GENERAL STANDARDS

GLOSSARY OF TECHNICAL TERMS - ELECTRONIC

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GLOSSARY OF TECHNICAL TERMS - ELECTRONIC

(For Use at Tektronix, Inc.)

1. PURPOSE. The purpose of this standard is to establish better communications within the company by providing a glossary of electronic technical terms and definitions pertinent to our products. It should be noted that many of these terms are only partially or not at all defined in existing professional, national, or international standards.

2. REFERENCES.

Analog Computers, Definitions of Terms for	IEEE 165 (1963)
Audio, Definitions of Terms for	IEEE 151 (1965)
Communications	USAS C42.65-1957
Dictionary of Electronics Terms and Symbols	IEEE (IRE) 1961
Electrical and Electronics Terms	IEEE 270 (1966)
Electron Tubes, Definitions of Terms for	IEEE 160 (1957)
Electronic Digital Computers, Definitions of	IEEE 162 (1963)
Electronics, Vocabulary	IEC 50-07 (1956)
Facsimile, Definitions of Terms for	IEEE 168 (1956)
Modulation Systems, Definitions of Terms for	IEEE 170 (1964)
Radio Aids to Navigation, Definitions of Terms	IEEE 172 (1954)
Receivers, Definitions of Terms for	IEEE 188 (1952)
Scientific and Industrial Measuring Instr	IEC 50-20 (1958)
Television, Definitions of Terms Relating to	IEEE 204 (1961)
Television: Color Terms, Definitions for	IEEE 201 (1955)

3. USE AND APPLICATION. This standard is for use throughout the company, and for the contained terms and definitions shall be the reference document for applications inside the company (i.e., the contained terms and definitions, when appearing in company media, shall be in agreement with this standard). Conflict with any other TEKTRONIX Standard shall be brought to the attention of Standards and Documentation.

4. OBTAINING TERMS OR DEFINITIONS NOT LISTED IN THIS STANDARD. This standard, as noted above, does not attempt to cover all the technical electronic terms and definitions used within the company. If you do not find a term for which you seek a definition or you have a term, which as defined, you believe is not clear or correct, or you believe a particular term and definition should be added, get in touch with Chuck Samuel, Chairman of the Definitions Subcommittee of the Technical Terminology Committee. The Subcommittee will review both the terms and their definitions, establish their correctness, and decide whether or not to add them to this glossary.

5. GENERAL TERMS.

6. GENERAL PURPOSE LABORATORY OSCILLOSCOPE TERMS. The definitions appearing in Paragraph 6 have been approved by the Subcommittee on Oscilloscopes of the G-IM Technical Committee on High Frequency Instruments and Measurements of the IEEE.

accelerating voltage - The cathode-to-viewing-area voltage applied to a cathode-ray tube for the purpose of accelerating the electron beam.

alternate operation - A means of displaying output signals of two or more channels by switching the channels, in sequence, after each sweep.

amplifier, difference - See differential amplifier

amplifier, differential - See differential amplifier

amplifier, horizontal - See horizontal amplifier

amplifier, intensity - See intensity amplifier

amplifier, vertical - See vertical amplifier

amplifier, X-axis - See horizontal amplifier

amplifier, Y-axis - See vertical amplifier

amplifier, Z-axis - See Z-axis amplifier and intensity amplifier

armed sweep - See single sweep

astigmatism - In the viewing plane of the cathode-ray tube, any deviation of the indicating spot from a circular shape.

attenuator - A device for reducing the amplitude of a signal without deliberately introducing distortion.

automatic triggering - A mode of triggering in which one or more of the triggering circuit controls are preset to conditions suitable for automatically displaying repetitive waveforms. The automatic mode may also provide a recurrent trigger or recurrent sweep in the absence of triggering signals.

axis, deflection - See deflection axis

balanced circuit - A circuit, the two branches of which are electrically alike and symmetrical with respect to a common reference point, usually ground. For an applied signal difference at the input, the signal relative to the reference at equivalent points in the two branches must be opposite in polarity and equal in amplitude.

bandwidth - A statement of the frequencies defining the upper and lower limits of a frequency spectrum where the amplitude response of an amplifier to a sinusoidal waveform becomes .707 (-3dB) the amplitude of a reference frequency. When only one number appears, it is taken as the upper limit.

Note 1: The reference frequency shall be at least 20 times greater for the lower bandwidth limit and at least 20 times less for the upper bandwidth limit than the limit frequency. The upper and lower reference frequencies are not required to be the same. In cases where exceptions must be made, they shall be noted.

Note 2: This definition assumes the amplitude response to be essentially free of departures from a smooth roll-off characteristic.

Note 3: If the lower bandwidth limit extends to DC, the response at DC shall be equal to the reference frequency, not -3dB from it.

beam finder - A provision for locating the beam on an oscilloscope when it is not visible.

beam locator - See beam finder

bezel - The flange or cover used for holding an external graticule or cathode-ray tube cover in front of the cathode-ray tube in an oscilloscope. May also be used for mounting a trace recording camera or other accessory item.

blanking - Extinguishing of the spot. Retrace blanking is the extinction of the spot during the retrace portion of the sweep waveform. The term does not necessarily imply blanking during the holdoff interval or while waiting for a trigger in a triggered sweep system.

blanking, chopped - See chopping transient blanking

blanking, transient - See chopping transient blanking

brightness - The attribute of visual perception in accordance with which an area appears to emit more or less light.

Note: See luminance

calibrator - A signal generator whose output is used for purposes of calibration; normally either amplitude or time.

cathode-ray oscilloscope - An oscilloscope employing a cathode-ray tube.

cathode-ray tube display area - See graticule area

channel - A single path for transmitting electric signals, usually in distinction from other parallel paths.

chopped blanking - See chopping transient blanking

chopped mode - A time sharing method of displaying output signals of two or more channels with a single cathode-ray tube gun, in sequence, at a rate not referenced to the sweep.

chopping frequency - See chopping rate.

chopping rate - The rate at which channel switching occurs in chopped mode.

chopping transient blanking - The process of blanking the indicating spot during the switching periods in chopped mode.

circuit, balanced - See balanced circuit.

circuit, push-pull - See balanced circuit.

common-mode rejection ratio (CMRR) - Ratio of the deflection factor for a common-mode signal to the deflection factor for a differential signal.

common-mode signal - The instantaneous algebraic average of two signals applied to a balanced circuit, all signals referred to a common reference.

common-mode signal maximum - The largest common-mode signal at which the specified common-mode rejection ratio is valid.

compression - An increase in the deflection factor, usually as the limits of the quality area are exceeded.

contrast - The comparative brightness between specified elements of a presentation.

