Online Glossary

This glossary is divided into chapter-by-chapter and alphabetical sections for ease of use. The alphabetical glossary begins on page 24.

Chapter-by-Chapter Glossary

Chapter 1 — What Is Amateur (Ham) Radio

AM (amplitude modulation) — The oldest voice operating mode still found on the amateur bands. The most common HF voice mode, SSB, is actually a narrower bandwidth variation of AM.

Amateur radio — A radiocommunication service for the purpose of self-training, intercommunication and technical investigation carried out by licensed individuals interested in radio technique solely with a personal aim and without pecuniary interest. (*Pecuniary* means payment of any type, whether money or goods.) Also called "ham radio."

Amateur radio operator — A person holding an FCC license to operate a radio station in the Amateur Radio Service.

Amateur radio station — A station licensed by the FCC in the Amateur Radio Service, including necessary equipment.

Amateur (Radio) Service — A radiocommunication service for the purpose of self-training, intercommunication and technical investigations carried out by licensed individuals interested in radio technique solely with a personal aim and without pecuniary interest.

AMSAT (Radio Amateur Satellite Corporation) — An international membership organization that designs, builds and promotes the use of amateur radio satellites, sometimes called "OSCARs."

APRS — Automatic Packet/Position Reporting System, a marriage of an application of the Global Positioning System and amateur radio to relay position and tracking information.

ARES (Amateur Radio Emergency Service) — An ARRL program for radio amateurs who participate in emergency communication.

ARISS — An acronym for Amateur Radio on the International Space Station. NASA, ARRL, AMSAT, and others cooperate in managing the ARISS program on a national and international level.

ARRL — The national association for amateur radio in the US; the US member-society in the ***IARU*** (International Amateur Radio Union).

ATV (amateur television) — An amateur radio operating mode for sharing realtime video. ATV may be analog or digital (DATV).

Band — A range of frequencies in the radio spectrum, usually designated by approximate wavelength in meters. For example, 7.0 to 7.3 MHz (megahertz) is the 40-meter amateur band. Hams are authorized to transmit on many different bands.

Bandwidth — In general, the width of a transmitted signal in terms of occupied spectrum. FCC definition: "The width of a frequency band outside of which the mean power of the transmitted signal is attenuated at least 26 dB below the mean power of the transmitted signal within the band."

Beacon — An amateur station transmitting communication for the purposes of observation of propagation and reception or other related experimental activities.

Beam antenna — A ham radio antenna having directional characteristics to enhance the transmitted signal in one direction at the expense of others. A "rotary beam" can be pointed in any direction.

Broadcasting — Transmissions intended for reception by the general public, either direct or relayed. Amateur radio licensees are not permitted to engage in broadcasting.

Call sign — A series of unique letters and numerals that the FCC assigns to an individual who has earned an amateur radio license.

Contact — A two-way communication between amateur radio operators.

Contest — A competitive amateur radio operating activity in which hams use their stations to contact the most stations within a designated time-period.

Courage Kenny Handiham Program — Membership organization for ham radio enthusiasts with various physical disabilities and abilities. Visit **handiham.org**.

CW — A synonym for radiotelegraphy (i.e., Morse code by radio). CW is an abbreviation for "continuous wave," a term used in the early years of wireless.

Digital communication — Computer-based communication modes such as RTTY, PSK31, packet and other radio transmissions that employ an accepted digital code to convey speech or data.

Dipole antenna — Typically, a wire antenna with a feed line connected to its center and having two legs. Dipoles most often are used on the high-frequency (HF) amateur bands.

DSP (digital signal processing) — Technology that allows software to replace electronic circuitry.

DX — A ham radio abbreviation that refers to distant stations, typically those in other countries.

DXCC — DX Century Club, a popular ARRL award earned for contacting amateur radio operators in 100 different countries or "entities."

DXpedition — A trip, often by a team of operators, to a location — perhaps an uninhabited island or other geographical or political entity — which has few, if any, amateur radio operators, thus making a contact with the DXpedition rare.

Elmer — A traditional term for a person who enjoys helping newcomers get started in ham radio; a mentor.

Emergency communication — Amateur radio communication during a disaster or emergency that support or supplants traditional means of telecommunication.

FCC (Federal Communications Commission) — The government agency that regulates non-government telecommunications, including amateur radio, in the US.

Field Day — A popular, annual amateur radio activity sponsored by ARRL, during which hams set up radio stations, often outdoors, using emergency power sources to simulate an emergency situation.

Field Organization — A cadre of ARRL volunteers who perform various services for the amateur radio community at the state and local level.

FM (frequency modulation) — A method of transmitting voice commonly used on ham radio repeaters.

Fox hunt — A competitive radio direction-finding activity in which participants track down the one or more hidden transmitters.

Fast-scan television — A mode of operation that amateur radio operators can use to exchange live TV images from their stations. Also called *ATV (Amateur Television)*.

Ham band — A range of frequencies in the radio spectrum on which ham radio communication is authorized.

Ham radio — Another name for amateur radio.

Ham radio operator — A radio operator holding a license granted by the FCC to operate on amateur radio frequencies.

HF (high frequency) — The radio frequencies from 3 to 30 MHz.

HSMM (high-speed multimedia) — A digital radio communication technique using spread spectrum modes primarily on UHF to simultaneously send and receive video, voice, text, and data.

IARU (International Amateur Radio Union) — The international organization made up of national amateur radio organizations or societies such as the ARRL.

Image — Facsimile and television signals.

International Morse code — A digital code in which alphanumeric characters are represented by a defined set of short and long transmission elements — called "dots and dashes" or "dits and dahs" — that many amateur radio operators use to communicate.

ITU (International Telecommunication Union) — An agency of the United Nations that allocates the radio spectrum among the various radio services at the international level.

MARS — Military Auxiliary Radio System, a volunteer adjunct communication program that supports the mission of the US Department of Defense. Most MARS operators are amateur radio operators.

Mode — A type of ham radio communication, such as frequency modulation (FM voice), slow-scan television (SSTV), SSB (single sideband voice), CW (Morse code), or digital (e.g., PSK-31, FT8, or JT65).

Morse code — A communication mode characterized by on/off keying of a radio signal to convey intelligence. Hams use the International Morse Code.

Net — An on-the-air meeting of hams at a set time, day and radio frequency, usually for a specific purpose.

Packet radio — A computer-to-computer radio communication mode in which information is encapsulated in short groups of data called packets. These packets contain addressing and error-detection information.

Phone — Emissions carrying speech or other sound information, such as FM, SSB, or AM.

Public service — Activities involving amateur radio that hams perform to benefit their communities.

QRP — An abbreviation for low transmitter power.

QSL bureau — A system for sending and receiving amateur radio verification or "QSL" cards.

QSL cards — Cards that provide written confirmation of a communication between two hams.

QSO — A contact between amateurs.

QST — The monthly journal of the ARRL. *QST* means "calling all radio amateurs."

RACES (Radio Amateur Civil Emergency Service) — A radio service that uses amateur stations for civil defense communication during periods of local, regional or national civil emergencies.

RF (radio frequency) — See ***Radio frequency (RF) signals***.

Radio (or ham) shack — Slang term that refers to an amateur station, regardless of where it is actually located.

Radiotelegraphy — See **Morse code**.

Receiver — A device that converts radio signals into a form that can be heard or viewed.

Repeater — A typically unattended amateur station, typically located on a mountaintop, hilltop, or tall building, that automatically and simultaneously receives and retransmits the signals of other stations on a different channel or channels for greater range. Repeaters allow radio amateurs using low-power handheld transceivers to transmit over greater distances.

RTTY (radioteletype) — Narrow-band direct-printing radioteletype that uses a digital code.

Space station — An amateur station located more than 50 kilometers above Earth's surface.

SSB (single sideband) — A common amateur radio voice mode of transmission.

SSTV (slow-scan television) — An operating mode used to exchange still pictures.

SWL (shortwave listener) — A person who enjoys listening to shortwave radio broadcasts or amateur radio conversations. (A *BCL* is someone who listens for distant AM stations on the Standard Broadcast Band. Some SWLs also are BCLs.)

TIS (Technical Information Service) — A service of the ARRL that helps hams solve technical problems (**www.arrl.org/tis**).

Transceiver — A radio transmitter and receiver integrated into a single package. Most hams use transceivers.

Transmitter — A device that produces radio-frequency (RF) signals.

UHF (ultra-high frequency) — The radio frequencies from 300 to 3000 MHz.

VE (Volunteer Examiner) — An amateur radio operator who is qualified to administer amateur radio licensing examinations.

VHF (very-high frequency) — The radio frequencies from 30 to 300 MHz.

WAS (Worked All States) — An ARRL award that is earned when an amateur radio operator confirms two-way radio contact with other stations in all 50 US states.

Wavelength — A means of designating a frequency band, such as the 80-meter band.

Work — To contact another ham.

Chapter 2 — Electrical Fundamentals

BASIC ELECTRICITY GLOSSARY

Alternating current (ac) — A flow of charged particles through a conductor, first in one direction, then in the other direction.

Ampere — A measure of flow of charged particles per unit of time. One ampere (A) represents one coulomb of charge flowing past a point in one second.

Atom — The smallest particle of matter that makes up a distinct chemical element. Atoms consist of protons and neutrons in the central region called the nucleus, with electrons surrounding the nucleus.

Circuit — Conducting path between two points of different voltage. In a *series circuit*, there is only one current path. In a *parallel circuit*, there are multiple current paths.

Conductor — Material in which electrons or ions can move easily.

Conventional current — Current defined as the flow of positive charges in the direction of positive to negative voltage. Conventional current flows in the opposite direction of electronic current, the flow of negative charges (electrons) from negative to positive voltage.

Coulomb — A unit of measure of a quantity of electrically charged particles. One coulomb (C) is equal to 6.25×10^{18} electrons.

Current (I) — The movement of electrical charge, measured in amperes and represented by *i* or *I* in equations.

Direct current (dc) — A flow of charged particles through a conductor in one direction only.

Electronic current — See ***Conventional Current***.

Electromotive force (EMF) — The source of energy that creates a force between charged particles or regions. define the force of attraction or repulsion between electrically charged regions. (See also ***Voltage***.)

Energy — Capability of doing work. It is usually measured in electrical terms as the number of watts of power consumed during a specific period of time, such as watt-seconds or kilowatt-hours.

Insulator — Material through which it is difficult for electrons or ions to move.

Ion — Atom or molecule with a positive or negative electrical charge.

Joule — Measure of a quantity of energy. One joule is defined as one newton (a measure of force) acting over a distance of one meter.

Polarity — The direction of EMF or voltage, from positive to negative.

Potential — See ***Voltage***.

Power — Power is the rate at which work is done. One watt of power is equal to one volt of EMF causing a current of one ampere through a resistor.

Voltage — The general term for the difference in electrical potential energy between two points. Measured in volts or joules/coulomb.

Voltage source — Device or system that creates a voltage difference at its terminals.

CONDUCTANCE AND RESISTANCE GLOSSARY

Conductance (G) — The reciprocal of resistance, measured in siemens (S).

Ohm — Unit of resistance. One ohm is defined as the resistance that will allow one ampere of current when one volt of EMF is impressed across the resistance.

Ohm's Law — The expression that describes resistance (R) as the proportional relationship between voltage (E) and current (I); R = E / I. Named for Georg Ohm who first described the relationship.

Resistance (R) — Opposition to current by conversion into other forms of energy, such as heat, measured in ohms (Ω).

Chapter 3 — Radio Fundamentals

GLOSSARY OF AC THEORY AND REACTANCE

Frequency (f) — The rate of change of an ac voltage or current, measured in cycles per second, or hertz (Hz).

Fundamental — The lowest frequency in a series of sine waves whose frequencies have an integer relationship.

Harmonic — A sine wave whose frequency is an integer multiple of a fundamental frequency.

Instantaneous value — the value of a waveform at a specific instant in time.

Peak (voltage or current) — The maximum value relative to zero that an ac voltage or current attains during any cycle.

Peak-to-peak (voltage or current) — The value of the total swing of an ac voltage or current from its peak negative value to its peak positive value, ordinarily twice the value of the peak voltage or current.

Period (T) — The duration of one ac voltage or current cycle, measured in seconds (s).

Power (P) — The rate of electrical-energy use, measured in watts (W).

Reactance (X) — Opposition to alternating current by storage in an electrical field (by a capacitor) or in a magnetic field (by an inductor), measured in ohms (Ω).

RMS (voltage or current) — Literally, "root mean square," the square root of the average of the squares of the instantaneous values for one cycle of a waveform. A dc voltage or current that will produce the same heating effect as the waveform. For a sine wave, the RMS value is equal to 0.707 times the peak value of ac voltage or current.

Time constant (ℑ) — The time required for the voltage in an RC circuit or the current in an RL circuit to rise from zero to approximately 63.2% of its maximum value or to fall from its maximum value 63.2% toward zero.

Chapter 4 — Circuits and Components

ANALOG DEVICES AND CIRCUITS GLOSSARY

AC ground — A circuit connection point that presents a very low impedance to ac signals.

Active — A device that requires power to operate.

Active region — The region in the characteristic curve of an analog device in which it is capable of processing the signal linearly.

Amplification — The process by which amplitude of a signal is increased. Gain is the amount by which the signal is amplified.

Analog signal — A signal that can have any amplitude (voltage or current) value and exists at any point in time.

Anode — The element of an analog device that accepts electrons or toward which electrons flow.

Attenuation — The process of reducing the amplitude of a signal.

Avalanche breakdown — Current flow through a semiconductor device in response to an applied voltage beyond the device's ability to control or block current flow.

Base — The terminal of a bipolar transistor in which control current flows.

Beta (β) — The dc current gain of a bipolar transistor, also designated h_{FE}.

Biasing — The addition of a dc voltage or current to a signal at the input of an analog device, changing or controlling the position of the device's operating point on the characteristic curve.

Bipolar transistor — An analog device made by sandwiching a layer of doped semiconductor between two layers of the opposite type: PNP or NPN.

Black box — Circuit or equipment that is analyzed only with regards to its external behavior.

Bode plot — Graphs showing amplitude response in dB and phase response in degrees versus frequency on a logarithmic scale.

Buffer — An analog stage that prevents loading of one analog stage by another.

Carrier — (1) Free electrons and holes in semiconductor material. (2) An unmodulated component of a modulated signal.

Cascade — Placing one analog stage after another to combine their effects on the signal.

Cathode — The element of an analog device that emits electrons or from which electrons are emitted or repelled.

