n is an integer.

Differential Input: A circuit with two inputs that is sensitive to the algebraic difference between the two.

Differential Linearity: A term often inappropriately used to mean differential non-linearity.

Differential Non-Linearity: **1.** The percentage departure from the average of the slope of the plot of output versus input from the slope of a reference line; **2.** The percentage of variation in ADCs or TDCs from the mean of the analog (or time) width of any single digital step. It is usually measured by driving the input with a large number of random amplitude pulses and then measuring the relative number of events in each digital bin.

Differential Output: A circuit with two outputs supplying one normal and one complementary level of output signal.

Differential Pulses: Two opposite polarity pulses coincident in time.

Dithering: Typically used when averaging signals (which have low noise content) to improve vertical resolution and decrease the effects of an ADC's non-linearities. The technique applies different offsets to each incoming waveform to ensure the signal is not always digitized by the same portion of the ADC. The offsets must be subtracted from the recorded signals before being included in the summed average.

Digital Filtering: The manipulation of digital data to both enhance desirable and to remove undesirable aspects of the data.

Dropout Trigger: A trigger that occurs if the input signal drops out for a time period longer than a preset amount (between 25 ns to 20 s on some LeCroy DSOs). This is very useful for triggering on microprocessor crashes, network hangups, bus contention problems or other phenomena where a signal stops occurring.

Duty Cycle: A computed value in digital scopes representing the average duration above midpoint value as a percentage of the period for time domain waveforms.

Dynamic Range: The ratio of the largest to smallest signal that can be accurately processed by a module.

Dynamic RAM (DRAM): A random access memory in which the internal memory must be refreshed periodically.

ECL: Emitter-coupled logic, an unsaturated logic performed by emitter-coupled transistors. Usually, ECL LOGICAL 1 = –1.6 V and LOGICAL 0 = –0.8 V.

EMI: Electromagnetic interference caused by current or voltage induced into a signal conductor by an electromagnetic field.

ENBW (Equivalent Noise Bandwidth): For a filter associated with each frequency bin, ENBW is the bandwidth of an equivalent rectangular filter (having the same gain at the center frequency) that would collect the same power from a white noise signal.

Enhanced Resolution (ERES): A facility in LeCroy DSOs to increase the amplitude resolution of single-shot waveform measurements. This technique, which applies digital filtering to achieve resolution enhancement at a reduced bandwidth, is optimum when the sampling rate of the instrument exceeds that required for the input signal bandwidth. For repetitive signals, either ERES or Signal Averaging, or both, can be used to achieve higher resolution with substantially smaller loss of bandwidth than for single-shot signals.

Envelope: The maximum, minimum, or maximum and minimum values of a sequence of measured waveforms. In LeCroy DSOs, the number is programmable from 1 to 10^6.

EPROM: Erasable, programmable read-only memory. An integrated circuit memory array that is made with a pattern of either all logical zeros or ones and has a pattern written into it by the user with a special hardware program.

Equivalent Time Sampling (EQT): (Also known as ETS.) A means of exploiting multiple acquisitions of a repetitive signal to increase the usable bandwidth of a digitizer by making it appear to sample more rapidly than its maximum single-shot sample rate. Works only with stable, repetitive signals.

Extrema: The computation of a waveform envelope, by repeated comparison of successive waveforms, of all maximum points (roof) and all minimum points (floor). Whenever a given data point of the new waveform exceeds the corresponding maximum value in the roof record, it is used to replace the previous value. Whenever a given data point of the new waveform is smaller than the corresponding floor value, it is used to replace the previous value.

Falltime: Unless otherwise defined, the time required for a pulse to go from 90 % to 10 % of full amplitude. Can also refer generally to the trailing edge of a pulse.

Fast Fourier Transform (FFT): In signal processing applications, an FFT is a mathematical algorithm that takes a discrete source waveform, defined over n points, and computes n complex Fourier coefficients, which are interpreted as harmonic components of the input signal. For a "real" source waveform (imaginary part equals 0), there are n/2 independent harmonic components.

Feedthrough: An unwanted signal that passes a closed gate or disabled input.

FFT: See Fast Fourier Transform.