DC balance - An adjustment of circuitry to avoid a change in DC level when changing gain.

DC drift - See stability

DC offset - A DC level which may be added to the input signal, referred to the input terminals.

DC shift - An error in transient response with a time constant approaching several seconds.

deflection axis - One of the major coordinates passing through the center of the viewing area. The vertical deflection axis, and the horizontal deflection axis.

deflection blanking - Blanking by means of a deflection structure in the cathode-ray tube electron gun which traps the electron beam inside the gun to extinguish the spot, permitting blanking during retrace and between sweeps regardless of intensity setting.

deflection coefficient - See deflection factor

deflection factor - The ratio of the input signal amplitude to the resultant displacement of the indicating spot (for example, volts/division).

deflection polarity - The relation between the polarity of the applied signal and the direction of the resultant displacement of the indicating spot. (Conventionally a plus polarity causes upward deflection or deflection from left to right.)

deflection sensitivity - The reciprocal of the deflection factor (for example, divisions/volt).

delay line - A passive transmission system intended to introduce a time delay.

delay pickoff - Circuitry for providing an output signal when a delay ramp has reached an amplitude, corresponding to a certain length of time (delay interval) since the start of the ramp. The output signal may be in the form of a pulse, a gate, or simply amplification of that part of the ramp following the pickoff time.

delay, signal - See signal delay

delayed sweep - 1. A sweep that has been delayed either by a predetermined period or by a period determined by an additional independent variable. 2. A mode of operation of a sweep, as defined above.

difference amplifier - See differential amplifier

differential amplifier - An amplifier whose output signal is proportional to the algebraic difference between two input signals.

difference signal - See differential signal

differential signal - The instantaneous, algebraic difference between two signals.

display - The visual presentation on the indicating device of an oscilloscope.

drift - See stability

dual-beam oscilloscope - An oscilloscope in which the cathode-ray tube produces two separate electron beams that may be individually or jointly controlled.

dual trace - A mode of operation in which a single beam in a cathode-ray tube is shared by two signal channels. See alternate mode and chopped mode.

edge lighting - A method of illuminating the lines on a graticule by introducing light into the edges of the graticule.

expanded sweep - See magnified sweep.

expansion - A decrease in the deflection factor, usually as the limits of the quality area are exceeded.

external sweep - A sweep generated external to the oscilloscope.

external triggering - Introducing the triggering signal directly into the trigger circuit from an external source.

floating input - Circuitry provided at the input of a deflection amplifier to render resistance to a common mode signal that may exist in the presence of a differential signal.

fluorescence - Emission of light from a substance (a phosphor) during excitation by radiant energy.

focus - Maximum convergence of the electron beam manifested by minimum spot size on the phosphor screen. (Note definition for astigmatism.)

free-running sweep - A sweep that recycles without being triggered and is not synchronized by any applied signal.

gated sweep - A sweep controlled by a gate waveform. Also, a sweep which will operate recurrently (free-running, synchronized, or triggered) during the application of a gating signal.

Gaussian response - A particular frequency response characteristic following the curve $y(f) = e^{-af^2}$. Typically, the frequency response approached by an amplifier having good transient response characteristics.

geometry - The degree to which a rectilinear display on a cathode-ray tube screen is accurately reproduced. Generally associated with properties of a cathode-ray tube. The name may be given to a cathode-ray tube electrode or its associated control.

graticule - A scale for measurement of quantities displayed on the cathode-ray tube of an oscilloscope.

graticule area - The area enclosed by the continuous outer graticule lines. Unless otherwise stated the graticule area shall be equal to or less than the viewing area. (See also quality area and viewing area.)

guarded input - Means of connecting an input signal so as to prevent any common mode signal from causing current to flow in the input, thus differences of source impedance do not cause conversion of the common mode signal into a differential signal.

holdoff - See sweep holdoff

horizontal amplifier - An amplifier for signals intended to produce horizontal deflection.

incremental sweep - A sweep which is not a continuous function, but which represents the independent variable in discrete steps. (See also, stair-step sweep)

information writing speed - The cathode-ray tube characteristic which is an indication of the maximum number of bits of information per second that can be photographically recorded and identified. Test conditions must be specified.

input current - A direct current, either polarity, that might be present at the input terminal of an amplifier when short circuited.

input RC characteristics - The DC resistance and capacitance to ground present at the input of an oscilloscope.

intensity - A term used to designate brightness or luminance.

intensity amplifier - An amplifier for signals controlling the intensity of the spot.

intensity modulation - The process and/or effect of varying the electron beam current in a cathode-ray tube resulting in varying brightness or luminance of the trace.

internal graticule - A graticule whose rulings are a permanent part of the inner surface of the cathode-ray tube faceplate.

internal triggering - The use of a portion of a deflection signal (usually the vertical deflection signal) as a triggering signal source.

inverted input - An input where the applied polarity causes a deflection opposite from conventional deflection polarity.

jitter - An aberration of a repetitive display indicating instability of the signal or of the oscilloscope. May be random or periodic, and is usually associated with the time axis. (See stability)

line triggering - Triggering from the power-line frequency.

Lissajous figure - A special case of an x-y plot where the signals applied to both axes are sinusoidal functions, useful for determining phase and harmonic relationships.

lockout - See sweep lockout

luminance - The photometric equivalent of brightness.