Characteristic curve — A plot of the relative responses of two or three analog device parameters, usually of an output with respect to an input. (Also called *I-V* or *V-I curve.*)

Class (amplifier) — For analog amplifiers (Class A, B, AB, C), a categorization of the fraction of the input signal cycle during which the amplifying device is active. For digital or switching amplifiers (Class D and above), a categorization of the method by which the signal is amplified.

Clipping — A nonlinearity in amplification in which the signal's amplitude can no longer be increased, usually resulting in distortion of the waveform. (Also called *clamping* or *limiting.*)

Closed-loop gain — Amplifier gain with an external feedback circuit connected.

Collector — The terminal of a bipolar transistor from which electrons are removed.

Common — A terminal shared by more than one port of a circuit or network.

Common mode — Signals that appear equally on all terminals of a signal port.

Comparator — A circuit, usually an amplifier, whose output indicates the relative amplitude of two input signals.

Compensation — The process of counteracting the effects of signals that are inadvertently fed back from the output to the input of an analog system. Compensation increases stability and prevents oscillation.

Compression — Reducing the dynamic range of a signal to increase the average power of the signal or prevent excessive signal levels.

Conversion efficiency — The amount of light energy converted to electrical energy by a photoelectric device, expressed in percent.

Coupling (ac or dc) — The type of connection between two circuits. DC coupling allows dc current to flow through the connection. AC coupling blocks dc current while allowing ac current to flow.

Cutoff frequency — Frequency at which a circuit's amplitude response is reduced to one-half its mid-band value (also called *half-power* or *corner* frequency).

Cutoff (region) — The region in the characteristic curve of an analog device in which there is no current through the device. Also called the OFF region.

Degeneration (emitter or source) — Negative feedback from the voltage drop across an emitter or source resistor to stabilize a circuit's bias and operating point.

Depletion mode — An FET with a channel that conducts current with zero gate-to-source voltage and whose conductivity is progressively reduced as reverse bias is applied.

Depletion region — The narrow region at a PN junction in which majority carriers have been removed. (Also called *spacecharge* or *transition* region.)

Diode — A two-element semiconductor with a cathode and an anode that conducts current in only one direction.

Drain — The connection at one end of a field-effect-transistor channel from which electrons are removed.

Dynamic range — The range of signal levels over which a circuit operates properly. Usually refers to the range over which signals are processed linearly.

Emitter — The terminal of a bipolar transistor into which electrons are injected.

Enhancement mode — An FET with a channel that does not conduct with zero gate-to-source voltage and whose conductivity is progressively increased as forward bias is applied.

Feedback — Routing a portion of an output signal back to the input of a circuit. Positive feedback causes the input signal to be reinforced. Negative feedback results in partial cancellation of the input signal.

Field-effect transistor (FET) — An analog device with a semiconductor channel whose width can be modified by an electric field. (Also called ***Unipolar transistor***.)

Forward bias — Voltage applied across a PN junction in the direction to cause current flow.

Forward voltage — The voltage required to cause forward current to flow through a PN junction.

Free electron — An electron in a semiconductor crystal lattice that is not bound to any atom.

Frequency response — A description of a circuit's gain (or other behavior) with frequency.

Gain — see ***Amplification***.

Gain-bandwidth product — The relationship between amplification and frequency that defines the limits of the ability of a device to act as a linear amplifier. In many amplifiers, gain times bandwidth is approximately constant.

Gate — The control electrode of a field-effect transistor.

High-side — A switch or controlling device connecting between a power source and load.

Hole — A positively charged carrier that results when an electron is removed from an atom in a semiconductor crystal structure.

Hysteresis — In a comparator circuit, the practice of using positive feedback to shift the input setpoint in such a way as to minimize output changes when the input signal(s) are near the setpoint.

Integrated circuit (IC) — A semiconductor device in which many components, such as diodes, bipolar transistors, field-effect transistors, resistors and capacitors are fabricated to make an entire circuit.

Isolation — Eliminating or reducing electrical contact between one portion of a circuit and another or between pieces of equipment.

Junction FET (JFET) — A field-effect transistor whose gate electrode forms a PN junction with the channel.

Linearity — Processing and combining of analog signals independently of amplitude.

Load line — A line drawn through a family of characteristic curves that shows the operating points of an analog device for a given load or circuit component values.

Loading — The condition that occurs when the output behavior of a circuit is affected by the connection of another circuit to that output.

Low-side — A switch or controlling device connected between a load and ground.

Metal-oxide semiconductor (MOSFET) — A field-effect transistor whose gate is insulated from the channel by an oxide layer. (Also called *insulated gate FET* or *IGFET*)

Multivibrator — A circuit that oscillates between two states.

NMOS — N-channel MOSFET.

N-type impurity — A doping atom with an excess of valence electrons that is added to semiconductor material to act as a source of free electrons.

Network — General name for any type of circuit.

Noise — Any unwanted signal, usually random in nature.

Open-loop gain — Gain of an amplifier with no feedback connection.

Operating point — Values of a set of circuit parameters that specify a device's operation at a particular time.

Operational amplifier (op amp) — An integrated circuit amplifier with high open-loop gain, high input impedance, and low output impedance.

Optoisolator — A device in which current in a light-emitting diode controls the operation of a phototransistor without a direct electrical connection between them.

Oscillator — A circuit whose output varies continuously and repeatedly, usually at a single frequency.

P-type impurity — A doping atom with a shortage of valence electrons that is added to semiconductor material to create an excess of holes.

Passive — A device that does not require power to operate.

Peak inverse voltage (PIV) — The highest voltage that can be tolerated by a reverse biased PN junction before current is conducted. (See also ***avalanche breakdown***.)

Photoconductivity — Phenomenon in which light affects the conductivity of semiconductor material.

Photoelectricity — Phenomenon in which light causes current to flow in semiconductor material.

PMOS — P-channel MOSFET.

PN junction — The structure that forms when P-type semiconductor material is placed in contact with N-type semiconductor material.

Pole — Frequency at which a circuit's transfer function becomes infinite.

Port — A pair of terminals through which a signal is applied to or output from a circuit.

Quiescent (Q-) point — Circuit or device's operating point with no input signal applied. (Also called *bias point.*)

Pinch-off — The condition in an FET in which the channel conductivity has been reduced to zero.

Rail — Power supply voltage(s) for a circuit.

Range — The total span of analog values that can be processed by an analog-to-digital conversion.

Recombination — The process by which free electrons and holes are combined to produce current flow across a PN junction.

Recovery time — The amount of time required for carriers to be removed from a PN junction device's depletion region, halting current flow.

Rectify — Convert ac to pulsating dc.

Resolution — Smallest change in an analog value that can be represented in a conversion between analog and digital quantities. (Also called *step size*.)

Reverse bias — Voltage applied across a PN junction in the direction that does not cause current flow.

Reverse breakdown — The condition in which reverse bias across a PN junction exceeds the ability of the depletion region to block current flow. (See also ***avalanche breakdown.***)

Roll-off — Change in a circuit's amplitude response per octave or decade of frequency.

Safe operating area (SOA) — The region of a device's characteristic curve in which it can operate without damage.

Saturation (region) — The region in the characteristic curve of an analog device in which the output signal can no longer be increased by the input signal. See also ***Clipping***.

Schottky barrier — A metal-to-semiconductor junction at which a depletion region is formed, similarly to a PN junction.

Semiconductor — (1) An element such as silicon with bulk conductivity between that of an insulator and a metal. (2) An electronic device whose function is created by a structure of chemically modified semiconductor materials.

Signal-to-noise ratio (SNR) — The ratio of the strength of the desired signal to that of the unwanted signal (noise), usually expressed in dB.

Slew rate — The maximum rate at which a device can change the amplitude of its output.

Small-signal — Conditions under which the variations in circuit parameters due to the input signal are small compared to the quiescent operating point and the device is operating in its active region.

Source — The connection at one end of the channel of a field-effect transistor into which electrons are injected.

Stage — One of a series of sequential signal processing circuits or devices.

Substrate — Base layer of material on which the structure of a semiconductor device is constructed.

Superposition — Process in which two or more signals are added together linearly.

Total harmonic distortion (THD) — A measure of how much noise and distortion are introduced by a signal processing function.

Thermal runaway — The condition in which increasing device temperature increases device current in a positive feedback cycle.

Transconductance — Ratio of output current to input voltage, with units of Siemens (S).

Transfer characteristics — A set of parameters that describe how a circuit or network behaves at and between its signal interfaces.

Transfer function — A mathematical expression of how a circuit modifies an input signal.

Unipolar transistor — See ***Field-effect transistor (FET)***.

Virtual ground — Point in a circuit maintained at ground potential by the circuit without it actually being connected to ground.

Zener diode — A heavily-doped PN-junction diode with a controlled reverse breakdown voltage, used as a voltage reference or regulator.

Zero — Frequency at which a circuit's transfer function becomes zero.

Chapter 5 — RF Techniques

Arc — Current flow through an insulator due to breakdown from excessive voltage.

Balun — A device that transfers power between *bal*anced and *un*balanced systems, sometimes transforming the impedance level as well. (See also ***Unun***.)

Bead — Hollow cylinder of magnetic material through which a wire is threaded to form an inductor.

Bilateral — A network that operates or responds in the same manner regardless of the direction of current flow in the network.

Choke balun — See ***Current balun***.

Core — Magnetic material around which wire is wound or through which it is threaded to form an inductor.

Current balun — A balun that transfers power from an unbalanced to a balanced system by forcing current flow in the balanced system to be balanced as well (also called a **choke balun**).

Dielectric strength — The rated ability of an insulator to withstand voltage.

Distributed element — Electronic component whose effects are spread out over a significant distance, area, or volume.

Dynamic resistance — The change in current in response to a small change in voltage.

Equivalent Series Inductance (ESL) — A capacitor's parasitic inductance.

Ferrite — A ferromagnetic ceramic.

Gain-bandwidth product — The frequency at which a device's gain drops unity. Below that frequency the product of the device's gain and frequency tends to be constant.

Hybrid-pi — High-frequency model for a bipolar transistor.

Impedance inversion — Dividing a characteristic impedance by the ratio of the impedance to be inverted to the characteristic impedance. For example, 25 Ω inverted about 50 Ω is 100 Ω and 200 Ω inverted about 50 Ω is 12.5 Ω.

Insertion loss (IL) — The loss inherent in a circuit due to parasitic resistance.

Inter-electrode capacitance — Capacitance between the internal elements of a semiconductor or vacuum tube.

Lumped element — Electronic component that exists at a single point.

Mix — The chemical composition of a ferrite or powdered-iron material (also called *type*).

Noise — Any unwanted signal. Usually refers to signals of natural origins or random effects resulting from interfering signals.

Noise factor (F) — The amount by which noise at the output of a device is greater than that at the input multiplied by the gain of the device. A measure of how much noise is generated by a device.

Noise figure (NF) — 10 log (noise factor).

Noise gain — Circuit output noise power divided by the available input noise power. This is not always equal to signal gain, depending on the source of the noise and the location of the noise source in the circuit.

Nonideal — Behavior that deviates from that of an ideal component. (See also ***Parasitic***.)

Nonlinear — A component that acts on a signal differently depending on the signal's amplitude.

Parasitic — Unintended characteristic related to the physical structure of a component.

Permeability — The ability of a material to support a magnetic field.

Return loss (RL) — The difference in dB between forward and reflected power at a network port.

Self-resonant — Resonance of a component due to parasitic characteristics.

Simulate — Model using numerical methods, usually on a computer.

Skin effect — The property of a conductor that restricts high-frequency ac current flow to a thin layer on its surface.

Skin depth — The depth of the layer at the surface of a conductor to which ac current flow is restricted. (See also ***Skin effect***.)

Spectral Power Density — The amount of power per unit of bandwidth, usually "root-Hz" or √Hz, the square root of the measurement bandwidth.

Stray — See ***Parasitic***.

Toroid (toroidal) — A ring-shaped continuous core.

Two-port network — A network with four terminals organized in two pairs, each pair called a port.

Two-port parameters — A set of four parameters that describe the relationship between signals at the network's two ports.

Unun — A device that transfers power between two unbalanced systems, usually performing an impedance transformation. (See also ***Balun***.)

Chapter 7 — Power Sources

Bleeder — A resistive load across the output or filter of a power supply, intended to quickly discharge stored energy once the supply is turned off.

Boost converter — A ***switchmode converter*** in which the output voltage is always greater than or equal to the input voltage.

Buck converter — A ***switchmode converter*** in which the output voltage is always less than or equal to the input voltage.

Buck-boost converter — A ***switchmode converter*** in which the magnitude of the output voltage can be either greater or less than the input voltage.

C-rate — The charging rate for a battery, expressed as a ratio of the battery's ampere-hour rating.

CCA (cold cranking amps) — A measure of a battery's ability to deliver high current to a starter motor.

Circular mils — A convenient way of expressing the cross-sectional area of a round conductor. The area of the conductor in circular mils is found by squaring its diameter in mils (thousandths of an inch), rather than squaring its radius and multiplying by pi. For example, the diameter of 10-gauge wire is 101.9 mils (0.1019 inch). Its cross-sectional area is 10380 CM, or 0.008155 square inches.

Core saturation (magnetic) — That condition whereby the magnetic flux in a transformer or inductor core is more than the core can handle. If the flux is forced beyond this point, the permeability of the core will decrease, and it will approach the permeability of air.

Crowbar — A last-ditch protection circuit included in many power supplies to protect the load equipment against failure of the regulator in the supply. The crowbar senses an overvoltage condition on the supply's output and fires a shorting device (usually an SCR) to directly short-circuit the supply's output and protect the load. This causes very high currents in the power supply, which blow the supply's input-line fuse.

Darlington transistor — A package of two transistors in one case, with the collectors tied together, and the emitter of one transistor connected to the base of the other. The effective current gain of the pair is approximately the product of the individual gains of the two devices.

DC-DC converter — A circuit for changing the voltage of a dc source to ac, transforming it to another level, and then rectifying the output to produce direct current.

Deep-cycle — A battery designed for repeated charge-discharge cycles to 20% of remaining capacity.

Equalizing resistors — Equal-value bypassing resistors placed across capacitors connected in series for use in a high-voltage power supply to keep the voltages across the capacitors in the string relatively constant.

Fast recovery rectifier — A specially doped rectifier diode designed to minimize the time necessary to halt conduction when the diode is switched from a forward-biased state to a reverse-biased state.

