A guide to connector industry definitions, acronyms, and technologies

CONNECTOR DEFINITIONS, ACRONYMS AND TECHNOLOGIES

A

Ambient temperature: The average temperature of the environment immediately surrounding a device or circuit.

Ampere: (I) A unit of electric current in the meter-kilogram-second system. It is the steady current that, when flowing in straight parallel wires of infinite length and negligible cross section, separated by a distance of one meter in free space, produces a force between the wires of 2×10^{-7} Newtons/meter of length. Also, the flow of one coulomb per second past a given point in a circuit. I = E/R

Anti-pad: Opening on a PCB reference plane, typically circular, around a via that is unconnected to that plane.

ATCA: Advanced Telecom Computing Architecture

Attenuation: Reduction in signal strength resulting from the combined effects of DC resistance, reflections, skin effect, and reactance in the system. Also, a loss of optical power, typically expressed in decibels (Db) at a specific wavelength. Also known as throughput loss.

B

Bandwidth: Maximum frequency which an electrical circuit or optical fiber is capable of delivering, with no more than 3Db (30%) attenuation. The specific permissible loss percentage is system-dependent.

BGA: Ball grid array. Interconnect system using reflowable solder balls to effect a permanent electrical connection.

Bit Error Rate (BER): The ratio between the number of erroneous bits received to the total number of bits transmitted.

Blindmate connector: Connector that incorporates guiding features that allow mating halves to self-align within design tolerances. A blindmate connector is typically used to interconnect between rail-guided modules and/or printed circuit boards.

BOM: Bill of material. Detailed list of components selected for use within a system.

Breakdown voltage: The voltage level that causes insulation failure.

Broadband: Denotes transmission facilities capable of handling a wide range of frequencies simultaneously, thus permitting multiple channels in data systems, rather than direct modulation.

Broadside coupled: A differential trace pair on adjacent signal layers in a dual stripline configuration.

Bulk resistance: Resistance in a connector attributed to the base material of a connector.

C

Capacitance: The property of an electric circuit or device to store an electrical charge.

Characteristic impedance: (Zo) Combined effect of inductance, capacitance, and resistance in a conductive path. It is a function of the geometry and materials in the circuit, and is independent of length.

Cladding: The material surrounding the core of an optical waveguide. The cladding must have a lower index of refraction to keep the light in the core.

Clearance distance: The shortest path in air separating two conductors.

Conductivity: A measure of the ability of a material to carry a current, the reciprocal of resistivity.

Constriction resistance: Resistance in a connector attributed to the compression of conductive paths to and from microscopic asperities at the interface.

Contact resistance: Resistance in a connector attributed to the conductivity at the interface only. Its value is calculated with the measured voltage drop at the rated current.

Core: The central region of an optical fiber through which light is transmitted.

COTS: Commercial off-the-shelf products, as opposed to custom products.

Coupling loss: Power loss suffered when coupling light from one optical device to another.

Creepage distance: The shortest distance separating two conductors as measured along an insulating surface touching both conductors.

Crosstalk: The amount of signal induced on one quiet line from adjacent driven lines. It represents both a loss from the driven line, and contamination of the quiet line. Digital systems exhibit both near-end and far-end crosstalk, and are used as performance criteria.

Current: The rate of transfer of electrical charge measured in amperes. The symbol “I” is used to represent current.

Current rating: The maximum amount of current a connector is designed to continuously conduct in defined conditions.

D

DC: Direct current; flow of electrons in one direction.

D-to-D converter: Typically, a PCB-mounted device that converts one DC voltage to another.

Decibel (dB): A unit of measurement of relative electrical or optical power. -10dB represents a 10X reduction, -20dB represents a 100X reduction, etc.

De-emphasis: Process of restoring after detection the amplitude vs. frequency characteristics of a signal.

Derating: Practice of applying components or devices at a lower stress level than specified capabilities in order to reduce the occurrence of failures.

Dielectric: An insulating material between conducting materials.

Dielectric constant: Property of a material that determines the propagation delay of a signal.

Dispersion: The cause of bandwidth limitations in a fiber. Dispersion causes a broadening of input pulses along the length of the fiber. Three major types are: (1) modal dispersion caused by differential optical path lengths in a multimode fiber; (2) chromatic dispersion caused by a differential delay of various wavelengths of light in a waveguide material; and (3) waveguide dispersion caused by light traveling in both the core and cladding materials in single-mode fibers.

Distributed Power Architecture (DPA): A power distribution system that delivers one intermediate bus DC voltage level to the PCB, where D-to-D converters reduce the voltage to the specific levels required by devices on the board.

Differential signaling: Digital signals transmitted as the difference in voltage of a pair of signal lines. Offers significant noise immunity.