FFT Frequency Bins: A Fast Fourier Transform (FFT) corresponds to analyzing the input signal with a bank of n/2 filters, all having the same shape and width, and centered at n/2 discrete frequencies. Each filter collects the signal energy that falls into the immediate neighborhood of its center frequency, and thus it can be said that there are n/2 "frequency bins." The distance, in Hz, between the center frequencies of two neighboring bins is always: delta f = 1/T, where T is the duration of the time-domain records in seconds. The nominal width of bin is equal to delta f.

FFT Frequency Range: The range of frequencies computed and displayed in an FFT is 0 Hz to the Nyquist frequency.

FFT Frequency Resolution: In a narrow sense, the frequency resolution is equal to the bin width, delta f. That is, if the input signal changes its frequency by delta f, the corresponding spectrum peak will be displaced by delta f. For smaller changes of frequency, only the shape of the peak will change. However, the effective frequency resolution (i.e., the ability to resolve two signals whose frequencies are almost the same) is further

limited by the use of window functions. The ENBW value of all windows other than the rectangular is greater than delta f (i.e., greater than the bin width).

FFT Number of Points: FFT is computed over the number of points (Transform Size) whose upper bound is the source number of points. FFT generates spectra having n/2 output points.

FFT Total Power: Area under the power density spectrum in frequency-domain measurements.

FIFO: First-in, first-out shift registers (sometimes called first-in, first-out memory).

Filter: An electronic circuit or digital data manipulation routine that either enhances desirable or removes undesirable aspects of an analog waveform or its digital representation. Filters are used to block specific frequency components from passing through a circuit, to linearize otherwise identical components (such as CCDs) used in a common circuit, or to perform waveform integration, differentiation, or smoothing, just to name a few types.

Flash ADC: A very fast analog-to-digital converter, usually consisting of a large set of fast comparators and associated logic, in which the analog signal simultaneously is compared to 2n – 1 different reference voltages, where n is the ADC resolution. Also called a parallel converter.

Floor: The record of points that make the bottom (or minimum) of an envelope created from a succession of waveforms.

FWHM: Full-Width Half Maximum. The width of a pulse or waveform at 50 % amplitude used to measure the duration of a signal.

Gate: **1.** A circuit element used to provide a logical function (e.g., AND, OR); **2.** An input control signal or pulse enabling the passage of other signals.

Glitch: A spike or short-time duration structural aberration on an otherwise smooth waveform that is normally characterized by more gradual amplitude changes. In digital electronics, where the circuit under test uses an internal clock, a glitch can be considered to be any pulse narrower than the clock width.

Glitch Trigger: A trigger on pulse widths smaller than a given value.

Ground Loop: A long ground connection along which voltage drops occur due either to heavy circuit current or external pick-up, with the result that circuit elements referred to different points along it operate at different effective ground references.

HF Sync: Reduces the trigger rate by including a frequency divider in the trigger path, enabling the input trigger rate to exceed the maximum for repetitive signals.

Histogram: A graphical representation of data such that the data is divided into intervals or bins. The intervals or bins are then plotted on a bar chart where the height is proportional to the number of data points contained in each interval or bin.

Holdoff by Events: Selects a minimum number of events between triggers. An event is generated when the trigger source meets its trigger conditions. A trigger is generated when the trigger condition is met after the selected number of events from the last trigger. The hold-off by events is initialized and started on each trigger.

Holdoff by Time: Selects a minimum time between triggers. A trigger is generated when the trigger condition is met after the selected delay from the last trigger. The timing for the delay is initialized and started on each trigger.

HPGL: Hewlett-Packard Graphics Language Format; Hewlett-Packard Company.

Hybrid Circuit: A small, self-contained, high-density circuit element usually consisting of screened or deposited conductors, insulating areas, resistors, etc., with welded or bonded combinations of discrete circuit elements and integrated circuit chips.

IC: Integrated Circuit. A self-contained, multiple-element circuit such as a monolithic or hybrid.

Integral Linearity: A term often used inappropriately to mean integral non-linearity.

Integral Non-Linearity: Deviation of ADC response from an appropriate straight line fit. The specification is sometimes defined as maximum deviation, expressed as a fraction of full scale. More recent ADCs have a specification expressed as a percent of reading plus a constant.