Flyback converter — A transformer-coupled version of the buck-boost converter.

Forward converter — A buck converter with multiple isolated outputs at different voltage levels and polarities.

Foldback current limiting — A special type of current limiting used in linear power supplies, which reduces the current through the supply's regulator to a low value under short-circuited load conditions to protect the series pass transistor from excessive power dissipation and possible destruction.

Ground fault (circuit) interrupter (GFI or GFCI) — A safety device installed between the household power mains and equipment where there is a danger of personnel touching an earth ground while operating the equipment. The GFI senses any current flowing directly to ground and immediately switches off all power to the equipment to minimize electrical shock. GFCIs are now standard equipment in bathroom and outdoor receptacles.

Input-output differential — The voltage drop appearing across the series pass transistor in a linear voltage regulator. This term is usually stated as a minimum value, which is that voltage necessary to allow the regulator to function and conduct current. A typical figure for this drop in most three-terminal regulator ICs is about 2.5 V. In other words, a regulator that is to provide 12.5 V dc will need a source voltage of at least 15.0 V at all times to maintain regulation.

Inverter — A circuit for producing ac power from a dc source.

Li-ion — Lithium-ion, a type of rechargeable battery that is about 1/3 the weight and 1/2 the volume of a NiCd battery of the same capacity.

Low dropout regulator — A three-terminal regulator designed to work with a low minimum input-output differential value.

Marine — A battery designed to retain significant energy over long periods of time without being continuously charged.

NiCd — Nickel cadmium, a type of rechargeable battery.

NiMH — Nickel metal hydride, a type of rechargeable battery that does not contain toxic substances.

Peak inverse voltage (PIV) — The maximum reverse-biased voltage that a semiconductor is rated to handle safely. Exceeding the peak inverse rating can result in junction breakdown and device destruction.

Phasing dots (•) — Phasing dots on transformer windings indicate the end of the winding at which ac voltages will have the same phase.

Power converter — Another term for a power supply.

Power processor — Another term for a power supply.

Primary battery — A battery intended for one-time use and then discarded.

RC (reserve capacity) — A measure of a battery's ability to deliver current over long periods.

Regulator — A device (such as a Zener diode) or circuitry in a power supply for maintaining a constant output voltage over a range of load currents and input voltages.

Resonant converter — A form of dc-dc converter characterized by the series pass switch turning on into an effective series-resonant load. This allows a zero current condition at turn-on and turn-off. The resonant converter normally operates at frequencies between 100 kHz and 500 kHz and is very compact in size for its power handling ability.

Ripple — The residual ac left after rectification, filtration, and regulation of the input power.

RMS — Root Mean Square. Refers to the effective value of an alternating voltage or current, corresponding to the dc voltage or current that would cause the same heating effect.

Secondary battery — A battery that may be recharged many times. Also called a storage battery.

Secondary breakdown — A runaway failure condition in a transistor, occurring at higher collector-emitter voltages, where hot spots occur due to (and promoting) localization of the collector current at that region of the chip.

Series pass transistor **or** ***pass transistor*** — The transistor(s) that control(s) the passage of power between the unregulated dc source and the load in a regulator. In a linear regulator, the series pass transistor acts as a controlled resistor to drop the voltage to that needed by the load. In a switch-mode regulator, the series pass transistor switches between its ON and OFF states.

SLI (starter, lights, ignition) — An automotive battery designed to start the vehicle and provide power to the lighting and ignition systems.

SOA (Safe Operating Area) — The range of permissible collector current and collector-emitter voltage combinations where a transistor may be safely operated without danger of device failure.

Surge — A moderate-duration perturbation on a power line, usually lasting for hundreds of milliseconds to several seconds.

Switching regulator — Another name for a ***switchmode converter***.

Switchmode converter — A high-efficiency switching circuit used for dc-dc power conversion. Switching circuits are usually much smaller and lighter than conventional 60 Hz, transformer-rectifier circuits because they operate at much higher frequencies — from 25 to 400 kHz or even higher.

Three-terminal regulator — A device used for voltage regulation that has three leads (terminals) and includes a voltage reference, a high-gain error amplifier, temperature-compensated voltage sensing resistors, and a pass element.

Transient — A short perturbation or "spike" on a power line, usually lasting for microseconds to tens of milliseconds.

Varistor — A surge suppression device used to absorb transients and spikes occurring on the power lines, thereby protecting electronic equipment plugged into that line. Frequently, the term MOV (Metal Oxide Varistor) is used instead.

Volt-Amperes (VA) — The product obtained by multiplying the current times the voltage in an ac circuit without regard for the phase angle between the two. This is also known as the apparent power delivered to the load as opposed to the actual or real power absorbed by the load, expressed in watts.

Voltage multiplier — A type of rectifier circuit that is arranged to charge a capacitor or capacitors on one half-cycle of the ac input voltage waveform, and then to connect these capacitors in series with the rectified line or other charged capacitors on the alternate half-cycle. The voltage doubler and tripler are commonly used forms of the voltage multiplier.

Voltage regulation — The change in power supply output voltage with load, expressed as a percentage.

Chapter 8 — DSP and SDR Fundamentals

Analog-to-digital converter (ADC) — A device that samples an analog signal and outputs a digital number representing the amplitude of the signal.

Anti-aliasing filter — A band-limiting filter placed before a sampler to make sure the incoming signal satisfies the Nyquist criterion.

Application-specific integrated circuit (ASIC) — A non-programmable IC that is designed for a particular application.

Arithmetic logic unit (ALU) — The portion of a microprocessor that performs basic arithmetic and logical operations.

Barrel shifter — A circuit in a microprocessor that can bit-shift a number by multiple bits at one time.

Baseband — The low-frequency portion of a signal. This is typically the modulation.

Binary point — The symbol that separates the integer part from the fractional part of a binary number.

Blocking dynamic range (BDR) — The difference between the noise level (usually in a 500-Hz bandwidth) and the signal level that causes a 1 dB reduction in the level of a weaker signal.

Circular buffers — A buffer in which the final entry is considered to be adjacent to the first.

Cognitive radio — A radio system in which a wireless node automatically changes its transmission or reception parameters to avoid interference with other nodes.

Complex number — A number that contains real and imaginary parts.

Complex PLD (CPLD) — A programmable logic device that is more complex than a small PLD, such as a PAL, but with a similar architecture.

Convolution — A mathematical operation that modifies a sequence of numbers with another sequence of numbers to produce a third sequence with a different frequency spectrum or other desired characteristic. An FIR filter is a convolution engine.

Cooley-Tukey algorithm — Another name for the fast Fourier transform.

Decimation — Reduction of sample rate by an integer factor.

Decimation in time — The division of a sequence of numbers into successively smaller sub-sequences to facilitate calculations such as the Fourier transform.

Digital downconverter (DDC) — A device that translates a band of frequencies to baseband, typically at a lower sample rate.

Digital signal processing — The processing of sequences of digital numbers that represent signals.

Digital signal processor (DSP) — A device to do digital signal processing. The term normally is understood to refer to a microprocessor-type device with special capabilities for signal processing.

Digital-to-analog converter (DAC) — A device that converts digital numbers to an analog signal with an amplitude proportional to the digital numbers.

Digital upconverter (DUC) — A device that frequency-translates a baseband signal to a higher frequency, typically at a higher sample rate.

Dithering — Randomly varying the amplitude or phase of a signal to overcome quantization effects.

Embedded system — A system that includes a microprocessor for purposes other than general-purpose computing.

Exponent — The number of digits that the radix point must be moved to represent a number.

Fast Fourier transform (FFT) — An algorithm that can calculate the discrete Fourier transform with an execution time proportional to nlog(n), instead of n^2 as is required by the straight-forward application of the Fourier transform equation.

Field-programmable gate array (FPGA) — An IC that contains a large array of complex logic blocks whose function and connections can be re-programmed in the field.

Floating-point — Refers to a number whose value is represented by a mantissa and an exponent.

Fourier transform — A mathematical operation that derives the frequency spectrum of a time-domain signal.

Hardware-description languages (HDL) — A computer language to specify the circuitry of a digital device or system.

Harmonic sampling — The use of a sample rate that is less than twice the highest frequency of the signal to be sampled. The sample rate must be greater than two times the bandwidth of the signal.

Harvard architecture — A computer architecture in which the program and data are stored in separate memories.

Imaginary number — A real number multiplied by the square root of minus one.

Impulse — A pulse of finite energy with a width that approaches zero.

In-circuit emulator (ICE) — A device that emulates the operation of a microprocessor while providing debugging tools to the operator. The ICE normally plugs into an IC socket that normally holds the microprocessor.

In-circuit debugger (ICD) — A device that uses debugging features built into the microprocessor so that it can be tested while in the circuit.

In-circuit programmable (ICP) — A programmable IC that can be programmed while it is connected to the application circuit.

In-circuit programmer (ICP) — A device to facilitate programming of programmable ICs while they are connected to the application circuit.

In-phase (I) — The portion of a radio signal that is in phase with a reference carrier.

Integrated development environment (IDE) — An integrated collection of software and hardware tools for developing a microprocessor project.

Interrupt service routine (ISR) — A software subroutine that is called automatically when the main routine is interrupted by some event.

Least-significant bit (LSB) — When used as a measurement unit, the size of the smallest step of a digital number.

Linear phase — Refers to a system in which the delay is constant at all frequencies, which means that the phase is linear with frequency.

Mantissa — The decimal or binary part of a logarithm or floating-point number.

Multiplier-accumulator (MAC) — A device that can multiply two numbers and add the result to a previous result all in one operation.

Multi-rate — Refers to a system with more than one sample rate.

Nyquist criterion — The requirement that the sample rate must be at least twice the bandwidth of the signal.

Nyquist frequency — One half the sample rate.

Nyquist rate — Twice the signal bandwidth.

One-time programmable (OTP) — A programmable device that may not be re-programmed.

Orthogonal — Perpendicular. In analogy with the mathematics of perpendicular geometrical vectors, the term is used in communications to refer to two signals that produce zero when convolved.

Oversampling — Use of a sample rate higher than required by the Nyquist criterion to improve the signal-to-noise ratio.

Chapter 9 — Oscillators and Synthesizers

Buffer — A circuit that amplifies the output of a circuit while isolating it from the load.

Bypass — Create a low ac impedance to ground at a point in the circuit.

Cavity — A hollow structure used as an electrical resonator.

Closed-loop — Operation under the control of a feedback loop. (See also ***Open-loop***.)

Coupling — The transfer of energy between circuits or structures.

Damping (factor) — the characteristics of the decay in a system's response to an input signal. The **damping factor, ζ,** is a numeric value specifying the degree of damping. An **underdamped** system alternately overshoots and undershoots the eventual steady-state output. An **overdamped** system approaches the steady-state output gradually, without overshoot. A **critically damped** system approaches the steady-state output as quickly as possible without overshoot.

dBc — deciBels with respect to a carrier level.

DC-FM — control of a signal generator's output frequency by a dc voltage.

Decouple — To provide isolation between circuits, usually by means of filtering.

Direct digital synthesis (DDS) — Generation of signals by using counters and accumulators to create an output waveform.

Distributed — Circuit elements that are inherent properties of an extended structure, such as a transmission line.

ESR — Equivalent series resistance.

Free-running — Oscillating without any form of external control.

Fundamental — Lowest frequency of natural vibration or oscillation.

Integrator — A low-pass filter whose output is approximately the integral of the input signal.

Intermodulation — Generation of distortion products from two signals interacting in a nonlinear medium, device, or connection.

Isolation — Preventing signal flow between two circuits or systems. *Reverse isolation* refers to signal flow against the desired signal path.

Jitter (phase jitter) — Random variations of a signal in time, usually refers to random variations in the transition time of digital signals between states.

Linearization — Creation of a linear amplification or frequency characteristic through corrections supplied by an external system.

Loop gain — The total gain applied to a signal traveling around a feedback control loop.

Lumped (element) — Circuit elements whose electrical functions are concentrated at one point in the form of an electronic component.

Match — Equal values of impedance.

Modulus — The number of states of a digital counter or divider.

Motional capacitance (inductance) — The electrical effect of a crystal's mechanical properties, modeled as a capacitance (inductance).

Natural frequency (w_n) — Frequency at which a system oscillates without any external control.

Noise bandwidth — The width of an ideal rectangular filter that would pass the same noise power from white noise as the filter being compared (also called **equivalent noise bandwidth**).

Open-loop — Operation without controlling feedback.

Oscillation — Repetitive mechanical motion or electrical activity created by the application of positive feedback.

Overtones — Vibration or oscillation at frequencies above the ***Fundamental***, usually harmonically related to the fundamental.

Permeability tuning — Varying the permeability of the core of an inductor used to control an oscillator's frequency.

Phase-lock — Maintain two signals in a fixed phase relationship by means of a control system.

Phase noise — Random variations of a signal in time, expressed as variations in phase of a sinusoidal signal.

Phasor — Representation of a sinusoidal signal as an amplitude and phase, often drawn as a vector.

Power density — Amount of power per unit of frequency, usually specified as dBc/Hz or as RMS voltage/√Hz.

Prescaler — A frequency divider used to reduce the frequency of an input signal for processing by slower circuitry.

Preselector — Filters applied at a receiver's input to reject out-of-band signals.

Pull — Change the frequency at which a crystal oscillates by changing reactance of the circuit in which it is installed.

Quadrature — A 90-degree phase difference maintained between two signals.

Reciprocal mixing — Noise in a mixer's output due to the LO's noise sidebands mixing with those of the desired signal.

Relaxation oscillation — Oscillation produced by a cycle of gradual accumulation of energy followed by its sudden release.

Resonator — Circuit or structure whose resonance acts as a filter.

Simulation — Calculate a circuit's behavior based on mathematical models of the components.

Spurious (spur) — A signal at an undesired frequency, usually unrelated to the frequency of a desired frequency.

Squegg (squeeg) — Chaotic or random jumps in an oscillator's amplitude and/or frequency.

Static (synthesizer) — A synthesizer designed to output a signal whose frequency does not change or that is not changed frequently.

Synthesis (frequency) — The generation of variable-frequency signals by means of nonlinear combination and filtering (direct synthesis) or by using phase-lock or phase-control techniques (indirect synthesis).

TCXO — Temperature-compensated crystal oscillator. A **digitally temperature-compensated oscillator (DTCXO)** is controlled by a microcontroller or computer to maintain a constant frequency. **Oven-controlled crystal oscillators (OCXO)** are placed in a heated enclosure to maintain a constant temperature and frequency.