Note: The term luminance is recommended for the photometric quality which has been called brightness. Use of this term permits brightness to be used entirely with reference to sensory response. The photometric quantity has been confused often with the sensation merely because of the use of one name for two distinct ideas. Brightness will continue to be used properly in nonquantitative statements, especially with reference to sensations and perceptions of light.

magnified sweep - A sweep whose time per division has been decreased by amplification of the sweep waveform rather than by changing the time constants used to generate it.

marker - A signal introduced into the presentation for the purpose of identification, measurement, calibration, or comparison.

maximum common mode signal - See common mode signal maximum

minus input - See inverted input

mixed sweep - In a system having both a delaying sweep and a delayed sweep, a means of displaying the delaying sweep to the delaying pickoff and the delayed sweep beyond that point.

modulation, intensity - See intensity modulation

multi-beam oscilloscope - An oscilloscope in which the cathode-ray tube produces two or more separate electron beams that may be individually, or jointly, controlled. (See dual-beam oscilloscope)

multi-trace - A mode of operation in which a single beam in a cathode-ray tube is shared by two or more signal channels. (See dual trace, alternate mode and chopped mode)

noise - Any extraneous electrical disturbance tending to interfere with the normal display.

orthogonality - The extent to which traces parallel to the vertical axis of a cathode-ray tube display conform to a right angle with the horizontal axis.

oscillogram - A record of the display presented by an oscillograph or an oscilloscope.

oscillograph - A device which graphically plots one quantity versus another quantity.

oscillography - The art and practice of utilizing the oscillograph.

oscilloscope - An oscillograph primarily intended for the immediate viewing of the graphic plot...most commonly used to denote a cathode-ray oscilloscope.

oscilloscope, cathode-ray - See cathode-ray oscilloscope

overshoot - In the display of a step function (usually of time), that portion of the waveform which, immediately following the step, exceeds its nominal or final amplitude.

persistence - See phosphor decay

phase shift - The change in the phase angle, with respect to a given reference angle, of a sinusoidal waveform produced upon passing through a network.

phosphor decay - A phosphorescence curve, energy emitted versus time.

phosphor screen - All the visible area of the phosphor on the cathode-ray tube faceplate.

phosphorescence - Emission of light from a substance after excitation has been removed.

plus input - An input where the applied polarity causes a deflection in agreement with conventional deflection polarity.

preshoot - In the display of a step function (usually of time), that portion of the waveform which immediately precedes the step. Polarity of the excursion is usually but not necessarily opposite to that of the step which follows.

push-pull circuit - See balanced circuit

quality area - The area of the cathode-ray tube phosphor screen which is limited by the cathode-ray tube and instrument specifications. (See graticule area and viewing area)

Note: If the quality area and the graticule area are not equal, this must be specified.

ramp - A voltage or current that varies at a constant rate; for example, that portion of the output waveform of a time-linear sweep generator used as a time base for the display.

raster - A predetermined pattern of scanning lines which provides substantially uniform coverage of an area.

recurrent sweep - A free running or synchronized sweep.

resolution - A measure of the total number of trace lines discernible along the coordinate axes, bounded by the extremities of the graticule or other specific limits.

response, Gaussian - See Gaussian response

response, transient - See transient response

retrace - Return of the spot on the cathode-ray tube to its starting point after a sweep; also that portion of the sweep waveform which returns the spot to its starting point.

retrace blanking - See blanking

return trace - The path of the scanning spot during the retrace.

ringing - A damped oscillatory transient occurring in the output of the system as a result of a sudden change of input.

risetime - The interval between the instants at which the instantaneous amplitude first reaches specified lower and upper limits. In the display of a step function of time, unless otherwise stated, these limits shall be 10% and 90% of the nominal or final amplitude of the step.

rolloff - A gradually increasing loss or attenuation with increase or decrease of frequency beyond the substantially flat portion of the amplitude-frequency response characteristic of a system or transducer.

rounding - In the display of a step function (usually of time), the loss of the corner following the step.

sawtooth - See sawtooth waveform

sawtooth sweep - A sweep generated by the ramp portion of a sawtooth waveform.

sawtooth waveform - A waveform containing a ramp and a return to initial value the two portions usually of unequal duration.

scan - The process of deflecting the electron beam. (See graticule area, uniform luminance area, and phosphor screen)

screen - See phosphor screen.

screen, viewing - See viewing area

signal delay - The transmission time of a signal through a network. The time is always finite, may be undesired, or may be purposely introduced. (See delay line)

sine-wave sweep - A sweep generated by a sine function.

single sweep - Operating mode for a triggered-sweep oscilloscope in which the sweep must be reset for each operation, thus preventing unwanted multiple displays. Particularly useful for trace photography. In the interval after the sweep is reset and before it is triggered, it is said to be armed.

slave sweep switching - A combination of sweep switching and multiple trace operation in which a specific channel is displayed with a specific time base.

spot - The illuminated spot that appears where the electron beam strikes the phosphor screen of a cathode-ray tube.

spot size - See trace width

stability - Property of retaining defined electrical characteristics for a prescribed period. Deviations from a stable state may be called drift or jitter. In triggered sweep systems, triggering stability may refer to the ability of the trigger and sweep systems to maintain jitter-free display of high-frequency waveforms for long (seconds to hours) periods of time. Also, the name of the control used on some oscilloscopes to adjust the sweep for triggered, free-running, or synchronized operation. (See sweep mode)

stairstep sweep - An incremental sweep in which each step is equal. The electrical deflection waveform producing a stairstep sweep is usually called a staircase or stairstep waveform. (See incremental sweep)

step response - The characteristic reaction to a step input. The display of this reaction.

sweep - An independent variable of a display; unless otherwise specified, this variable is a linear function of time, but may be any quantity that varies in a definable manner.

sweep accuracy - Accuracy of the trace horizontal (vertical) displacement compared with the reference independent variable usually expressed in terms of average rate error as a percent of full scale. (See sweep linearity)

sweep delay accuracy - Accuracy of indicated sweep delay, usually specified in error terms.

sweep, delayed - See delayed sweep

sweep duration - In a sawtooth sweep, the time required for the sweep ramp.

sweep duty factor - Ratio of the sweep duration to the interval between the start of one sweep and the start of the next.

sweep, expanded - See magnified sweep

sweep, external - See external sweep

sweep, free-running - See free-running sweep

sweep frequency - Sweep repetition rate.