Interleaved Clocking: Supplying clock pulses of equal frequency but different identical circuits or instruments in order to increase the system sample rate. For example, use of two transient recorders with inputs in parallel but complementary clocks to allow operation at twice the maximum rate of a single unit.

Interval Trigger: Selects an interval between two edges of the same slope. The trigger can be generated on the second edge if it occurs within the selected interval or after the selected interval. The timing for the interval is initialized and restarted whenever the selected edge occurs.

Jitter: Short-term fluctuations in the output of a circuit or instrument that are independent of the input.

Leakage: When observing the Power Spectrum of a sine wave having an integral number of periods in the time window using the rectangular window, leakage is the broadening of the base of the peak spectral component that accurately represents the source waveform's amplitude.

Limiter: A circuit element that limits the amplitude of an input (used for input protection, pulse standardizing, etc.).

Logical 1: A signal level indicating the TRUE state; corresponds to the unit being set (i.e., if interrogated, the answer is yes).

Logical 0: A signal level indicating the FALSE state; corresponds to the unit NOT being set (i.e., if interrogated, the answer is no).

Long-Term Stability: Refers to stability over a long time, such as several days or months.

MCA: multichannel analyzer (e.g., pulse height analyzer)

Mean Value: Average or DC level of all data points selected in a waveform.

Median Value: The data value of a waveform above and below which there are an equal number of data points.

Mode Value: The most frequently occurring data value of a waveform.

Monolithic IC: An integrated circuit whose elements (transistors, diodes, resistors, small capacitors, etc.) are formed on or within a semiconductor substrate.

Monotonic: A function with a derivative that does not change sign.

Multiplexer: A device used to selectively switch a number of signal paths to one input or output.

NAND: An AND circuit, except with a complementary (negative true) output.

Negation: The process of transposing all negative values into positives and all positive values into negatives.

NLTS: non-linear transition shift

Noise Equivalent Power: NEP (W); the RMS value of optical power that is required to produce unity RMS signal-to-noise ratio.

NOR: An OR circuit, except with a complementary (negative true) output.

NRZ: non-return to zero

Nyquist Frequency: The Nyquist frequency (f/2) is the maximum frequency that can be accurately measured by a digitizer sampling at a rate of (f). In other terms, a digitizer sampling at a rate of (f) cannot measure an input signal with bandwidth components exceeding f/2 without experiencing "aliasing" inaccuracies.

Offset: The amount by which an analog or digital output or input baseline is shifted with respect to a specific reference value (usually zero).

OR: A logic circuit having the property that if at least one input is true, the output is true.

Overshoot, Negative: A time-domain parameter in waveform measurements, equal to the base value of a waveform minus the minimum sample value, expressed as a percentage of the amplitude.

Overshoot, Positive: A time-domain parameter in waveform measurements, equal to the maximum sample value minus the top value, expressed as a percentage of the amplitude. The top value is the most probable state determined from a statistical distribution of data point values in the waveform.

Parallel Converter: A technique for analog-to-digital conversion in which the analog signal is simultaneously compared to 2n - 1 different reference voltages, where n is the ADC resolution.

Pass/Fail Testing: Post-acquisition testing of a waveform against a reference mask or of waveform parameters against reference values.

PCMCIA: Personal Computer Memory Card Industry Association standard for PC memory cards. Also known as JEIDA in Japan.

PCX: The PC Paintbrush Format for graphic images; ZSoft Corporation, Marietta, GA.

Peak Spectral Amplitude: Amplitude of the largest frequency component in a waveform in frequency domain analysis.

Period: A full period is the time measured between the first and third 50 % crossing points (mesial points) of a cyclic waveform.

Persistence: A display operating mode of a DSO where a user-determined number of measured traces remain on the display without being erased and overwritten.

PES: position error signal

PHA (Pulse Height Analyzer): A device that gives a measure of the amplitude of a signal applied to its input.