Dry circuit resistance: Measurement of resistance using very low voltages. Open circuit voltages of 20 or 50 millivolts are typically specified.

E

Edge coupled: A differential pair trace on the same signal layer.

EMC: Electro magnetic compatibility

EMI: Electromagnetic interference. Internally or externally generated energy that can corrupt a signal.

EMS: Electronic manufacturing services

EYE patterns: An overlay of all the individual bits in a data stream that creates the “eye” opening. The eye pattern gives a visual representation of signal fidelity in terms of amplitude (eye opening vertically) and jitter (eye opening horizontally).

F

Ferrule: A mechanical fixture, generally a rigid tube, used to protect and align a fiber in a connector; generally associated with fiber optic connectors.

FPGA: Field programmable gate array

G

GBIC: Gigabit interface converter. Modular I/O interface that permits the use of copper of fiber optic interconnect.

Gigahertz (GHz): A unit of frequency that is equal to one billion cycles per second, 10^9 Hertz.

H

Heat sink: Structure through which thermal energy is transferred to an external cooling medium.

Hot Swap (Hot mating, Hot pluggable): Ability to mate or disconnect a connector in an energized circuit without degradation of the connector.

I

Inductance: The inherent reactive property (measured in henrys, “L”) of a circuit that opposes a change in current flow. Inductance causes current changes to lag behind voltage changes.

Insertion loss: A reduction in signal amplitude resulting from the insertion of a device in a transmission line expressed in dB; also commonly referred to as attenuation.

Intersymbol Interference (ISI): Distortion of the received digital signal resulting from the spreading and consequent overlap of individual pulses to the degree that the receiver cannot reliably distinguish between changes of state.

I/O: Input/Output

Internet Protocol (IP): A protocol used for communicating data across a packet switched network.

J

Jitter: Deviation of a signal-timing event from its ideal position.

- **Deterministic Jitter:** Caused by the characteristics of the data stream; a predictable occurrence.
- **Random Jitter:** Caused by inherent characteristics of the circuit and cannot be predicted.

Joule: A standard international unit of energy; one watt-second, 1055 Joules is equal to 1 BTU.

K

L

LAN: Local area network, typically with limited geography.

LGA: Land grid array. Interconnect system using a spring-loaded contact on a flat pad.

Loss tangent: Measure of how much of the electromagnetic field traveling through a dielectric is absorbed by the material, also known as dissipation factor.

M

Megahertz (MHz): A unit of frequency that is equal to one million cycles per second.

MEMS: Microelectromechanical system. Individual assemblies created by adding or removing material at the atomic level.

Microstrip: Printed circuit board surface traces referenced above a single ground or power plane. Microstrip structures have faster propagation delays than internal stripline, but are subject to more loss.

Minimum loss window: In an optical fiber, the transmission frequency window at which the attenuation coefficient is near a minimum.

Mode: A single electromagnetic field or ray of light that travels in an optical fiber.

Modal loss: Loss in an optical fiber due to anomalies that cause changes in the propagation mode of the wave.

Modal dispersion: Spreading of a pulse caused by modal effects.

MSA: Multisource agreement

Multimode fiber: Optical fiber whose core diameter is large, relative to the wavelengths propagated.

N

N+1 redundancy: The design practice of having one extra element in a system to act as an on-line replacement for an element that fails.

Nanometer (nm): One billionth of a meter.

Normal Force: Mechanical force applied at the point of contact. Typically measured in grams or Newtons.

Numerical Aperture (NA): The number that expresses the light-gathering ability of an optical fiber; related to the acceptance angle or the difference in index of refraction between the core and the cladding.

O

ODM: Original Design Manufacturer

OEM: Original Equipment Manufacturer

Ohm: Unit measure of resistance (W). The passage of one ampere through one ohm produces one volt.

Ohm's Law: Fundamental mathematical relationship between current (I), voltage (E), and resistance(R). I = E/R

Operating temperature: The range of ambient temperatures through which a connector is specified to operate safely and to perform within specified limits.

P

PAN: Personal area network

Parallel signaling: Each bit of a byte transmitted simultaneously on separate wires.

PCB: Printed circuit board

POF: Plastic optical fiber, typically 1+mm multimode fiber used in short reach applications.

Power (P): The rate of generating, transferring, or using energy, measured in watts. E (voltage) X I (current) = P (power)

Propagation delay (Tpd): Time required for a signal to travel through a portion of a transmission line system.

Plated Through Hole (PTH): Drilled hole in a printed circuit board that is made conductive by deposition of metal that provides electrical connection to the copper layers within the board.

PCI Industrial Computer Manufacturers Group (PICMG): Industry consortium that creates and promotes hardware and protocol standards within the computer industry.