sweep gate - Rectangular waveform used to control the duration of the sweep; usually also used to unblank the cathode-ray tube for the duration of the sweep.

sweep, gated - See gated sweep

sweep generator - A unit that generates a signal used as an independent variable; the signal is usually a ramp, changing amplitude at a constant rate.

sweep holdoff - The interval between sweeps during which the sweep and (or) trigger circuits are inhibited.

sweep, incremental - See incremental sweep

sweep linearity - Maximum displacement error of the independent variable between specified points on the display area.

sweep lockout - Means for preventing multiple sweeps when operating in a single-sweep mode.

sweep magnifier - Circuit or control for expanding part of the sweep display. Sometimes known as sweep expander.

sweep mode - The name of the control used on some oscilloscopes to adjust the sweep for triggered, free-running, or synchronized operation.

sweep range - The set of sweep time/division settings provided.

sweep rate - See sweep time/division

sweep recovery time - The minimum possible time between the completion of one sweep and the initiation of the next, usually the sweep holdoff interval.

sweep, recurrent - See recurrent sweep

sweep reset - In oscilloscopes with single-sweep operation, the arming of the sweep generator to allow it to cycle once.

sweep switching (automatic) - Alternate display of two or more time bases or other sweeps using a single-beam cathode-ray tube; comparable to dual- or multiple-trace operation of the deflection amplifier.

sweep time - See sweep time/division

sweep time/division - The time required for the spot in the reference coordinate to move from one graticule division to the next. Also the name of the control used to select this time.

synchronized sweep - A sweep which would free run in the absence of an applied signal but in the presence of the signal, is synchronized by it.

synchronizing signal - A signal used to synchronize two repetitive functions.

time base - The sweep generator in an oscilloscope.

trace - The cathode-ray tube display produced by a moving spot. (See spot)

trace finder - See beam finder

trace width - The distance between two points on opposite sides of a trace at which luminance is 50% of maximum. If the trace departs from a well-behaved (approximately Gaussian) form, it should be smoothed for the purpose of measurement.

transient blanking - See chopping transient blanking

transient response - The name of a number of characteristic time-domain reactions to abruptly applied inputs.

trigger - A pulse used to initiate some function (for example, a triggered sweep or delay ramp). Where the terms trigger and triggering signal are used together, triggering signal conventionally refers to a waveform applied to the triggering circuits and from which a trigger or trigger pulse is derived. Otherwise, trigger may loosely refer to a waveform of any s shape used as a signal from which to derive a trigger pulse, as in "trigger source", "trigger input", etc.

trigger countdown - A process that reduces the repetition rate of a triggering signal.

trigger lockout - See sweep lockout

trigger pickoff - A process or a circuit for extracting a triggering signal.

triggered sweep - A sweep that can be initiated only by a trigger signal (not free-running).

triggering level - The instantaneous level of a triggering signal at which a trigger is to be generated. Also, the name of the control which selects the level.

triggering signal - The signal from which a trigger is derived.

triggering slope - The positive going (+ slope) or negative going (- slope) portion of a triggering signal from which a trigger is to be derived. Also, the control which selects the slope to be employed.

Note: + slope and - slope apply to the slope of the waveform only, and not to the absolute polarity.

unblanking - Turning on of the cathode-ray tube beam.

undershoot - In the display of a step function (usually of time), that portion of the waveform which, following any overshoot or rounding which may be present, falls below its nominal or final value.

uniform luminance area - The area in which a display on a cathode-ray tube retains 70% or more of its luminance at the center of the tube.

Note: The corners of the rectangle formed by the vertical and horizontal dimensions of this area may be below the 70% luminance level.

vertical amplifier - An amplifier for signals intended to produce vertical deflection.

viewing area - The area of the phosphor screen of a cathode-ray tube which can be excited to emit light by the electron beam.

viewing screen - See viewing area.

waveform distortion - An unwanted deviation from the original waveform.

writing rate - See writing time/division

writing speed - See information writing speed

writing time - See writing time/division

writing time/division - The minimum time per unit distance required to record a trace. The method of recording must be specified.

X-axis amplifier - See horizontal amplifier

X-Y display - A rectilinear coordinate plot of two variables.

Y-amplifier - See vertical amplifier

Y-axis amplifier - See vertical amplifier

Y-T display - An oscilloscope display in which a time dependent variable is displayed against time.

Z-axis amplifier - An amplifier for signals controlling a display perpendicular to the X-Y Axis (commonly intensity of the spot). (See intensity amplifier)

7. CATHODE-RAY TUBE TERMS.

aluminum peel - Darkened areas in the phosphor caused by peeling or blistering of the aluminum from the phosphor screen in an aluminized cathode ray tube.

aluminized phosphor screen - A phosphor screen to which a thin film of aluminum has been applied.

background luminance - The luminance of the stored target when it is completely erased and at a specified operating voltage.

backplate - See storage target backplate.

blister - A bubble in the faceplate glass greater than 0.030 inch in diameter. (see seed).

bruise check - A fissure or crack on the surface which does not extend through the glass.

burr - A localized defocusing of the electron beam caused by foreign material on internal tube elements.

cathode double peaking - Brightening, dimming, then brightening of the display as the intensity control is rotated through its range. This is caused by a cathode defect.

cathode interface - An impedance between the cathode base metal and cathode coating which may cause the start of the trace to appear brighter than the rest of the trace.

charge - Spurious conditions in the cathode ray tube which exhibit the effect of static voltages. The charge may occur on the rods, the bulb walls, the helix, the faceplate, or any insulating surface, and produces a distortion of the geometry or spot size.

cord - A narrow band of glass on the faceplate of the CRT with a different index of refraction from the surrounding glass causing a stringy appearance.

collimation lens - In a storage tube an electrostatic lens used to adjust the trajectories of flood gun electrons.

collimation electrode - An element used in the collimation lens.

contrast enhancement - A method of altering electrode potentials to increase contrast ratio.

contrast ratio - The ratio of stored luminance to background luminance at a given operating voltage.

conventional mode - That mode of operating a storage tube where the display does not store but performs with the usual phosphor luminance and decay.