Temperature coefficient (tempco) — The amount of change in a component's value per degree of change in temperature.

Temperature compensation — Causing a circuit's behavior to change with temperature in such a way as to oppose and cancel the change with temperature of some temperature-sensitive component, such as a crystal.

Varactor (Varicap) — Reverse-biased diode used as a tunable capacitor.

VCO — Voltage-controlled oscillator (also called **voltage-tuned oscillator**).

VFO — Variable-frequency oscillator.

VXO — Variable crystal oscillator, whose frequency is adjustable around that of the crystal.

Chapter 10 — Analog and Digital Filtering

Active filter — A filter that uses active (powered) devices to implement its function.

Adaptive filter — A filter whose coefficients can be changed automatically.

All-pass — Filter response in which the magnitude response does not change with frequency, but the phase response does change with frequency.

Amplitude response — See ***Magnitude response***.

Band-pass — Filter response in which signals are passed in a range of frequencies and rejected outside that range.

Band-stop — Filter response in which signals are rejected in a range of frequencies and passed outside that range (also called *band-reject* or *notch* filter).

Bandwidth — Range of frequencies over which signals are passed (low-pass, high-pass, band-pass) or rejected (band-stop).

Brick wall response — An ideal filter response in which signals are either passed with no attenuation or attenuated completely.

Chebyshev filter — A filter with equal ripple in the passband, stopband or both.

Cutoff frequency — Frequency at which a filter's output is 3 dB below its passband output (also called *corner frequency* or *3 dB frequency*).

Decade — A ratio of 10 in frequency.

Decimation — Reduction of sample rate by an integer factor.

Diplexer — A device, typically a pair of filters, that allows antennas or transceivers for two different bands to share a single feed line.

Duplexer — A device that allows transceivers, transmitters, or receivers operating on different frequencies within a single band to share a common antenna. The duplexer may be implemented with filters or other feed line components, such as a circulator or isolator.

Equiripple — Equalized ripple in a filter's magnitude response across the passband, stopband, or both.

Filter coefficient — One of a series of numbers that define the transfer function of a filter.

Finite impulse response (FIR) — An impulse response that is zero for all time that is greater than some finite amount from the time of the impulse.

Flat — Refers to a filter's magnitude response that is constant across a range of frequencies.

Group delay — The transit time of signals through a filter.

High-pass — Filter response in which signals above the cutoff frequency are passed and rejected at lower frequencies.

Ideal filter — Filter that passes signals without loss or attenuates them completely. An ideal filter has no transition regions. (See also ***Brick wall response***.)

Impulse — A pulse of finite energy with a width that approaches zero.

Impulse-invariant — A design technique for IIR filters in which the impulse response is the same as the impulse response of a certain analog filter.

Impulse response — The response versus time of a filter to an impulse.

Infinite impulse response (IIR) — An impulse response that theoretically never goes to and remains at zero.

Insertion loss — The loss incurred by signals in a filter's passband.

Interpolation — Increasing the sample rate by an integer factor.

Low-pass — Filter response in which signals below the cutoff frequency are passed and rejected at higher frequencies.

Lumped elements — Discrete inductors and capacitors; a lumped-element filter made from discrete inductors and capacitors.

Magnitude response — Graph of a filter's output amplitude versus frequency.

Microstrip — A type of transmission line made from a strip of metal separated from a ground plane by a layer of insulating material, such as on a printed-circuit board.

Normalize — The technique of converting numeric values to their ratio with respect to some reference value. (To denormalize is to reverse the normalization, converting the ratios back to the original values.)

Notch filter — See ***Band-stop***.

Octave — A ratio of two in frequency (See also ***Decade***.)

Overshoot — The condition in which the output of a circuit, in responding to a change in its input, temporarily exceeds the steady-state value that the input should cause.

Overtone — Vibration mode at a higher frequency than the fundamental mode, usually harmonically related.

Passband — The range of frequencies passed by a filter.

Passive filter — A filter that does not require power to perform its function. (See also ***Lumped element***.)

Phase response — Graph of the difference in angular units (degrees or radians) between a filter's input and output versus frequency.

Radian — Unit of angular measurement equal to 1/2π of a circle, equal to 360 / 2π degrees.

Ringing — The condition in which the output of a circuit, in responding to a change in its input, exhibits a damped alternating sequence of exceeding and falling below the steady-state value that the input should cause before settling at the steady-state value.

Ripple — A regular variation with frequency in a filter's magnitude response.

Rolloff — The rate of change in a filter's magnitude response in the transition region and stopband.

Scaling — Changing a filter's impedance or frequency characteristics through multiplication or division by a constant.

Shape factor — The ratio of a filter's bandwidth between the points at which its magnitude response is 6 dB and 60 dB below the response in the filter's passband.

Stopband — The range of frequencies that are rejected by a filter.

Stripline — A transmission line consisting of a metal strip suspended between two ground planes.

Tap — One processing block, consisting of a coefficient memory, signal register, multiplier and adder, of an FIR filter.

TEM — Transverse electromagnetic mode in which the electric and magnetic fields of electromagnetic energy are aligned perpendicularly to the direction of motion.

Topology — The arrangement of connections of components in the filter. For example, "capacitor-input" and "inductor-input" are two different topologies.

Transition region — Range of frequencies between a filter's passband and stopband.

Triplexer — See ***Diplexer***. The triplexer operates on three different bands.

Chapter 15 — Digital Protocols and Modes

ACK — Acknowledgment, the control signal sent to indicate the correct receipt of a transmission block.

Address — A character or group of characters that identifies a source or destination.

AFSK — Audio frequency-shift keying.

ALE — Automatic link establishment.

Algorithm — Numerical method or process.

APCO — Association of Public Safety Communications Officials.

ARQ — Automatic Repeat reQuest, an error-sending station, after transmitting a data block, awaits a reply (ACK or NAK) to determine whether to repeat the last block or proceed to the next.

ASCII — American National Standard Code for Information Interchange, a code consisting of seven information bits.

AX.25 — Amateur packet-radio link-layer protocol.

Baud — A unit of signaling speed equal to the number of discrete conditions or events per second. (If the duration of a pulse is 20 ms, the signaling rate is 50 baud or the reciprocal of 0.02, abbreviated Bd).

Baudot code — A coded character set in which five bits represent one character. Used in the US to refer to ITA2.

Bell 103 — A 300-baud full-duplex modem using 200-Hz-shift FSK of tones centered at 1170 and 2125 Hz.

Bell 202 — A 1200-baud modem standard with 1200-Hz mark, 2200-Hz space, used for VHF FM packet radio.

BER — Bit error rate.

BERT — Bit-error-rate test.

Bit stuffing — Insertion and deletion of 0s in a frame to preclude accidental occurrences of flags other than at the beginning and end of frames.

Bit — Binary digit, a single symbol, in binary terms either a one or zero.

Bit/s or ***bps*** — Bits per second.

Bitmap — See ***Raster***.

Bit rate — Rate at which bits are transmitted in bit/s or bps. **Gross** (or **raw**) **bit rate** includes all bits transmitted, regardless of purpose. **Net bit rate** (also called **throughput**) only includes bits that represent data.

BLER — Block error rate.

BLERT — Block-error-rate test.

BPSK — Binary phase-shift keying in which there are two combinations of phase used to represent data symbols.

Byte — A group of bits, usually eight.

Cache — To store data or packets in anticipation of future use, thus improving routing or delivery performance.

Channel — Medium through which data is transmitted.

Checksum — Data representing the sum of all character values in a packet or message.

CLOVER — Trade name of digital communications system developed by Hal Communications.

COFDM — Coded Orthogonal Frequency Division Multiplex, OFDM plus coding to provide error correction and noise immunity.

Code — Method of representing data.

Codec — Algorithm for compressing and decompressing data.

Collision — A condition that occurs when two or more transmissions occur at the same time and cause interference to the intended receivers.

Compression — Method of reducing the amount of data required to represent a signal or data set. **Decompression** is the method of reversing the compression process.

Constellation — A set of points that represent the various combinations of phase and amplitude in a QAM or other complex modulation scheme.

Contention — A condition on a communications channel that occurs when two or more stations try to transmit at the same time.

Control characters — Data values with special meanings in a protocol, used to cause specific functions to be performed.

Control field — An 8-bit pattern in an HDLC frame containing commands or responses, and sequence numbers.

Convolution — The process of combining or comparing signals based on their behavior over time.

Cyclic Redundancy Check (CRC) — The result of a calculation representing all character values in a packet or message. The result of the CRC is sent with a transmission block. The receiving station uses the received CRC to check transmitted data integrity.

Datagram — A data packet in a connectionless protocol.

Data stream — Flow of information, either over the air or in a network.

DBPSK — Differential binary phase-shift keying.

Dibit — A two-bit combination.

DQPSK — Differential quadrature phase-shift keying.

Domino — A conversational HF digital mode similar in some respects to MFSK15.

DRM — Digital Radio Mondiale. A consortium of broadcasters, manufacturers, research and governmental organizations which developed a system for digital sound broadcasting in bands between 100 kHzand 30 MHz.

DV — Digital voice.

Emission — A signal transmitted over the air.

Encoding — Changing data into a form represented by a particular code.

Encryption — Process of using codes and encoding to obscure the meaning of a transmitted message.

Decryption — Reverses the encryption process to recover the original data.

Error Correcting Code (ECC) — Code used to repair transmission errors.

Eye pattern — An oscilloscope display in the shape of one or more eyes for observing the shape of a serial digital stream and any impairments.

Fast Fourier Transform (FFT) — An algorithm that produces the spectrum of a signal from the set of sampled value of the waveform.

FEC — Forward error correction.

Frame — Data set transmitted as one package or set.

Facsimile (fax) — A form of telegraphy for the transmission of fixed images, with or without half-tones, with a view to their reproduction in a permanent form.

FCS — Frame check sequence. (See also ***Cyclic redundancy check (CRC)***.)

FDM — Frequency division multiplexing.

FDMA — Frequency division multiple access.

FEC — Forward error correction, an error-control technique in which the transmitted data is sufficiently redundant to permit the receiving station to correct some errors.

FSK — Frequency-shift keying.

Gray code — A code that minimizes the number of bits that change between sequential numeric values.

G-TOR — A digital communications system developed by Kantronics.

HDLC — High-level data link control procedures as specified in ISO 3309.

Hellschreiber — A facsimile system for transmitting text.

Host — As used in packet radio, a computer with applications programs accessible by remote stations.

IA5 — International Alphabet, designating a specific set of characters as an ITU standard.

Information field — Any sequence of bits containing the intelligence to be conveyed.

Interleave — Combine more than one data stream into a single stream or alter the data stream in such a way as to optimize it for the modulation and channel characteristics being used.

IP — Internet Protocol, a network protocol used to route information between addresses on the Internet.

ISO — International Organization for Standardization.

ITU — International Telecommunication Union, a specialized agency of the United Nations. (See **www.itu.int**.)

ITU-T — Telecommunication Standardization Sector of the ITU, formerly CCITT.

Jitter — Unwanted variations in timing or phase in a digital signal.

Layer — In communications protocols, one of the strata or levels in a reference model.

Least significant bit (LSB) — The bit in a byte or word that represents the smallest value.

Level 1 — Physical layer of the OSI reference model.

Level 2 — Link layer of the OSI reference model.

Level 3 — Network layer of the OSI reference model.

Level 4 — Transport layer of the OSI reference model.

Level 5 — Session layer of the OSI reference model.

Level 6 — Presentation layer of the OSI reference model.

Level 7 — Application layer of the OSI reference model.

Lossless (compression) — Method of compression that results in an exact copy of the original data.

Lossy (compression) — Method of compression in which some of the original data is lost

MFSK16 — A multi-frequency shift communications system.

Modem — Modulator-demodulator, a device that connects between a data terminal and communication line (or radio). Also called **data set**.

Most significant bit (MSB) — The bit in a byte or word that represents the greatest value.

Multicast — A protocol designed to distribute packets of data to many users without communications between the user and data source.

MSK — Frequency-shift keying where the shift in Hz is equal to half the signaling rate in bit/s.

MT63 — A keyboard-to-keyboard mode similar to PSK31 and RTTY.

Nibble — A four-bit quantity. Half a byte.

Node — A point within a network, usually where two or more links come together, performing switching, routine, and concentrating functions.

OFDM — Orthogonal Frequency Division Multiplex. A method of using spaced subcarriers that are phased in such a way as to reduce the interference between them.

OSI-RM — Open Systems Interconnection Reference Model specified in ISO 7498 and ITU-T Recommendation X.200.

PACTOR — Trade name of digital communications protocols offered by Special Communications Systems GmbH & Co KG (SCS).

Packet — (1) Radio: communication using the AX.25 protocol. (2) Data: transmitted data structure for a particular protocol. (See also ***Frame***.)

Parity (parity check) — Number of bits with a particular value in a specific data element, such as a byte or word or packet. Parity can be odd or even. A **parity bit** contains the information about the element parity.

Pixel — Abbreviation for "picture element."

Primitive — An instruction for creating a signal or data set, such as in a drawing or for speech.

Project 25 — Digital voice system developed for APCO, also known as P25.

Protocol — A formal set of rules and procedures for the exchange of information.

PSK — Phase-shift keying.

PSK31 — A narrow-band digital communications system developed by Peter Martinez, G3PLX.

QAM — Quadrature Amplitude Modulation. A method of simultaneous phase and amplitude modulation. The number that precedes it, for example, 64QAM, indicates the number of discrete stages in each symbol.

QPSK — Quadrature phase-shift keying in which there are four different combinations of signal phase that represent symbols.

Raster (image) — Images represented as individual data elements, called pixels.

Router — A network packet switch. In packet radio, a network level relay station capable of routing packets.

RTTY — Radioteletype.

Sample — Convert an analog signal to a set of digital values.

Shift — (1) The difference between mark and space frequencies in an FSK or AFSK signal. (2) To change between character sets, such as between LTRS and FIGS in RTTY.

SSID — Secondary station identifier. In AX.25 link-layer protocol, a multipurpose octet to identify several packet radio stations operating under the same call sign.

State — Particular combination of signal attributes used to represent data, such as amplitude or phase.

Start (stop) bit — Symbol used to synchronize receiving equipment at the beginning (end) of a data byte.

Symbol — Specific state or change in state of a transmission representing a particular signaling event. **Symbol rate** is the number of symbols transmitted per unit of time. (See also ***Baud***.)