Picket Fence Effect: In FFT, if a sine wave has a whole number of periods in the time-domain record, the Power Spectrum obtained with the rectangular window will have a sharp peak, corresponding exactly to the frequency and amplitude of the sine wave. If it does not, the spectrum obtained will be lower and broader. The highest point in the power spectrum can be 3.92 dB lower (1.57 times) when the source frequency is halfway between two discrete bin frequencies. This variation of the spectrum magnitude is called the Picket Fence Effect (the loss is called the Scallop Loss). All window functions compensate this loss to some extent, but the best compensation is obtained with the Flat Top window.

Power Spectrum: The square of the magnitude spectrum (V^2). The Power Spectrum is displayed on the dBm scale, with 0 dBm corresponding to V^2_{ref} = (0.316 V peak)^2, where V_{ref} is the peak value of the sinusoidal voltage which is equivalent to 1 mW into 50 (omega).

Power Density Spectrum: The Power Spectrum divided by the equivalent noise bandwidth of the filter (V^2/ Hz), in Hz. The Power Density Spectrum is displayed on the dBm scale, with 0 dBm corresponding to (V^2_{ref}/ Hz).

Pre-trigger Sampling: A design concept used in transient recording in which a predetermined number of samples taken before a stop trigger are preserved.

PRML: pulse response maximum likelihood

Pulse Width: Determines the duration between the Pulse Start (mesial point, i.e., the 50 % magnitude transition point, on the leading edge) and the Pulse Stop (mesial point on the trailing edge) of a pulse waveform.

Pulse Start: The 50 % magnitude transition point (mesial point) on the leading edge of a pulse waveform.

Pulse Stop: The 50 % magnitude transition point (mesial point) on the trailing edge of a pulse waveform.

Pulse Trigger: Selects a pulse width, either maximum or minimum. The trigger is generated on the selected edge when the pulse width is either greater than or less than the selected width. The timing for the width is initialized and restarted on the edge opposite to the edge selected.

RAM: A memory in which each data address can either be written into or read from at any time.

Random Interleaved Sampling (RIS): One method of EQT (or ETS). Acting upon stable, repetitive signals, it represents the process of storing different full sampling sweeps in a DSO or digitizer system, where each sweep is slightly offset from the other to achieve a higher effective sampling rate than the single-shot rate. A major advantage of RIS over other EQT techniques is "pretrigger viewing."

Real Time: A process that occurs without having to pause for internal conversions and references. Real Time processes usually have little or no intrinsic dead time and are able to proceed at a rate that permits almost simultaneous transitions from inputs to outputs.

Reciprocal: The division of unity by the data value being processed.

Reflection Coefficient: The amount of signal amplitude that is reflected from an input, expressed as a percentage of the original input signal.

Resolution: The minimum measurable increment, such as one bit level of an ADC.

Reverse Termination: An output so constructed that pulses reflected back from the rest of the system meet a matching impedance and are absorbed.

RF (Radio Frequency): Normally in the megahertz range.

RFI (Radio Frequency Interference): A special case of EMI wherein the field causing the induced signal falls into the radio portion of the electromagnetic spectrum.

Risetime: Unless otherwise defined, the time required for a pulse to go from 10 % to 90 % of full amplitude. Can also refer generally to the leading edge of a pulse.

RMS (Root Mean Square): Is derived from the square root of the average of the squares of the magnitudes, for all the data as described above. For time-domain waveforms, the square root of the sum of squares divided by the number of points for the part of the measured waveform between the cursors. For histogram waveforms, the square root of sum of squares divided by number of values computed on the distribution.

ROM: Read-only memory is any type of memory that cannot be readily rewritten. The information is stored on a permanent basis and used repeatedly. Usually randomly accessible.

Roof: The record of points that make the top (or maximum) of an envelope created from a succession of waveforms.

SAM: sequenced amplitude margin

Sample and Hold: A circuit that, on command, stores on a capacitor the instantaneous amplitude of an input signal.

Sampling Frequency: The clock rate at which samples are taken during the process of digitizing an analog signal in a DSO or digitizer.

Scallop Loss: Loss associated with the picket fence effect.

SECAM: sequence and memory color television system

Sensitivity: **1.** The minimum signal input capable of causing an output signal with the desired characteristics. **2.** The ratio of the magnitude of the instrument response to the input magnitude (e.g., a voltage ADC has a sensitivity that is usually measured in counts/mV). Often, sensitivity is referred to the input and is therefore stated as the inverse.