edge defocusing - Change in size and/or shape of the indicating spot as it approaches the edge of the cathode ray tube.

edge flaking - Phosphor screen defect in which portions of the phosphor have been broken away from the outside edges.

enhance - To momentarily alter the electrode potentials in a storage tube to increase performance (n: Enhancement).

erase - To momentarily change electrode potentials in such a manner that previously stored information is removed (n: Erasure).

erase cycle - The sequence of potential changes required to erase the storage target and return it to the ready-to-write state.

faceplate - That wall of the cathode ray tube providing the display area.

fade positive level - The highest operating voltage at which stored information can be retained.

fade up - In a storage tube the failure of a unwritten area to remain at background brightness. The background spontaneously moves to the stored brightness of the written state.

flare - Extraneous light output from the phosphor screen.

flood gun - A low-energy electron gun directing a large cone of electrons toward the entire storage target.

fully written - The condition under which the entire storage target is in the written state.

grid emission - An emission from the grid most easily observed under conditions of cathode cutoff as a circle or ellipse of light on the phosphor screen.

hole - A void area in the phosphor.

integrate - To interrupt flooding of the storage target and permit the writing gun electrons to sum over several sweeps (n: Integration).

ion repeller - An electrode that produces a potential barrier against ions.

locate zone - A non-storing zone to the side of the graticule that permits presetting of the vertical position of the trace.

luminance uniformity ratio - The ratio of the luminance of the brightest to the dimmest area on the target when the target is fully written.

non-store level - The backplate voltage of a storage tube in the conventional mode.

operating level - The mid-point of the operating range.

operating point - The operating voltage (within the operating range) chosen for a given tube performance.

operating range - The voltage range within which information can be written and completely stored under given conditions of operation (upper writing limit minus writing threshold).

operating voltage (or store level) - The potential difference between the flood gun cathode and the storage target backplate.

phosphor contamination - Any foreign material in the phosphor.

pit - An open bubble on the faceplate glass.

ready-to-write state - The stable mode of any area of the storage target after erasure and before writing.

rest potential - The equilibrium potential assumed by the unwritten areas of the target when it is operated in the storage mode.

retention threshold - The lowest operating voltage at which stored information can be retained anywhere within the quality area.

seed - A bubble, 0.030 inch or smaller in the faceplate glass (see blister).

stable range - In a storage tube the operating voltage range within which information can be retained (fade positive minus retention threshold).

stone - Any irregular opaque mass embedded in the glass of the faceplate.

store - To retain the written information on the storage target after the writing beam has passed.

stored luminance - The luminance of stored information at a given operating voltage.

storage mode - The mode of operation that permits the storage target to retain written information.

storage target - A surface having the ability to store information when bombarded by an electron beam.

storage target backplate - A conductive surface electrically coupled to and usually physically supporting the storage target.

stored resolution - A measure of the tubes capability to display discrete elements of stored information usually defined by the number of line pairs resolvable per centimeter on the tube face.

stored writing rate - The reciprocal of stored writing speed (seconds per centimeter or other units).

stored writing speed - The speed (centimeters per second or other units) at which the writing beam will register stored information when scanning the storage target, under stated conditions of operation.

upper writing limit - The highest operating voltage at which a signal can be written and still maintain a given stored resolution under given conditions of operation.

write - To bombard the phosphor screen with electrons and produce luminescence.

write through mode - That mode of operating a storage tube where the stored information is retained, and the writing beam is operated to produce a non-storing display, as in the conventional mode.

written state - The stable mode of any area of a storage target after writing and before erasure.

writing gun - A high-energy electron gun giving a narrow focused beam which can be deflected and is used to write the information to be stored.

writing speed enhancement - A method of altering electrode potentials to increase the stored writing speed.

writing threshold - The lowest operating voltage at which a signal can be written and completely stored under given conditions of operation.

8. OPTICAL TERMS.

acutance - A physical measure of definition.

angstrom - A unit of linear measure equal to 10^{-8} centimeter usually used to measure the wavelength of light.

aperture - In an optical system, an opening that limits the size of a bundle of rays traversing the system.

aperture selector - A device used to select an aperture size.

beam splitter - A device such as a prism or half-silvered mirror which splits a light beam into 2 or more beams not necessarily equal in intensity.

binocular - A term applying to vision with both eyes.

black body - A theoretically perfect absorber and emitter of radiation.

cable release - A cable provided for remote actuation of a camera shutter.

camera adapter - A bezel used to attach a camera to an oscilloscope.

candela - A unit of luminous intensity defined such that the luminance of a black body radiator at the temperature of solidification of platinum (2042°K) is 60 candelas per square centimeter.

candle - A unit of luminous intensity (see candela).

candlepower - A unit of measure of the illuminating power of a light source. The candlepower (number of candelas) is the luminous intensity of the light source. A luminous intensity of one candlepower produces one lumen of luminous flux per steradian measured from the source.

CRT phosphor plane - The plane which contains the phosphor screen. This is the object plane in oscilloscope photographs.

coated lens - A lens with a chemical coating which has been applied for protection, increasing transmittance, and/or decreasing reflectivity.

collimate - To render parallel.

collimating lens - A lens which changes converging or diverging light rays to parallel rays.

color corrected lens - A lens designed to reduce distortions due to different colors of light focusing in different planes.

color temperature - Temperature, in degrees Kelvin (°K), to which a perfect black body radiator would have to be heated to emit light of the same color as the light source in question.

definition - The degree of clarity of reproduction of an object by an optical system.

density - The reciprocal of transmittance.

depth of field - In an optical system, the maximum separation, normal to the image plane, of two objects, both of which appear in acceptable focus at the image (film) plane with a given setting of the focus controls (see depth of focus).

depth of focus - In an optical system with a given object distance, the extent to which the focusing controls can be varied and retain acceptable image sharpness.

diaphragm - In an optical system, an opaque element containing a fixed or adjustable opening. Diaphragms are used to intercept scattered light, to limit field angles or to limit image forming bundles of rays.

dichroic - Exhibiting the quality of selective reflection and transmission of light as a function of color.

diffraction - The deviation of a light ray from its path at the edge of an opaque object, such as a diaphragm.