TAPR — Tucson Amateur Packet Radio Corporation, a nonprofit organization involved in digital mode development.

TDM — Time division multiplexing.

TDMA — Time division multiple access.

Throb — A multi-frequency shift mode like MFSK15.

TNC — Terminal node controller, a device that assembles and disassembles packets (frames).

Trellis — The set of allowed combinations of signal states that represent data. (See also ***Constellation***.)

Turnaround time — The time required to reverse the direction of a half-duplex circuit, required by propagation, modem reversal and transmit-receive switching time of transceiver.

Unicast — A protocol in which information is exchanged between a single pair of points on a network.

Varicode — A code in which the different data values are represented by codes with different lengths.

Vector — Image represented as a collection of drawing instructions.

Word — Set of bits larger than a byte.

Chapter 19 — Propagation of Radio Signals

A index — An open-ended linear index that corresponds roughly to the cumulative **K index** values (it's the daily average of the eight K indices after converting the K indices to a linear scale). The A index commonly varies between 0 and 30 during quiet to active conditions, and up to 100 and higher during geomagnetic storms.

Absorption — The dissipation of the energy of a radio wave as it travels through a medium such as the ionosphere.

Antipode — Locations directly opposite each other on a globe.

Atmosphere — The mass of air surrounding the Earth. Radio signals travel through the atmosphere and different conditions in the atmosphere (in conjunction with the signal's frequency) affect how those signals travel or propagate.

Aurora — A disturbance of the atmosphere at high latitudes resulting from an interaction between electrically charged particles from the magnetosphere and the magnetic field of the Earth. *Auroral propagation* occurs when HF through UHF signals are reflected from the aurora to reach another station.

Auroral E — Sporadic E in the auroral zone.

Backscatter — Single-hop signals that have been scattered by the Earth or the ocean at some distant point back toward the transmitting station.

Beacon station — A station that transmits continuously, allowing other stations to assess propagation to and from the location of the beacon station.

Coronal hole — A region on the Sun where the magnetic field is open to the interplanetary magnetic field (IMF) and ionized particles can escape into the solar wind.

Critical angle — The largest angle at which a radio wave of a specified frequency can be returned to Earth by the ionosphere.

Critical frequency — The highest frequency that returns echoes from the E and F regions at vertical incidence.

D region — The lowest region of the ionosphere. The D region (or layer) contributes very little to short-wave radio propagation. It absorbs energy from radio waves as they pass through it. This absorption has a significant effect on signals below about 7.5 MHz during daylight.

Diffraction — Bending of waves by an edge or corner.

E region — The second lowest ionospheric region, the E region (or layer) has its highest electron density during the day and falls to a much lower electron density during the night. The E region can refract radio waves enough to return them to Earth.

Earth-Moon-Earth (EME) or ***Moonbounce*** — A method of communicating with other stations by reflecting radio signals off the Moon's surface.

Electromagnetic wave — A wave of energy composed of an electric and magnetic field.

Equinoxes — One of two points in the orbit of the Earth around the Sun at which the Earth crosses a horizontal plane extending through the equator of the Sun. The vernal equinox marks the beginning of spring, and the autumnal equinox marks the beginning of autumn.

Faraday rotation — A rotation of the polarization of radio waves when the waves travel through an ionized medium that is immersed in a magnetic field (for example, the Earth's ionosphere).

F region — A combination of the two highest ionospheric regions (or layers), the F_1 and F_2 regions. The F region refracts radio waves and returns them to Earth. Its height varies greatly depending on the time of day, season of the year and amount of sunspot activity.

Field-aligned irregularities (FAI) — A propagation mechanism observed at 50 and 144 MHz that occurs when irregularities in the distribution of free electrons in the ionosphere are aligned parallel to the Earth's magnetic field.

Free-space attenuation — The dissipation of the energy of a radio wave that results from the spherical spreading of radio energy from its source.

Gray-line — A special form of ***Long-path propagation*** propagation that takes into account the unusual ionospheric configuration along the twilight region between night and day.

Ground-wave propagation — The method by which radio waves travel along the Earth's surface.

High frequency (HF) — The term used for the frequency range between 3 MHz and 30 MHz. The amateur HF bands are where you are most likely to make long distance (worldwide) contacts.

Ionosphere — A region of electrically charged (ionized) gases high in the atmosphere. The ionosphere bends radio waves as they travel through it, returning them to Earth. (See also ***Sky-wave propagation***.)

K index — A geomagnetic-field measurement that is updated every three hours at various observatories around the world. Changes in the K index can be used to indicate HF propagation conditions. Rising values generally indicate disturbed conditions while falling values indicate improving conditions.

Line-of-sight propagation — The term used to describe VHF and UHF propagation in a straight line directly from one station to another.

Long-path propagation — Propagation between two points on the Earth's surface that follows a path along the great circle between them, but in a direction opposite from the shortest distance between them.

Lowest usable frequency (LUF) — The frequency below the ***Maximum usable frequency (MUF)*** at which ionospheric absorption and noise at the receiving location make the received signal-to-noise ratio too low to be usable.

M-factor — The ratio between the ***Maximum usable frequency (MUF)*** and the critical frequency.

Maximum usable frequency (MUF) — The highest-frequency radio signal that will reach a particular destination using ***sky-wave propagation***, or ***skip***. The MUF may vary for radio signals sent to different destinations.

Meteor-scatter communication — A method of radio communication that uses the ionized trail of a meteor that burned up in the Earth's atmosphere to reflect, refract, or scatter radio signals back to Earth.

Microwave — Radio waves or signals with frequencies greater than 1000 MHz (1 GHz). This is not a strict definition, just a conventional way of referring to those frequencies.

Moonbounce — A common name for EME communication in which signals are bounced off the Moon before being received.

Multihop propagation — Long-distance radio propagation using several skips or hops between the Earth and the ionosphere.

Multipath — A fading effect caused by the transmitted signal traveling to the receiving station over more than one path.

Near Vertical Incidence Skywave (NVIS) propagation — A propagation mechanism that allows stations located within the ***Skip zone***, but too far apart for ground wave propagation, to maintain communications by going to a lower frequency.

Path loss — The total signal loss between transmitting and receiving stations relative to the total radiated signal energy.

Pedersen ray — A high-angle radio wave that penetrates deeper into the F region of the ionosphere, so the wave is bent less than a lower-angle wave, and thus for some distance parallels the Earth's surface in the F region, returning to Earth at a distance farther than normally expected for single-hop propagation.

Polarization — The orientation of the electrical- field of a radio wave. An antenna that is parallel to the surface of the Earth, such as a dipole, produces horizontally polarized waves. One that is perpendicular to the Earth's surface, such as a quarter-wave vertical, produces vertically polarized waves. An antenna that has both horizontal and vertical polarization is said to be circularly polarized.

Propagation — The process by which radio waves travel.

Radio frequency (RF) signals — (1) RF signals are generally considered to be any electrical signals with a frequency higher than 20000 Hz, up to 300 GHz. (2) Electromagnetic radiation in the form of radio waves.

Radio horizon — The position at which a direct wave radiated from an antenna becomes tangent to the surface of the Earth. Note that as the wave continues past the horizon, the wave gets higher and higher above the surface.

Radiation inversion — A weather condition that affects propagation at VHF and above. Radiation inversions form only over land after sunset because of progressive cooling of the air near the Earth's surface.

Rain scatter — A special case of tropospheric scatter practical in the 3.3 to 24 GHz range that is caused by scatter from raindrops.

Reflection — Signals that travel by ***Line-of-sight propagation*** are reflected by large objects like buildings.

Refraction — Bending waves by changing the velocity of propagation. Radio waves refract as they travel through the ionosphere. If the radio waves refract enough, they will return to Earth. This is the basis for long-distance communication on the HF bands.

Scattering — Radio wave propagation by means of multiple reflections in the layers of the atmosphere or from an obstruction. Scatter propagation also occurs in the ionosphere when there is not enough ionization for refraction or reflection, but enough to send weak electromagnetic waves off into varied directions.

Scintillation fading — Fading that occurs when a signal arrives at the receiver by two or more different paths simultaneously, causing addition or partial cancellation depending on the relative phases and amplitudes of the paths.

Selective fading — A variation of radio wave intensity that changes over small frequency changes. It may be caused by changes in the medium through which the wave is traveling or changes in transmission path, among other things.

Short path — The shorter of the two great circle paths between two stations.

Skip — Propagation by means of ionospheric refraction. Traversing the distance to the ionosphere and back to the ground is called a ***hop***.

Skip zone — A ring-shaped area of poor radio communication, too distant for ground waves and too close for sky waves.

Sky-wave propagation — The method by which radio waves travel through the ionosphere and back to Earth. Sometimes called ***Skip***, sky-wave propagation has a far greater range than ***Line-of-sight*** and ***Ground-wave propagation***.

Solar cycle — The approximate 11-year period of variation in solar activity.

Solar flare — An eruption on the surface of the Sun that launches a wide spectrum of electromagnetic energy into space, disrupting communications on Earth. A large flare can also release relativistic protons that cause additional absorption in the polar cap.

Solar wind — Electrically charged particles emitted by the Sun and traveling through space. Variations in the solar wind may have a sudden impact on radio communications when they arrive at the atmosphere of the Earth.

Sporadic E — A form of enhanced radio wave propagation that occurs when radio signals are reflected from small, thin and dense ionization patches in the E region of the ionosphere. Sporadic E is observed on the 15-, 10-, 6- and 2-meter bands, and occasionally on the 1.25-meter band.

Sunspot cycle — The number of ***Sunspots*** increases and decreases in a somewhat predictable cycle that lasts about 11 years.

Sunspots — Dark spots on the surface of the Sun. When there are few sunspots, long-distance radio propagation is poor on the higher-frequency bands. When there are many sunspots, long-distance HF propagation improves.

Temperature inversion — A condition in the atmosphere in which a region of cool air is trapped beneath warmer air.

Transequatorial propagation — A form of F layer ionospheric propagation, in which signals of higher frequency than the expected MUF are propagated across the Earth's magnetic equator.

Troposphere — The region in Earth's atmosphere just above the Earth's surface and below the ionosphere.

Tropospheric bending — When radio waves are bent in the troposphere, they return to Earth farther away than the visible horizon. 100 to 500 kilometers (60 to 310 miles), depending on frequency.

Ultra high frequency (UHF) — The term used for the frequency range between 300 MHz and 3000 MHz (3 GHz). Technician licensees have full privileges on all Amateur UHF bands.

Very high frequency (VHF) — The term used for the frequency range between 30 MHz and 300 MHz.

Tropospheric ducting — A type of VHF propagation that can occur when warm air overruns cold air (a temperature inversion).

Tropospheric scatter — A method of radio communication at VHF and above that takes advantage of scattering in the **troposphere** to allow contacts beyond the radio horizon out to a working distance of 60 and 310 miles.

Visible horizon — The most distant point one can see by line of sight.

WWV/WWVH — Radio stations run by the US NIST (National Institute of Standards and Technology) to provide accurate time and frequencies.

Chapter 20 — Transmission Lines

Antenna tuner — A device that matches the antenna system input impedance to the transmitter, receiver or transceiver output impedance. Also called an *antenna-matching network, impedance matcher, transmatch, ATU,* and *matchbox*.

Balanced line — A symmetrical two-conductor feed line that has uniform voltage and current distribution along its length.

Balun — Contraction of "balanced to unbalanced." A device to couple a balanced load to an unbalanced feed line or device, or vice versa. May be in the form of a choke balun, or a transformer that provides a specific impedance transformation (including 1:1). Often used in antenna systems to interface a coaxial transmission line to the feed point of a balanced antenna, such as a dipole.

Characteristic impedance — The ratio of voltage to current in a matched feed line, it is determined by the physical geometry and materials used to construct the feed line. Also known as *surge impedance* since it represents the impedance electromagnetic energy encounters when entering a feed line.

Choke balun — A balun that prevents current from flowing on the outside of a coaxial cable shield when connected to a balanced load, such as an antenna.

Coax — See ***Coaxial cable***.

Coaxial cable — Transmission lines that have the outer shield (solid or braided) concentric with the same axis as the inner or center conductor. The insulating material can be a gas (air or nitrogen) or a solid or foam insulating material.

Common-mode current — Current that flows equally and in phase on all conductors of a feed line or multiconductor cable.

Conductor — A metal body such as tubing, rod, or wire that permits current to travel continuously along its length.

Conjugate match — Creating a purely resistive impedance by connecting an impedance with an equal-and-opposite reactive component.

Current balun — See ***Choke balun***.

Decibel — A logarithmic power ratio, abbreviated dB. May also represent a voltage or current ratio if the voltages or currents are measured across (or through) identical impedances. Suffixes to the abbreviation indicate references: dBi, isotropic radiator; dBm, milliwatt; dBW, watt.

Dielectrics — Various insulating materials used in antenna systems, such as found in insulators and transmission lines.

Dielectric constant (k) — Relative figure of merit for an insulating material used as a dielectric. This property determines how much electric energy can be stored in a unit volume of the material per volt of applied potential.

Electric field — An electric field exists in a region of space if an electrically charged object placed in the region is subjected to an electrical force.

Electromagnetic wave — A wave of energy composed of an electric and magnetic field.

Feed line — See ***Transmission line***.

Feed point — The point at which a feed line is electrically connected to an antenna.

Feed point impedance — The ratio of RF voltage to current at the feed point of an antenna.

Ferrite — A ceramic material with magnetic properties.

Hardline — Coaxial cable with a solid metal outer conductor to reduce losses compared to flexible cables. Hardline may or may not be flexible.

Impedance match — To adjust impedances to be equal or the case in which two impedances are equal. Usually refers to the point at which a feed line is connected to an antenna or to transmitting equipment. If the impedances are different, that is a **mismatch**.

Impedance matcher — See ***Antenna tuner***.

Impedance matching (circuit) — A circuit that transforms impedance from one value to another. Adjustable impedance matching circuits are used at the output of transmitters and amplifiers to allow maximum power output over a wide range of load impedances.

Impedance transformer — A transformer designed specifically for transforming impedances in RF equipment.

L network — A combination of two reactive components used to transform or match impedances. One component is connected in series between the source and load and the other shunted across either the source or the load. Most L networks have one inductor and one capacitor, but two-inductor and two-capacitor configurations are also used.

Ladder line — See ***Open-wire line***.

Lambda (λ) — Greek symbol used to represent wavelength.

Line loss — The power dissipated by a transmission line as heat, usually expressed in decibels.