PMC: PCI mezzanine card

Q

R

Reflections: Energy reflected back to its source as it encounters impedance discontinuities in the signal path.

Resistance (R): Property of an electric conductor by which it opposes a flow of electricity and dissipates electrical energy away from the circuit, usually as heat.

RMS value: Root mean Square, the heating effect of an AC voltage comparable to a DC voltage.

Return loss: A summation of all reflected signal energy coming back to the end where it originated, and is a result of the dissimilarity between impedances in metallic transmission lines and loads. Expressed in dB as a reduction in amplitude of the reflected to forward energy, and varies with frequency. In optic systems, the amount of optic power reflected at the connector interface, expressed in dB. Values range from minus 15 to minus 60 dB. Higher numbers reflect better performance. Also known as back reflection loss.

Risetime (tr): Time required for a digital signal to reach 90 percent of its maximum amplitude. Some differential applications use an 80 percent value.

RoHS: Restriction on the use Of Hazardous Substances driven by the European Parliament. Seeks to eliminate a number of materials used in electronic equipment, including lead.

RTM: Rear transition module. Small daughter plugged into the back of a midplane that is used to adapt signals for the I/O interface.

S

S-parameter: Scattering parameter. Matrix of amplitude and phase data that can quantify signal fidelity. The S12 parameter that plots attenuation vs. frequency is one of the most common used to document connector performance, and is also known as insertion loss.

SERDES: Serializer/Deserializer. Device that creates a high-speed serial bit stream by combining data from multiple parallel lines.

Serial signaling: Sequential transmission of all bits of a byte over one wire if single ended, or a pair of wires if differential.

SFP: Small form factor pluggable. Smaller, higher speed GBIC.

SIG: Special interest group

Signal integrity (SI): Process of analyzing and making appropriate system design decisions that result in optimal high-speed system performance.

Single ended signaling: Signals transmitted over one wire using a common ground return.

Single mode fiber: Optical fiber whose core diameter is so small, relative to the wavelength of light, that only one mode is propagated.

Skew: Difference in propagation delay between two conductors through a high-speed circuit, causing loss of fidelity.

- **Differential skew:** Difference in propagation time between signals in a differential pair.
- **Channel skew:** Difference in propagation time between two differential pairs.

Skin effect: Loss of signal due to the tendency for high-speed signals to propagate on the surface of conductors. Resistance increases as the conductor size is reduced (e.g. reduced PCB trace widths).

Smith Chart: Used to convert between impedance and S-parameters.

Spectral loss curve: A plot of attenuation as a function of wavelength.

SPICE: Simulated Program with Integrated Circuit Emphasis. An analog circuit analysis program that is used to predict the high-speed performance of digital circuits. SPICE is a time domain tool.

Stripline: A signal trace structure between two reference planes, either power or ground. Striplines are used for internal signal layers in PCBs.

Supertemperature: Temperature at the individual asperity contact points on an electrical interface.

Surge/inrush current: Instantaneous spike in current that occurs in a circuit as it is switched on, and persists until the capacitive characteristics of the circuit have been charged.

T

TDR: Time domain reflectometer. Instrument used to identify impedance discontinuities in a transmission line system and measure their reflection coefficients.

Telematics: The integration of wireless communications, vehicle monitoring systems, and location devices in transportation-related applications.

Thermal runaway: A condition in a separable interface where an increase in temperature increases power loss, causing a further increase in temperature; a spiraling effect which may lead to connector and system failure. Heat generated is greater than heat dissipated.

Transmission line: Signal path where the rise time of the signal is less than the round-trip time of flight of the signal.

U

V

Vertical-cavity surface-emitting laser (VCSEL): Semiconductor laser diode that produces a laser beam emission perpendicular to the top surface of the device.

Via: In PCB design, via refers to a pad with a plated hole that connects copper tracks from one layer of the board to other layers. In IC design, a via is a small opening in an insulating oxide layer that allows metallic

interconnect on different interconnect layers to form a connection.

VME: Versa Module Eurocard system bus structure

VoIP: Voice-over-Internet Protocol

Volt (V): A unit of electromotive force in the International System of Units that will produce a current of 1 ampere in a circuit that has resistance of 1 ohm.

W

Watt (W): a standard unit of power defined as one Joule of energy transferred or dissipated in one second. One watt is the amount of power that is delivered to a component of an electric circuit when a current of 1 ampere flows through the component and a voltage of 1 volt exists across it. W = E (volts) X I (amps)

Wavelength: The distance between two successive points of an electromagnetic waveform, usually measured in nanometers (nm).

Wavelength-Division Multiplexing: Transmission method where several signals are transmitted simultaneously at different wavelengths (colors) over a single fiber.

WiMax: Worldwide Interoperability for Microwave Access

X

Y

Z