diffusion - The scattering of light by reflection or transmission.

distortion - See image distortion.

entrance pupil - The effective diameter of the limiting aperture in an optical system.

erecting system - A system of lenses or prisms used to produce an erect image which would otherwise be inverted.

f stop, *f* number - See relative aperture.

fiber optics - A system for transmitting an image by means of a large number of transparent fibers. Each fiber carries only one element of the image so that the image is a mosaic rather than a continuous picture.

field of view - The maximum size of an object at a given distance, which can be imaged by an optical system.

filter - In optics, a device used to control the rendering of color, polarity, or intensity of light.

flux - Rate of flow (radiant flux is radiant energy per unit of time).

focal length - The distance between the focal point and the transverse center of a single thin lens (or its equivalent in a compound and/or thick lens) when the light rays incident upon the lens are parallel.
(See Figure 1, Page 24)

focal plane - The plane, normal to the optical axis, which contains the focal point.

focal point - The point of convergence of light rays which have been acted upon by a lens or other converging device.

focus - The process of positioning the focal point, usually for sharpest (clearest) image. (See focal point)

fog - A generalized change in density of film. The change may be due to chemical or radiation effects.

foot-candle - The illumination received at a surface one foot from a standard candle. One foot-candle equals the illumination received by a surface represented by one square foot on a sphere of 1 foot radius with a 1 candela source at the center of the sphere.

gray scale - A reference series of gray tones extending in regular steps of increasing depth of tones from white (clear) to black (opaque).

image - A representation of an object produced by means of radiant energy.

image distance - The distance between an acceptably focused image and the transverse center of a single thin lens or its equivalent in a compound and/or thick lens.

image distortion - Any non-linear change in the relationship between object and image.

image plane - The plane normal to the optical axis at the image distance.

image, real - See real image.

image, virtual - See virtual image.

incandescence - The emission of light due to thermal action.

index of refraction - A number applied to transparent substances which denotes the relation between the angle of incidence and the angle of refraction when light passes from a vacuum into the substance.

interference - A term used to denote the additive processes whereby the amplitudes of two or more light waves are systematically attenuated and reinforced.

infrared - That portion of the radiation spectrum frequency specified as having a wavelength in the range from 760 nanometers (760 millimicrons) to 1 millimeter (1000 microns).

iris diaphragm - A diaphragm whose aperture can be smoothly and continuously adjusted for size.

lambert - A unit of luminance from a reflecting surface equal to $1/\pi$ candela per square centimeter; or equal to the average luminance of a surface reflecting or emitting light at the rate of one lumen per square centimeter.

lens - An element which transmits a portion of the electromagnetic spectrum and which changes the convergence (or divergence) of the transmitted rays. (See Figure 2 and 3, Page 24)

lens speed - The lens characteristic that indicates the amount of light it passes (see relative aperture).

light - Radiant energy which can be detected by the human eye. This is defined by the 1924 Photoptic Luminosity function curve of the International Commission on Illumination.

lumen - A unit of luminous flux. It equals the flux emitted through a unit solid angle (one steradian) from a uniform point source of one candela.

luminescence - An emission of light not due directly to incandescence and occurring at a temperature below that of incandescent bodies.

luminosity factor - The ratio of the amount of light at a particular wavelength to the radiant energy at that wavelength. It can be expressed in lumens per watt.

luminous (adj) - Radiating or reflecting light.

luminous efficiency - For non-monochromatic light, the ratio of the amount of light to the radiant energy. For monochromatic light, luminous efficiency is synonymous with luminosity factor.

luminous flux - The rate of flow of luminous energy from a source. The unit of luminous flux is the lumen (see candlepower).

lux - The illumination received at a surface one meter from a standard candle. One lux equals the illumination received by a surface represented by one square meter on a sphere of 1 meter radius with a one candela source at the center of the sphere.

magnification - The ratio of the size or apparent size of the image to an object when viewed through or imaged by an optical system.

micron - 10^{-6} meter, use micrometer.

mirror - A smooth, highly polished surface for reflecting light.

nanometer - 10^{-9} centimeter.

object - The figure viewed through or imaged by an optical system.

object distance - The distance between the object and the transverse center of a single thin lens or its equivalent in a compound and/or thick lens.

objective - The lens in an optical system which is nearest the object (along the optical path).

optical axis - In an optical system, the line passing through the centers of curvatures of the optical surfaces. (See Figure 2 and 3, Page 24)

optical density - The logarithm (base 10) of the reciprocal of transmittance.

optical element - An optical part constructed of a single piece of optical material; a single lens, mirror or prism.

optical glass - A glass which, during manufacture, is carefully controlled so that its optical characteristics (index of refraction, dispersion, spectral transmittance, etc.) have the values required for the optical application for which it will be used.

optics - That branch of physical science which is concerned with the nature and properties of electromagnetic radiation and with the phenomena of vision.

parallax - The apparent displacement of an observed object due to the angle of observation.

photometer - Instrument for measuring illumination in which the relative luminous intensity of a given source is determined by comparing it with another source.

polarized light - A light beam whose waves vibrate in specific directions normal to the path of propagation.

postfogging - A technique of increasing the apparent sensitivity of film by a uniformly controlled exposure to light after the image producing exposure.

prefogging - A technique of increasing the apparent sensitivity of film by a uniformly controlled exposure to light before the image producing exposure.

prism - A transparent body with at least two polished faces, inclined with respect to each other, from which light is reflected or through which light is refracted.

radiant efficiency - See luminosity factor.

radiant energy - The energy of electromagnetic waves.

real image - An image which can be formed on a reflecting or diffuse transmitting surface. This image is formed by rays converging toward it.
(See Figure 2, Page 24.)

reciprocity - A general term used to describe linear response of film to light energy at a given wavelength. The non-linear response of the film in the end regions of the curve is reciprocity failure.

reticle - A scale indicator, or pattern placed in one of the focal planes of an optical instrument which appears to the observer to be superimposed on the field of view.

rectilinear - Having the properties of a straight line.

reflection - The change of direction of light when meeting an interface between two mediums without entering the second medium.

reflectivity - The ratio of the amount of light reflected from a surface to the total incident light.

refraction - The change of direction of light when meeting an interface between two media and entering the second media.

relative aperture - The diameter of the entrance pupil of a lens or optical system measured in terms of the equivalent focal length of that lens or system. It is written as a fraction in which the equivalent focal length is the numerator, and it is symbolized by $f/$ followed by a numerical value. For example, $f/2$ signifies that the diameter of the entrance pupil is equal to 1/2 the equivalent focal length. Relative aperture is applicable for determining exposure time only when the object is at infinity.

resolving power - The degree to which a system or a device distinguishes fineness of detail.

shutter - A device which will admit light to an optical system for controlled periods.

steradian - The solid angle subtended at the center of a sphere by an area on its surface numerically equal to the square of the radius. The unit of solid angular measurement.
(See Figure 4, Page 24.)

stop - A diaphragm which limits the size of the aperture or determines the usable field of view.