Load — (noun) The component, antenna, or circuit to which power is delivered; (verb) To apply a load to a circuit or a transmission line.

Loading — The process of a transferring power from its source to a load. The effect a load has on a power source.

Magnetic field — A region through which a magnetic force will act on a magnetic object.

Matched-line loss — The line loss in a feed line terminated by a load equal to its characteristic impedance.

Matching — The process of effecting an impedance match between two electrical circuits of unlike impedance. One example is matching a transmission line to the feed point of an antenna. Maximum power transfer to the load (antenna system) will occur when a matched condition exists.

Microstrip — A transmission line made from a strip of printed-circuit board conductor above a ground plane, used primarily at UHF and microwave frequencies.

Open-wire line — Parallel-conductor feed line with parallel

insulators at regular intervals to maintain the line spacing. The dielectric is principally air, making it a low-loss type of line. Also known as *ladder line* or *window line*.

Output impedance — The equivalent impedance of a signal source.

Parallel-conductor line — A type of transmission line that uses two parallel wires spaced from each other by insulating material. Also known as *open-wire*, *ladder*, or *window line*.

Phasing lines — Sections of transmission line that are used to ensure the correct phase relationship between the elements of a driven array, or between bays of an array of antennas. Also used to effect impedance transformations while maintaining the desired phase.

Q section — Term used in reference to transmission-line matching transformers and phasing lines.

Reflection coefficient (ρ) — The ratio of the reflected voltage at a given point on a transmission line to the incident voltage at the same point. The reflection coefficient is also equal to the ratio of reflected and incident currents. The Greek letter rho (ρ) is used to represent reflection coefficient.

Reflectometer — See ***SWR bridge***.

Resonance — (1) The condition in which a system's natural response and the frequency of an applied or emitted signal are the same. (2) The frequency at which a circuit's capacitive and inductive reactances are equal and cancel.

Resonant frequency — The frequency at which the maximum response of a circuit occurs. In an antenna, the resonant frequency is one at which the feed point impedance is purely resistive.

Return loss — The absolute value of the ratio in dB of the power reflected from a load to the power delivered to the load.

Rise time — The time it takes for a waveform to reach a maximum value.

Series-input network — A network such as a filter or impedance matching circuit in which the input current flows through a component in series with the input.

Shunt-input network — A network such as a filter or impedance matching circuit with a component connected directly across the input.

Skin effect — The phenomenon in which ac current at high frequencies flows in a thin layer near the surface of a conductor.

Smith chart — A coordinate system developed by Phillip Smith to represent complex impedances graphically. This chart makes it easy to perform calculations involving antenna and transmission-line impedances and SWR.

Standing-wave ratio (SWR) — Sometimes called voltage standing-wave ratio (VSWR). A measure of the impedance match between a feed line's characteristic impedance and the attached load (usually an antenna). VSWR is the ratio of maximum voltage to minimum voltage along the feed line, or of antenna impedance to feed line impedance.

Stacking — The technique of placing similar directive antennas atop or beside one another, forming a "stacked array." Stacking provides more gain or directivity than a single antenna.

Stub — A section of transmission line used to perform impedance matching or filtering.

Surge impedance — see ***Characteristic impedance***.

SWR — see ***Standing-wave ratio (SWR)***.

SWR bridge — Device for measuring SWR in a transmission line. Also known as an SWR meter or reflectometer.

TE mode — Transverse electric field mode. Condition in a waveguide in which the E-field component of the traveling electromagnetic energy is oriented perpendicular to (transverse) the direction the energy is traveling in the waveguide.

TM mode — Transverse magnetic field mode. Condition in a waveguide in which the H-field (magnetic field) component of the traveling electromagnetic energy is oriented perpendicular to (transverse) the direction the energy is traveling in the waveguide.

Transmatch — See ***Antenna tuner***.

Transmission line — The wires or cable used to connect a transmitter or receiver to an antenna. Also called ***feed line***.

Twin-lead — Parallel-conductor transmission line in which both conductors are completely embedded in continuous strip of insulating material.

Unbalanced line — Feed line with one conductor at dc ground potential, such as coaxial cable.

Universal stub system — A matching network consisting of a pair of transmission line stubs that can transform any impedance to any other impedance.

Velocity factor (VF) — The speed at which an electromagnetic wave will travel through a material or feed line stated as a fraction of the speed of the wave in free space (where the wave would have its maximum velocity).

VSWR — Voltage standing-wave ratio. (See also ***Standing Wave Ratio (SWR)***.)

Waveguide — A hollow conductor through which electromagnetic energy flows. Usually used at UHF and microwave frequencies instead of coaxial cable.

Window line — See ***Open-wire line***.

Chapter 21 — Antennas

Antenna — An electrical conductor or array of conductors that radiates signal energy (transmitting) or collects signal energy (receiving).

Antenna tuner — A device containing variable reactances (and perhaps a balun) used to convert an antenna or feed line impedance to 50 Ω. (Also called transmatch, impedance-matching unit, or matchbox.)

Apex angle — The included angle between the legs of an inverted-V antenna.

Azimuth (azimuthal) pattern — A radiation pattern in a plane oriented parallel to the Earth's surface or at a specified angle to the Earth's surface.

Balanced feed line — A two-conductor feed line with each conductor having the same impedance with respect to a reference potential, usually an earth connection (also called open-wire line, ladder line, window line, or twin-lead).

Balun — A device that transfers energy between a balanced and unbalanced system. A balun may or may not change the impedance ratio between the systems.

Base loading — Adding a coil to the base of a ground-plane antenna to increase its electrical length.

Beamwidth — The width in degrees of the major lobe of a directive antenna between the two angles at which the relative radiated power is equal to one-half its value (–3 dB) at the peak of the lobe.

Capacitance hat — A conducting structure with a large surface area that is added to an antenna to add capacitive reactance at that point on the antenna.

Center loading — Adding a coil near the center of a ground-plane antenna to increase its electrical length.

Coaxial cable (coax) — A coaxial transmission line with a center conductor surrounded by a layer of insulation and then a tubular shield conductor and covered by an insulating jacket. (See also ***Unbalanced feed line***.)

Delta loop — A full-wavelength loop, usually in the vertical plane, shaped like a triangle or delta.

Delta match — Center-feed technique used with antenna elements that are not split at the center in which the transmission line is spread apart and connected to the element symmetrically, forming a triangle or delta.

Dipole — An antenna, usually one-half wavelength long, divided into two parts at a feed point. An *off-center-fed (OCF) dipole* has a feed point offset from the center.

Directivity — The property of an antenna that concentrates the radiated energy to form one or more major lobes.

Director — An antenna element in a parasitic array that causes radiated energy from the driven element to be focused along the line from the driven element to the director.

Doublet — A more general name for a wire antenna fed in the center and that may or may not be resonant at the operating frequency.

Driven array — An array of antenna elements which are all driven or excited by means of a transmission line.

Driven element — An antenna element excited by means of a transmission line.

E-plane — The plane in which the electric field of an electromagnetic wave is maximum.

Efficiency (antenna) — The ratio of radiated power to input power.

Elements — The conductive parts of an antenna system that determine the antenna's characteristics.

Elevation pattern — A radiation pattern in a plane perpendicular to the Earth's surface.

End effect — The effect of capacitance at the end of an antenna element that acts to electrically lengthen the element.

End-fed half wave (EFHW) — A half-wavelength antenna fed at one end, usually with open-wire feed line.

Feed line — See ***Transmission line***.

Feed point — location at which a transmission line delivers power to an antenna.

Front-to-back ratio — The ratio in dB of the radiation from an antenna in a favored direction to that in the opposite direction.

Front-to-rear ratio — The ratio in dB of the radiation from an antenna is a favored direction to an average of the radiation in the opposite direction across some specified angle.

Front-to-side ratio — The ratio in dB of the radiation from an antenna in a favored direction to that at right angles to the favored direction.

Gain — The increase in radiated power with respect to a reference antenna in the desired direction of the major lobe.

Gamma match — A matching system used with driven antenna elements in which a conductor is placed near the element and connected to the feed line with an adjustable capacitor at the end closest to the center and connected to the element at the other.

Ground plane — A system of conductors configured to act as a substitute for an earth ground to an antenna element and connected to one side of the transmission line.

H-plane — The plane in which the magnetic field of an electromagnetic wave is maximum.

Hairpin match — A U-shaped inductor that is connected across the feed point of a driven element for the purpose of creating a match to a feed line.

Impedance — The ratio of voltage to current in a feed line or along an antenna.

Inverted-V — A dipole antenna supported at its mid-point with halves angled down toward the ground.

Isotropic — An imaginary antenna that radiates and receives equally well in all directions.

Ladder line — See ***Balanced line***.

Line loss — The power lost in a transmission line, specified in dB per unit of length.

Load — The electrical system or component to which power is delivered.

Lobe — A region of increased radiation in an antenna's radiation pattern between two nulls. A *main lobe* is the largest lobe in the pattern and all other lobes are *side lobes*.

Matching — The process by which power at one impedance is transferred to a system having a different impedance.

Monopole — An antenna with a single element that functions in concert with a ground-plane.

Null — A point of minimum radiation in an antenna's radiation pattern.

Open-wire line — See ***Balanced line***.

Parasitic array — A set of elements that form a radiation pattern through coupling and re-radiation of energy from one or more driven elements.

Polarization — The orientation of an antenna or electromagnetic field, referring to the orientation of the E field.

Q section — A quarter-wavelength section of transmission line used for impedance-matching purposes.

Quad — A directive antenna based on the Yagi with elements that consist of one wavelength loops.

Radiation pattern — The characteristics of an antenna's distribution of energy in a single plane. (See also ***Elevation pattern*** and ***Azimuth pattern***.)

Radiation resistance — A resistance that represents the work done by the current in an antenna to radiate power.

Reflector — An antenna element in a parasitic array that causes radiated energy from the driven element to be focused along the line from the driven element away from the reflector.

Sense Antenna — An antenna added to a bidirectional array or loop that samples the incoming signal's phase for comparison to that of the main receiving antenna.

Stacking — Arranging two or more directive antennas such that their radiation pattern characteristics reinforce each other.

SWR (VSWR) — Standing-wave ratio. A measure of the match between a transmission line and a load such as an antenna.

T-match — A symmetrical version of the gamma match for a balanced antenna system.

Top loading — Addition of a reactance, usually capacitive, at the top of a ground-plane antenna to increase its electrical length.

Transmatch — See ***Antenna tuner***.

Trap — A parallel LC-circuit used to isolate sections of an antenna.

Twin-lead — See ***Balanced line***.

Unbalanced feed line — A transmission line such as coaxial cable with conductors that have different impedances with respect to a reference potential, usually an earth connection. One conductor is usually connected directly to the reference. (See also ***Balanced line***.)

Unipole — See ***Monopole***.

Yagi — Short for Yagi-Uda antenna. A parasitic array consisting of a driven element and one or more director and reflectors.

Zepp — See ***End-fed half wave***.

Chapter 24 — Assembling a Station

REMOTE STATION GLOSSARY

API — Application Programming Interface is a software interface that allows two applications to interact with each other without any user intervention.

App — An application (program) installed on a cellular smartphone.

Band decoder — An interface device that reads frequency data from a modern transceiver and facilitates automatic control switching of other equipment such as a bandpass filter.

Bandwidth — Typically expressed in Mbps or kbps, this is used to represent both the capability of an internet connection for data transfer as well as the amount of data that can be transferred.

CAT — Computer Aided Transceiver. Used for interface between modern amateur radio transceiver and computer. Provides radio control and audio interfacing.

Cellular Modem — Also known as a "hot spot," allows an internet connection through the cellular phone network.

CEPT — European Conference of Postal and Telecommunications Administrators. US amateurs are permitted to operate from member nations without the requirement of obtaining additional licenses or permits.

CI-V — Proprietary communications medium for interfacing Icom transceivers to computers and associated equipment.

CMD — *Windows Command Prompt* is a program that emulates the input field in a text-based user interface screen with the *Windows Graphical User Interface (GUI)*. It can be used to execute entered commands and perform advanced administrative functions. It can also be used to troubleshoot and solve certain kinds of *Windows* issues.

DDNS — Dynamic Domain Name System. Internet services provided to associate domain names with Dynamic IP addresses.

DHCP — Dynamic Host Configuration Protocol. This functionality is incorporated into most routers and provides automatic assignment of IP addresses to computer devices on a LAN where fixed or static IP addresses are not required.

DSL — Digital Subscriber Line. A technology for bringing high-bandwidth data to homes and small businesses over ordinary copper telephone lines.

DTMF — Dual-Tone Multi-Frequency signaling. Keypad signaling system using the voice-frequency band over telephone lines between telephone equipment and other communications devices. Also known by the trade name Touch-Tone.

Duty cycle — A device which is constantly "on" would normally be considered to have a 100% duty cycle. Morse code keying has spaces between the elements and the characters; therefore, the duty cycle would be less.

ERC — Easy Rotator Control. Electronic interfaces for controlling rotators from a computer.

Firewall — Firmware or software capabilities in computers and routers that can be configured to minimize or completely block unauthorized users from access.

Flow — JavaScript based function module, part of the web browser-based visual programming environment that makes up the elements of a Node-Red project.

GUI — Graphical User Interface is a visual form of user interface that allows users to interact with electronic devices.

HAMNET — Broadband-Hamnet (BBHN). A high speed wireless computer network using commercial WiFi equipment with custom firmware on amateur radio frequencies.

Internet Service Provider (ISP) — An organization that provides services for accessing and using the internet.

IP — Internet Protocol. The communications protocol used to route packets of information between devices on the internet. (See also ***TCP***.)

IPv4 — The fourth version of the Internet Protocol (IP), based on 32-bit (four-byte) decimal addressing.

IPv6 — The sixth and most recent version of the Internet Protocol (IP), based on 128-bit addressing, using eight groups of four hexadecimal digits.

IP Address — Every computer or device accessible via the internet or a LAN has a unique numeric address, such as 192.168.1.1 assigned to it. The IP address is associated to the fixed MAC address of the device.

kbps — Kilobits per second (one thousand bits per second). Typically used as a reference to bandwidth data rate capability or actual usage.

LAN — Local Area Network. A home LAN enables multiple computers to connect to a single internet service.

Latency — The delays involved in data routing from one point to another, but also a factor in A/D conversion processes.

MAC address — Media Access Control address. A unique address given to network interface devices such as Ethernet or WiFi interface cards.