Shot Noise: Noise caused by current fluctuations, due to the discrete nature of charge carriers and random emission of charged particles from an emitter. Many refer to shot noise loosely, when speaking of the mean square shot noise current (amps) rather than a noise power (watts).

SMART Trigger: The SMART Trigger allows the setting of additional qualifications before a trigger is generated. These qualifications can be used to capture rare phenomena such as glitches or spikes, specific logic

states or missing bits. One qualification can include, for example, generating a trigger only on a pulse wider or narrower than specified.

Smoothing, N-Point: The process of evening out the display of a waveform by displaying a moving average of "N" adjacent data points added to each other.

SNR: Signal-to-Noise Ratio is the ratio of the magnitude of the signal to that of the noise.

Square: The process of multiplying a value by itself.

Stage Delay: The time delay in a circuit between input and output, usually measured between the front edges (half maximum) of the respective signals.

Standard Deviation: The standard deviation of the measured points from the mean. It is calculated from the following formula:

Standard Trigger: Standard Trigger causes a trigger to occur whenever the selected trigger source meets its conditions, which are defined by the trigger level, coupling, high-frequency sync, and slope. Edge trigger is Waverunner's standard trigger type.

State Qualified: State-Qualified triggering generates a trigger when the trigger source meets its conditions during the selected pattern. A pattern is defined as a logical AND combination of trigger states. A trigger state is either high or low— high when a trigger source is greater than the trigger level, and low if it is less than the trigger level.

Stop Trigger: A pulse that is used to stop a transient recording or similar sequence.

Summed, or Summation, Averaging: The repeated addition, with equal weight, of successive waveforms divided by the total number of waveforms acquired.

TAA: track average amplitude

TDC: Time-to-digital converter.

Terminate: Normally, to provide a matching impedance at the end of coaxial cable to prevent reflections.

Test Template: A general form of waveshape limit test, which defines an arbitrary limit (or non-uniform tolerance) on each measured point in a waveform.

TFT: thin film transistor

Threshold: The voltage or current level at which a circuit will respond to a signal at its input. Also referred to as trigger level.

TIE: time interval error

TIFF (Tagged Image File Format): Industry standard for bit-mapped graphic files.

Time Between Patterns: Selects a delay, either maximum or minimum, between exiting one pattern and entering the next. The trigger is generated on entering the second pattern either within the selected time or after the selected minimum time.

Timeout: A Timeout occurs when a protective timer completes its assigned time without the expected event occurring. Timeouts prevent the system from waiting indefinitely in case of error or failure.

Time Qualified: Time-Qualified triggering generates a trigger when the trigger source meets its trigger condition after entering or exiting the pattern. The trigger can occur even if the pattern disappears before the trigger meets its trigger conditions.

Tolerance Mask: A form of waveshape limit test that defines a maximum deviation equal to a uniform tolerance on each measured point in a waveform.

Track and Hold: A circuit preceding an analog-to-digital converter that has the ability on command to store instantaneous values of a rapidly varying analog signal. Allows the ADC to accurately digitize within tighter time domains.

Transient Recorder: See Waveform Digitizer.

TTL (Transistor-Transistor Logic): Signal levels defined as follows: LOGICAL 0 = 0 to 0.8 V and LOGICAL 1 = 2.0 to 5.0 V.

Trend: Plot of a parameter value or other characteristic of a measurement over a period of time.

VIS: Viterbi input samples

Waveform Digitizer: An instrument that samples an input waveform at specified intervals, digitizes the analog values at the sampled points, and stores the results in a digital memory.

Window Functions: Used to modify the spectrum of a truncated waveform prior to Fourier analysis. Alternately, window functions determine the selectivity (filter shape) in a Fourier transform spectrum analyzer. In LeCroy scopes, all window functions belong to the sum of cosines family with one to three non-zero cosine terms [$W = \ldots a_m \cos(2\pi k/N)$, where N is the number of points in the decimated source waveform, and k is the time index).

X-Y Display: A plot of one trace against another trace. This technique is normally used to compare the amplitude information of two waveforms. It can reveal phase and frequency information through the analysis of patterns called Lissajous figures.

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