T-stop, T-number - The equivalent f-number of a fictitious lens that has a circular opening and 100 percent transmittance, and that gives the same central illumination as the actual lens under consideration.

T-stop, T-number (continued)-

$$T\ stop = \frac{F\ \pi}{2\ At}$$

Where F = the equivalent focal length, A is the area of the entrance pupil and t is the transmittance of the lens system.

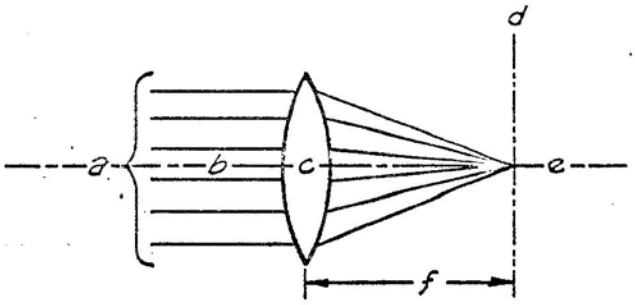
transmission - The process of conduction of radiant energy through a medium.

transmittance - The ratio of flux transmitted by an object to incident flux.

ultraviolet - That portion of the radiation spectrum frequently specified as having a wavelength in the range from 400 nanometers (400 millimicrons) to 100 nanometers.

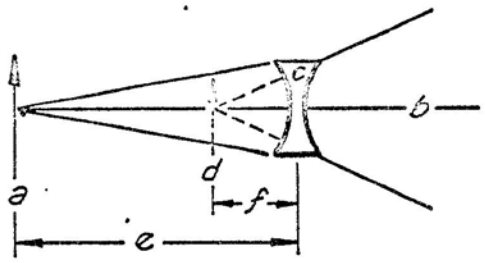
vignetting - Loss of the periphery of the image due to restriction of light by the optical system.

virtual image - An image which cannot be formed on a reflecting or diffuse transmitting surface. This image appears as if formed by rays of light diverging from it.
(See Figure 3, Page 24.)



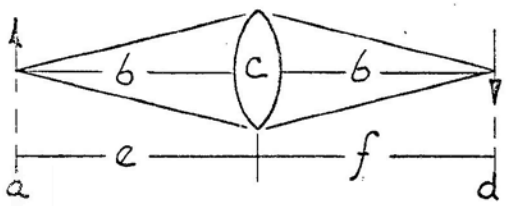
a. Parallel light (collimated) from a point source at infinity
b. Optical axis
c. Single thin lens or equivalent thin lens
d. Focal plane, normal to optical axis
e. Focal point
f. Focal length

Figure 1.



a. Object
b. Optical axis
c. Concave lens
d. Virtual image
e. Object distance
f. Image distance

Figure 3.



a. Object
b. Optical axis
c. Convex lens
d. Real image
e. Object distance
f. Image distance

Figure 2.

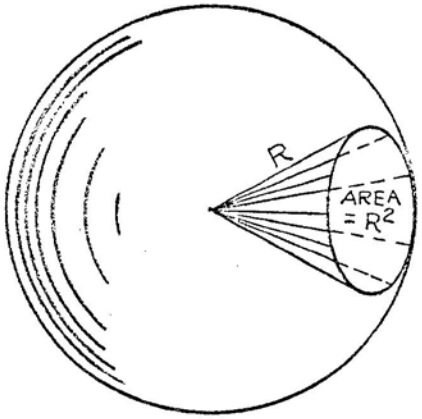


Figure 4.

9. SPECTRUM ANALYZER TERMS.

center frequency (radio frequency or intermediate frequency) - That frequency which corresponds to the center of the reference coordinate.

center frequency range (radio frequency) - That range of frequencies that can be displayed at the center of the reference coordinate. When referred to a control (e.g., Intermediate Frequency Center Frequency Range) the term indicates the amount of frequency change available with the control.

dispersion (sweep width) - The frequency sweep excursion over the frequency axis of the display. Can be expressed as frequency/full frequency axis or frequency (Hz)/div in a linear display.

display flatness - Uniformity of amplitude response over the rated maximum dispersion (usually in units of dB).

drift (frequency drift)(stability) - Long term frequency changes or instabilities caused by a frequency change in the spectrum analyzer local oscillators. Drift limits the time interval that a spectrum analyzer can be used without retuning or resetting the front panel controls (units may be Hz/sec, Hz/°C, etc).

dynamic range (on screen) - The maximum ratio of signal amplitudes that can be simultaneously observed within the graticule (usually in units of dB).

dynamic range, maximum useful - The ratio between the maximum input power and the spectrum analyzer sensitivity (usually in units of dB).

frequency band - A range of frequencies that can be covered without switching.

frequency scale - The range of frequencies that can be read on one line of the frequency indicating dial.

frequency synthesizer - A device that translates the output of a precision frequency standard to another frequency or frequencies.

incidental frequency modulation (residual frequency modulation) - Short term frequency jitter or undesired frequency deviation caused by instabilities in the spectrum analyzer local oscillators. Incidental frequency modulation limits the usable resolution and dispersion (in units of Hz).

incremental linearity - A term used to describe local aberrations seen as non-linearities for narrow dispersions.

linear display - A display in which the vertical deflection is a linear function of the input signal voltage.