Mbps — Megabits per second (one million bits per second). Typically used as a reference to bandwidth data rate capability or actual usage.

ms — Milliseconds. The unit of time typically used for measuring latency.

Netbook — A portable computer smaller than a traditional laptop or notebook. Many netbooks now use solid-state instead of rotating hard drives.

Packet — A formatted set of digital information. All information sent via the internet is first converted into packets for transmission.

Panadapter — A device similar to a spectrum analyzer that allows you to visually see the RF spectrum received by the radio.

Pathping — A hybrid utility of the *path* and *tracert* functions which requires more time for analysis between two internet connection points, but results in a more detailed analysis.

Ping — A utility used to ascertain the availability of another computer device over the internet or LAN and also measure the round trip time required for the connection.

Port forwarding — Functionality most commonly used in routers to direct or re-direct incoming internet traffic to specific destinations on a local network.

POTS — Plain Old Telephone Service. This generally refers to the use of a regular analog telephone system for purposes of remote audio and control signal routing in lieu of the internet.

QoS — Quality of Service. The overall performance of a telephony or computer network. Performance can be enhanced by prioritizing services on the network.

RDP — Remote Desktop Protocol. A proprietary protocol developed by Microsoft, which provides a user with a graphical interface to connect to another computer over a network connection.

Remote Client — The remote location from which the operator will be controlling the host station site. This could be a home location or hotel room but can be anywhere connectivity to the host station site is available.

Router — A device that allows traffic on a single internet service line to be selectively distributed to multiple computer devices on a LAN. Many routers provide for assignment of local IP addresses as well as automatically via DHCP.

SDR — Software Defined Radio. A radio communication system where components that have been typically implemented in hardware (e.g., mixers, filters, amplifiers, modulators/demodulators, detectors, etc.) are instead implemented by means of software on a personal computer or embedded system.

Serial Port Server — A device that transfers data between a computer or device serial port (COM port) and an Ethernet local area network (LAN).

Smartphone — A generic term for portable cellular phones with integrated computer capabilities.

Static IP — A fixed IP address in a computer or device.

Station site — The actual physical location of the transmitter, host computer, antennas and related equipment necessary to generate an RF signal on the HF bands. Some have used the term *Remote Base*.

Switch — A network device that allows multiple computers or devices to share the same internet or LAN connection.

TCP — Transport Control Protocol. An internet protocol (see also ***IP***), usually combined with IP to transfer data between devices over networks.

TCP Client — Software designed for remotely connecting to and processing data from equipment through a TCP Server over a home network or the internet.

TCP Server — Host software used for providing TCP Client software remote access to a computer or device.

Tracert — A CMD utility for tracing the path taken by packets across the internet and latency assessing analysis along the route.

VNC — Virtual Network Computing. A graphical desktop sharing system that uses the Remote Frame Buffer protocol (RFB) to remotely control another computer.

VPN — Virtual Private Network. Allows you to create a secure connection to another network over the internet.

Waterfall — A graphical display that shows a continually updating sequence of RF spectra.

WiFi — A form of network connectivity without a physical wired connection, although with limited range. Also known by its controlling standard, IEEE 802.11.

Wireless bridge — Low powered transmitter-receiver devices for providing point-to-point digital communications, usually Ethernet, such as for interfacing internet services to areas without traditional means.

Chapter 27 — RFI and EMC

Balanced circuit — A circuit whose two conductors have equal impedance to a common reference, such as a reference plane or circuit common.

Bond — (noun) A low-impedance, mechanically robust, electrical connection.

Common-mode — In a group of conductors, such as multi-conductor cable, voltage or current that is present with the same amplitude, phase and polarity on all conductors in a group, such as multi-conductor cable. AC current flowing on the outside of a coaxial cable shield is also considered to be common-mode current.

Conducted RFI — RFI received via a conducting path.

Coupled RFI — RFI received via inductive or capacitive coupling between conductors.

Differential mode — A signal that exists and is transmitted as a voltage *between* two conductors of a cable. At any instant, signal current on one conductor is equal to but of the opposite polarity to the current on the other conductor. Ordinary connections between equipment in systems are differential mode signals.

Disturbance — The improper operation of a device because of interference.

Electric field — The field present between two or more conductive objects because of potential difference (voltage) between those objects.

Electromagnetic field — The combination of a magnetic field and electric field in which the fields are directly related to each other, are at right angles to each other, and move through space as radio waves in a direction that is mutually perpendicular to both fields. An electrical conductor designed to produce electromagnetic fields when carrying an RF current is called an antenna.

Equipment ground — The connection of all exposed parts of electrical equipment to earth, or to a body that serves in place of earth.

Fundamental overload — (1) (Receiver Performance) Interference to a receiver caused by a signal at its input whose amplitude exceeds the maximum signal handling capabilities of one or more receiver stages. (2) (RF interference) — Any disruption to the function of any RFI victim caused by the fundamental component of a transmitted signal or intended in-band output of a transmitter.

Ground — (1) A low impedance electrical connection to earth, or to a body that serves in place of earth. (2) A common signal connection in an electrical circuit.

Immunity — The ability of a device to function properly in the presence of unwanted electromagnetic energy. (After Ott, section 1.3)

Intentional radiator — A device that uses radio waves to transmit information by antenna action. A radio transmitter, with its associated antenna, is an intentional radiator.

Interference — (1) Disruption of a device's normal function because of an electromagnetic field, voltage, or current. (2) Disruption by a signal or noise of a receiver's ability to acquire and process a desired signal.

Magnetic field — The field produced by a permanent magnet or current flow through a conductor.

Path — The route by which electromagnetic energy is transferred from a transmitter to a receiver or from a source to a victim.

Radiated RFI — RFI received through radiation.

Shielding — A conductive barrier or enclosure interposed between two regions of space with the intent of preventing a field in one region from reaching the other region.

Source — A device that produces an electromagnetic, electric, or magnetic field, voltage, or current. If RFI is the result, the source is an *RFI source*.

Spurious emission — An emission outside the bandwidth needed for transmission of the mode being employed, the level of which may be reduced without reducing the quality of information being transmitted. Spurious emissions are most commonly the products of distortion (harmonics, intermodulation), of circuit instability (oscillation, including RF feedback), or of digital transmission with excessively fast rise times (including key clicks). Phase noise, such as that produced by a frequency synthesizer is also a spurious emission.

Susceptibility — The capability of a device to respond to unwanted electromagnetic energy. (After Ott, section 1.3)

System ground — A bond between one current-carrying conductor of the power system and earth.

Unintentional radiator — A device that produces RF as part of its normal operation but does not intentionally radiate it.

Victim — A device that receives interference from a *source*.

Alphabetical Glossary

A index — An open-ended linear index that corresponds roughly to the cumulative K index values (it's the daily average of the eight K indices after converting the K indices to a linear scale). The A index commonly varies between 0 and 30 during quiet to active conditions, and up to 100 and higher during geomagnetic storms.

Absorption — The dissipation of the energy of a radio wave as it travels through a medium such as the ionosphere.

AC ground — A circuit connection point that presents a very low impedance to ac signals.

ACK — Acknowledgment, the control signal sent to indicate the correct receipt of a transmission block.

Active — A device that requires power to operate.

Active filter — A filter that uses active (powered) devices to implement its function.

Active region — The region in the characteristic curve of an analog device in which it can process the signal linearly.

Adaptive filter — A filter whose coefficients can be changed automatically.

Address — A character or group of characters that identifies a source or destination.

AFSK — Audio frequency-shift keying.

ALE — Automatic link establishment.

Algorithm — Numerical method or process.

All-pass — Filter response in which the magnitude response does not change with frequency, but the phase response does change with frequency.

Alternating current (ac) — A flow of charged particles through a conductor, first in one direction, then in the other direction.

AM (amplitude modulation) — The oldest voice operating mode still found on the amateur bands. The most common HF voice mode, SSB, is actually a narrower bandwidth variation of AM.

Amateur (Radio) Service — A radiocommunication service for the purpose of self-training, intercommunication and technical investigations carried out by licensed individuals interested in radio technique solely with a personal aim and without pecuniary interest.

Amateur radio — A radiocommunication service for the purpose of self-training, intercommunication and technical investigation carried out by licensed individuals interested in radio technique solely with a personal aim and without pecuniary interest. (Pecuniary means payment of any type, whether money or goods.) Also called "ham radio."

Amateur radio operator — A person holding an FCC license to operate a radio station in the Amateur Radio Service.

Amateur radio station — A station licensed by the FCC in the Amateur Radio Service, including necessary equipment.

Ampere — A measure of flow of charged particles per unit of time. One ampere (A) represents one coulomb of charge flowing past a point in one second.

Amplification — The process by which amplitude of a signal is increased. Gain is the amount by which the signal is amplified.

Amplitude response — See ***Magnitude response***.

AMSAT (Radio Amateur Satellite Corporation) — An international membership organization that designs, builds and promotes the use of amateur radio satellites, sometimes called "OSCARs."

Analog signal — A signal that can have any amplitude (voltage or current) value and exists at any point in time.

Analog-to-digital converter (ADC) — A device that samples an analog signal and outputs a digital number representing the amplitude of the signal.

Anode — The element of an analog device that accepts electrons or toward which electrons flow.

Antenna — An electrical conductor or array of conductors that radiates signal energy (transmitting) or collects signal energy (receiving).

Antenna tuner — A device containing variable reactances (and perhaps a balun) that matches the antenna system input impedance to the transmitter, receiver or transceiver output impedance. Also called an *antenna-matching network*, *impedance matcher*, *transmatch*, *ATU*, and *matchbox*.

Anti-aliasing filter — A band-limiting filter placed before a sampler to make sure the incoming signal satisfies the Nyquist criterion.

Antipode — Locations directly opposite each other on a globe.

APCO — Association of Public Safety Communications Officials.

Apex angle — The included angle between the legs of an inverted-V antenna.

API — Application Programming Interface is a software interface that allows two applications to interact with each other without any user intervention.

App — An application (program) installed on a cellular smartphone.

Application-specific integrated circuit (ASIC) — A non-programmable IC that is designed for a particular application.

APRS — Automatic Packet/Position Reporting System, a marriage of an application of the Global Positioning System and amateur radio to relay position and tracking information.

Arc — Current flow through an insulator due to breakdown from excessive voltage.

ARES (Amateur Radio Emergency Service) — An ARRL program for radio amateurs who participate in emergency communication.

ARISS — An acronym for Amateur Radio on the International Space Station. NASA, ARRL, AMSAT, and others cooperate in managing the ARISS program on a national and international level.

Arithmetic logic unit (ALU) — The portion of a microprocessor that performs basic arithmetic and logical operations.

ARQ — Automatic Repeat reQuest, an error-sending station, after transmitting a data block, awaits a reply (ACK or NAK) to determine whether to repeat the last block or proceed to the next.

ARRL — The national association for amateur radio in the US; the US member-society in the IARU (International Amateur Radio Union).

ASCII — American National Standard Code for Information Interchange, a code consisting of seven information bits.

Atmosphere — The mass of air surrounding the Earth. Radio signals travel through the atmosphere and different conditions in the atmosphere (in conjunction with the signal's frequency) affect how those signals travel or propagate.

Atom — The smallest particle of matter that makes up a distinct chemical element. Atoms consist of protons and neutrons in the central region called the nucleus, with electrons surrounding the nucleus.

Attenuation — The process of reducing the amplitude of a signal.

ATV (amateur television) — An amateur radio operating mode for sharing real time video. ATV may be analog or digital (DATV).

Aurora — A disturbance of the atmosphere at high latitudes resulting from an interaction between electrically charged particles from the magnetosphere and the magnetic field of the Earth. Auroral propagation occurs when HF through UHF signals are reflected from the aurora to reach another station.

Auroral E — Sporadic E in the auroral zone.

Avalanche breakdown — Current flow through a semiconductor device in response to an applied voltage beyond the device's ability to control or block current flow.

AX.25 — Amateur packet-radio link-layer protocol.

Azimuth (azimuthal) pattern — A radiation pattern in a plane oriented parallel to the Earth's surface or at a specified angle to the Earth's surface.

Backscatter — Single-hop signals that have been scattered by the Earth or the ocean at some distant point back toward the transmitting station.

Balanced circuit — A circuit whose two conductors have equal impedance to a common reference, such as a reference plane or circuit common.

Balanced feed line — A two-conductor feed line with each conductor having the same impedance with respect to a reference potential, usually an earth connection (also called open-wire line, ladder line, window line, twin-lead).

Balanced line — A symmetrical two-conductor feed line that has uniform voltage and current distribution along its length.

Balun — Contraction of "balanced to unbalanced." A device to couple a balanced load to an unbalanced feed line or device, or vice versa. May be in the form of a choke balun, or a transformer that provides a specific impedance transformation (including 1:1). Often used in antenna systems to interface a coaxial transmission line to the feed point of a balanced antenna, such as a dipole. (See also ***Unun***.)

Band — A range of frequencies in the radio spectrum, usually designated by approximate wavelength in meters. For example, 7.0 to 7.3 MHz (megahertz) is the 40-meter amateur band. Hams are authorized to transmit on many different bands.

Band decoder — An interface device that reads frequency data from a modern transceiver and facilitates automatic control switching of other equipment such as a bandpass filter.

Band-pass — Filter response in which signals are passed in a range of frequencies and rejected outside that range.

Band-stop — Filter response in which signals are rejected in a range of frequencies and passed outside that range (also called *band-reject* or *notch filter*).

Bandwidth — (1) In general, the width of a transmitted signal in terms of occupied spectrum. FCC definition: "The width of a frequency band outside of which the mean power of the transmitted signal is attenuated at least 26 dB below the mean power of the transmitted signal within the band." (2) Range of frequencies over which signals are passed (low-pass, high-pass, band-pass) or rejected (band-stop). (3) Typically expressed in Mbps or kbps, this is used to represent both the capability of an internet connection for data transfer as well as the amount of data that can be transferred.

Barrel shifter — A circuit in a microprocessor that can bit-shift a number by multiple bits at one time.

Base — The terminal of a bipolar transistor in which control current flows.

Base loading — Adding a coil to the base of a ground-plane antenna to increase its electrical length.

Baseband — The low-frequency portion of a signal. This is typically the modulation.

Baud — A unit of signaling speed equal to the number of discrete conditions or events per second. (If the duration of a pulse is 20 ms, the signaling rate is 50 baud or the reciprocal of 0.02, abbreviated Bd).

Baudot code — A coded character set in which five bits represent one character. Used in the US to refer to ITA2.