linearity (dispersion linearity) - Measure of the comparison of frequency across the dispersion to a straight line frequency change. Measured by displaying a quantity of equally spaced (in frequency) frequency markers across the dispersion and observing the positional deviation of the markers from an idealized sweep as measured against a linear graticule. Linearity is within $\frac{\Delta W}{W} \times 100\%$ where ΔW is maximum positional deviation and W is the full graticule width.

maximum input power - The upper level of input power that the spectrum analyzer can accommodate without degradation in performance (spurious responses and signal compression). (Usually in units of dBm for example).

minimum usable dispersion - The narrowest dispersion obtainable for meaningful analysis. Defined as ten times the incidental frequency modulation when limited by "incidental frequency modulation." (in units of Hz).

optimum resolution - The best resolution obtainable for a given dispersion and a given sweep time and theoretically (in units of Hz):

$$\text{optimum resolution} = \sqrt{\frac{\text{dispersion (in Hz)}}{\text{sweep time (in seconds)}}}$$

optimum resolution (bandwidth) - The bandwidth at which best resolution is obtained for a given dispersion and a given sweep time as per: (in units of Hz)

$$\text{optimum resolution (bandwidth)} = 0.66\sqrt{\frac{\text{dispersion}}{\text{sweep time}}}$$

phase lock - The synchronization of the local oscillator with a stable reference frequency.

picket fence - A term used to describe a display of frequency markers on a frequency base.

resolution - The ability of the spectrum analyzer to display adjacent signal frequencies discretely. The measure of resolution is the frequency separation of two equal amplitude signals, the displays of which merge at the 3dB down points (in units of Hz).

The resolution of a given display depends on three factors; sweep time, dispersion and the bandwidth of the most selective amplifier. The 6dB bandwidth of the most selective amplifier (when Gaussian) is called resolution bandwidth and is the narrowest bandwidth that can be displayed as dispersion and sweep time are varied. At very long sweep times, resolution and resolution bandwidth are synonymous.

resolution (bandwidth) - Refer to resolution.

safe power level - The upper level of input power that the spectrum analyzer can accommodate without physical damage (usually in units of dBm).

scanning velocity - Product of dispersion and sweep repetition rate (units of Hz/unit time).

sensitivity - Rating factor of spectrum analyzers ability to display signals.

1. Signal equals noise. That input signal level (usually in dBm) which results in a display where the signal level above the residual noise is equal to the residual noise level above the baseline; expressed as: signal + noise = twice noise.

sensitivity (cont'd)

2. Minimum discernible signal. That input signal level (usually in dBm) which results in a display where the signal is just distinguishable from the noise.

skirt selectivity - A measure of the resolution capability of the spectrum analyzer when displaying signals of unequal amplitude. A unit of measure would be the bandwidth at some level below the 6dB down points, (e.g. 10, 20, 40dB down). (units of dB).

spectrum analyzer - A device which displays a graph of relative power distribution as a function of frequency, typical on a cathode ray tube or chart recorder.

A. Real Time Spectrum Analyzer - A spectrum analyzer that performs a continuous analysis of the incoming signal with the time sequence of events preserved between input and output.

B. Non-Real Time - A spectrum analyzer that performs an analysis of a repetitive event by a sampling process.

1. Swept front end spectrum analyzer - a superheterodyne spectrum analyzer in which the first local oscillator is swept.
2. Swept intermediate frequency spectrum analyzer - a superheterodyne spectrum analyzer in which a local oscillator other than the first is swept.

spurious responses (spurii, spur) - A characteristic of a spectrum analyzer wherein displays appear which do not conform to the calibration of the radio frequency dial. Spurii and spur are the colloquialisms used to mean spurious responses (plural) and spurious response (singular) respectively. Spurious responses are of the following type:

A. Intermediate frequency feedthrough. Wherein signals within the intermediate frequency passband of the spectrum analyzer reach the intermediate frequency amplifier and produce displays on the cathode ray tube that are not tunable with the RF center frequency controls. These signals do not enter into a conversion process in the first mixer and are not affected by the first local oscillator frequency.

B. Image response. The superheterodyne process results in two major responses separated from each other by twice the intermediate frequency. The spectrum analyzer is usually calibrated for only one of these responses. The other is called the image.

C. Harmonic conversion. The spectrum analyzer will respond to signals that mix with harmonics of the local oscillator and produce the intermediate frequency. Most spectrum analyzer's have dials calibrated for some of these higher order conversions. The uncalibrated conversions are spurious responses.

D. Intermodulation. In the case of more than one input signal, the myriad of combinations of the sums and differences of these signals between themselves and their multiples creates extraneous responses known as intermodulation. The most harmful intermodulation is third order, caused by the second harmonic of one signal combining with the fundamental of another.

E. Video detection. The first mixer will act as a video detector if sufficient input signal is applied. A narrow pulse may have sufficient energy at the intermediate frequency to show up as intermediate frequency feedthrough.

F. Internal. A display shown on the cathode ray tube caused by a source or sources within the spectrum analyzer itself and with no external input signal. Zero frequency feedthrough is an example of such a spurious response.

G. Anomalous IF responses. The filter characteristic of the resolution-determining amplifier may exhibit extraneous passbands. This results in extraneous spectrum analyzer responses when a signal is being analyzed.

sweep repetition rate - The number of sweep excursions per unit of time. Sometimes approximated as the inverse of sweep time for a free-running sweep.

sweep time - The time required for the spot in the reference coordinate (frequency in spectrum analyzers) to move across the graticule. (In a linear spectrum analyzer system sweep time is TIME/DIVISION multiplied by total divisions.)

vertical logarithmic display - A display in which the vertical deflection is a logarithmic function of the input signal voltage.

vertical square law display - A display in which the vertical deflection is a linear function of the input signal power.

vertical video display - A mode of operating a spectrum analyzer to obtain conventional oscilloscope display of amplitude vs. time.

zero frequency feedthrough (zero pip) - The response of a spectrum analyzer which appears when the frequency of the first local oscillator is equal to the intermediate frequency. This corresponds to zero input frequency and is sometimes not suppressed so as to act as a zero frequency marker.