Beacon — An amateur station transmitting communication for the purposes of observation of propagation and reception or other related experimental activities.

Beacon station — A station that transmits continuously, allowing other stations to assess propagation to and from the location of the beacon station.

Bead — Hollow cylinder of magnetic material through which a wire is threaded to form an inductor.

Beam antenna — A ham radio antenna having directional characteristics to enhance the transmitted signal in one direction at the expense of others. A "rotary beam" can be pointed in any direction.

Beamwidth — The width in degrees of the major lobe of a directive antenna between the two angles at which the relative radiated power is equal to one-half its value (–3 dB) at the peak of the lobe.

Bell 103 — A 300-baud full-duplex modem using 200-Hz-shift FSK of tones centered at 1170 and 2125 Hz.

Bell 202 — A 1200-baud modem standard with 1200-Hz mark, 2200-Hz space, used for VHF FM packet radio.

BER — Bit error rate.

BERT — Bit-error-rate test.

Beta (β) — The dc current gain of a bipolar transistor, also designated hFE.

Biasing — The addition of a dc voltage or current to a signal at the input of an analog device, changing or controlling the position of the device's operating point on the characteristic curve.

Bilateral — A network that operates or responds in the same manner regardless of the direction of current flow in the network.

Binary point — The symbol that separates the integer part from the fractional part of a binary number.

Bipolar transistor — An analog device made by sandwiching a layer of doped semiconductor between two layers of the opposite type: PNP or NPN.

Bit — Binary digit, a single symbol, in binary terms either a one or zero.

Bit rate — Rate at which bits are transmitted in bit/s or bps. Gross (or raw) bit rate includes all bits transmitted, regardless of purpose. Net bit rate (also called throughput) only includes bits that represent data.

Bit stuffing — Insertion and deletion of 0s in a frame to preclude accidental occurrences of flags other than at the beginning and end of frames.

Bit/s or bps — Bits per second.

Bitmap — See ***Raster***.

Black box — Circuit or equipment that is analyzed only with regards to its external behavior.

Bleeder — A resistive load across the output or filter of a power supply, intended to quickly discharge stored energy once the supply is turned off.

BLER — Block error rate.

BLERT — Block-error-rate test.

Blocking dynamic range (BDR) — The difference between the noise level (usually in a 500-Hz bandwidth) and the signal level that causes a 1 dB reduction in the level of a weaker signal.

Bode plot — Graphs showing amplitude response in dB and phase response in degrees versus frequency on a logarithmic scale.

Bond — (noun) A low-impedance, mechanically robust, electrical connection.

Boost converter — A ***Switchmode converter*** in which the output voltage is always greater than or equal to the input voltage.

BPSK — Binary phase-shift keying in which there are two combinations of phase used to represent data symbols.

Brick wall response — An ideal filter response in which signals are either passed with no attenuation or attenuated completely.

Broadcasting — Transmissions intended for reception by the general public, either direct or relayed. Amateur radio licensees are not permitted to engage in broadcasting.

Buck converter — A ***Switchmode converter*** in which the output voltage is always less than or equal to the input voltage.

Buck-boost converter — A ***Switchmode converter*** in which the magnitude of the output voltage can be either greater or less than the input voltage.

Buffer — (1) An analog stage that prevents loading of one analog stage by another. (2) A circuit that amplifies the output of a circuit while isolating it from the load.

Bypass — Create a low ac impedance to ground at a point in the circuit.

Byte — A group of bits, usually eight.

Cache — To store data or packets in anticipation of future use, thus improving routing or delivery performance.

Call sign — A series of unique letters and numerals that the FCC assigns to an individual who has earned an amateur radio license.

Capacitance hat — A conducting structure with a large surface area that is added to an antenna to add capacitive reactance at that point on the antenna.

Carrier — (1) Free electrons and holes in semiconductor material. (2) An unmodulated component of a modulated signal.

Cascade — Placing one analog stage after another to combine their effects on the signal.

CAT — Computer Aided Transceiver. Used for interface between modern amateur radio transceiver and computer. Provides radio control and audio interfacing.

Cathode — The element of an analog device that emits electrons or from which electrons are emitted or repelled.

Cavity — A hollow structure used as an electrical resonator.

CCA (cold cranking amps) — A measure of a battery's ability to deliver high current to a starter motor.

Cellular Modem — Also known as a "hot spot," allows an internet connection through the cellular phone network.

Center loading — Adding a coil near the center of a groundplane antenna to increase its electrical length.

CEPT — European Conference of Postal and Telecommunications Administrators. US amateurs are permitted to operate from member nations without the requirement of obtaining additional licensees or permits.

Channel — Medium through which data is transmitted.

Characteristic curve — A plot of the relative responses of two or three analog device parameters, usually of an output with respect to an input. (Also called I-V or V-I curve.)

Characteristic impedance — The ratio of voltage to current in a matched feed line, it is determined by the physical geometry and materials used to construct the feed line. Also known as surge impedance since it represents the impedance electromagnetic energy encounters when entering a feed line.

Chebyshev filter — A filter with equal ripple in the passband, stopband or both.

Checksum — Data representing the sum of all character values in a packet or message.

Choke balun — A balun that prevents current from flowing on the outside of a coaxial cable shield when connected to a balanced load, such as an antenna. (See also, ***Current balun***.)

Circuit — Conducting path between two points of different voltage. In a series circuit, there is only one current path. In a parallel circuit, there are multiple current paths.

Circular buffers — A buffer in which the final entry is considered to be adjacent to the first.

Circular mils — A convenient way of expressing the cross-sectional area of a round conductor. The area of the conductor in circular mils is found by squaring its diameter in mils (thousandths of an inch), rather than squaring its radius and multiplying by pi. For example, the diameter of 10-gauge wire is 101.9 mils (0.1019 inch). Its cross-sectional area is 10380 CM, or 0.008155 square inches.

CI-V — Proprietary communications medium for interfacing Icom transceivers to computers and associated equipment.

Class (amplifier) — For analog amplifiers (Class A, B, AB, C), a categorization of the fraction of the input signal cycle during which the amplifying device is active. For digital or switching amplifiers (Class D and above), a categorization of the method by which the signal is amplified.

Clipping — A nonlinearity in amplification in which the signal's amplitude can no longer be increased, usually resulting in distortion of the waveform. (Also called clamping or limiting.)

Closed-loop — Operation under the control of a feedback loop. (See also ***Open-loop***.)

Closed-loop gain — Amplifier gain with an external feedback circuit connected.

CLOVER — Trade name of digital communications system developed by Hal Communications.

CMD — *Windows Command Prompt* is a program that emulates the input field in a text-based user interface screen with the *Windows Graphical User Interface (GUI)*. It can be used to execute entered commands and perform advanced administrative functions. It can also be used to troubleshoot and solve certain kinds of *Windows* issues.

Coax — See ***Coaxial cable***.

Coaxial cable — Transmission lines that have the outer shield (solid or braided) concentric with the same axis as the inner or center conductor. The insulating material can be a gas (air or nitrogen) or a solid or foam insulating material. (See also ***Unbalanced feed line***.)

Code — Method of representing data.

Codec — Algorithm for compressing and decompressing data.

COFDM — Coded Orthogonal Frequency Division Multiplex, OFDM plus coding to provide error correction and noise immunity.

Cognitive radio — A radio system in which a wireless node automatically changes its transmission or reception parameters to avoid interference with other nodes.

Collector — The terminal of a bipolar transistor from which electrons are removed.

Collision — A condition that occurs when two or more transmissions occur at the same time and cause interference to the intended receivers.

Common — A terminal shared by more than one port of a circuit or network.

Common mode — (1) Signals that appear equally on all terminals of a signal port. (2) In a group of conductors, such as multi-conductor cable, voltage or current that is present with the same amplitude, phase and polarity on all conductors in a group, such as multi-conductor cable. AC current flowing on the outside of a coaxial cable shield is also considered to be common-mode current.

Common-mode current — Current that flows equally and in phase on all conductors of a feed line or multiconductor cable.

Comparator — A circuit, usually an amplifier, whose output indicates the relative amplitude of two input signals.

Compensation — The process of counteracting the effects of signals that are inadvertently fed back from the output to the input of an analog system. Compensation increases stability and prevents oscillation.

Complex number — A number that contains real and imaginary parts.

Complex PLD (CPLD) — A programmable logic device that is more complex than a small PLD, such as a PAL, but with a similar architecture.

Compression — (1) Reducing the dynamic range of a signal to increase the average power of the signal or prevent excessive signal levels. (2) Method of reducing the amount of data required to represent a signal or data set. Decompression is the method of reversing the compression process.

Conductance (G) — The reciprocal of resistance, measured in siemens (S).

Conducted RFI — RFI received via a conducting path.

Conductor — (1) Material in which electrons or ions can move easily. (2) A metal body such as tubing, rod or wire that permits current to travel continuously along its length.

Conjugate match — Creating a purely resistive impedance by connecting an impedance with an equal-and-opposite reactive component.

Constellation — A set of points that represent the various combinations of phase and amplitude in a QAM or other complex modulation scheme.

Contact — A two-way communication between amateur radio operators.

Contention — A condition on a communications channel that occurs when two or more stations try to transmit at the same time.

Contest — A competitive amateur radio operating activity in which hams use their stations to contact the most stations within a designated time-period.

Control characters — Data values with special meanings in a protocol, used to cause specific functions to be performed.

Control field — An 8-bit pattern in an HDLC frame containing commands or responses, and sequence numbers.

Conventional current — Current defined as the flow of positive charges in the direction of positive to negative voltage. Conventional current flows in the opposite direction of electronic current, the flow of negative charges (electrons) from negative to positive voltage.

Conversion efficiency — The amount of light energy converted to electrical energy by a photoelectric device, expressed in percent.

Convolution — (1) The process of combining or comparing signals based on their behavior over time. (2) A mathematical operation that modifies a sequence of numbers with another sequence of numbers to produce a third sequence with a different frequency spectrum or other desired characteristic. An FIR filter is a convolution engine.

Cooley-Tukey algorithm — Another name for the fast Fourier transform.

Core — Magnetic material around which wire is wound or through which it is threaded to form an inductor.

Core saturation (magnetic) — That condition whereby the magnetic flux in a transformer or inductor core is more than the core can handle. If the flux is forced beyond this point, the permeability of the core will decrease, and it will approach the permeability of air.

Coronal hole — A region on the Sun where the magnetic field is open to the interplanetary magnetic field (IMF) and ionized particles can escape into the solar wind.

Coulomb — A unit of measure of a quantity of electrically charged particles. One coulomb (C) is equal to 6.25 × 1018 electrons.

Coupled RFI — RFI received via inductive or capacitive coupling between conductors.

Coupling — The transfer of energy between circuits or structures.

Coupling (ac or dc) — The type of connection between two circuits. DC coupling allows dc current to flow through the connection. AC coupling blocks dc current while allowing ac current to flow.

Courage Kenny Handiham Program — Membership organization for ham radio enthusiasts with various physical disabilities and abilities. Visit **handiham.org**.

C-rate — The charging rate for a battery, expressed as a ratio of the battery's ampere-hour rating.

Critical angle — The largest angle at which a radio wave of a specified frequency can be returned to Earth by the ionosphere.

Critical frequency — The highest frequency that returns echoes from the E and F regions at vertical incidence.

Crowbar — A last-ditch protection circuit included in many power supplies to protect the load equipment against failure of the regulator in the supply. The crowbar senses an overvoltage condition on the supply's output and fires a shorting device (usually an SCR) to directly short-circuit the supply's output and protect the load. This causes very high currents in the power supply, which blow the supply's input-line fuse.

Current (I) — The movement of electrical charge, measured in amperes and represented by i or I in equations.

Current balun — A balun that transfers power from an unbalanced to a balanced system by forcing current flow in the balanced system to be balanced as well. (See also, ***choke balun***.)

Cutoff (region) — The region in the characteristic curve of an analog device in which there is no current through the device. Also called the OFF region.

Cutoff frequency — (1) Frequency at which a circuit's amplitude response is reduced to one-half its mid-band value (also called half-power or corner frequency). (2) Frequency at which a filter's output is 3 dB below its passband output (also called corner frequency or 3 dB frequency).

CW — A synonym for radiotelegraphy (i.e., Morse code by radio). CW is an abbreviation for "continuous wave," a term used in the early years of wireless.

Cyclic Redundancy Check (CRC) — The result of a calculation representing all character values in a packet or message. The result of the CRC is sent with a transmission block. The receiving station uses the received CRC to check transmitted data integrity.

D region — The lowest region of the ionosphere. The D region (or layer) contributes very little to short-wave radio propagation. It absorbs energy from radio waves as they pass through it. This absorption has a significant effect on signals below about 7.5 MHz during daylight.

Damping (factor) — the characteristics of the decay in a system's response to an input signal. The damping factor, z, is a numeric value specifying the degree of damping. An underdamped system alternately overshoots and undershoots the eventual steady-state output. An overdamped system approaches the steady-state output gradually, without overshoot. A critically-damped system approaches the steady-state output as quickly as possible without overshoot.

Darlington transistor — A package of two transistors in one case, with the collectors tied together, and the emitter of one transistor connected to the base of the other. The effective current gain of the pair is approximately the product of the individual gains of the two devices.

Data stream — Flow of information, either over the air or in a network.

Datagram — A data packet in a connectionless protocol.

dBc — deciBels with respect to a carrier level.

DBPSK — Differential binary phase-shift keying.

DC-DC converter — A circuit for changing the voltage of a dc source to ac, transforming it to another level, and then rectifying the output to produce direct current.

DC-FM — control of a signal generator's output frequency by a dc voltage.

DDNS — Dynamic Domain Name System. Internet services provided to associate domain names with Dynamic IP addresses.

Decade — A ratio of 10 in frequency.

Decibel — A logarithmic power ratio, abbreviated dB. May also represent a voltage or current ratio if the voltages or currents are measured across (or through) identical impedances. Suffixes to the abbreviation indicate references: dBi, isotropic radiator; dBm, milliwatt; dBW, watt.

Decimation — Reduction of sample rate by an integer factor.

Decimation in time — The division of a sequence of numbers into successively smaller sub-sequences to facilitate calculations such as the Fourier transform.

Decouple — To provide isolation between circuits, usually by means of filtering.

Decryption — Reverses the encryption process to recover the original data.

Deep-cycle — A battery designed for repeated charge-discharge cycles to 20% of remaining capacity.

Degeneration (emitter or source) — Negative feedback from the voltage drop across an emitter or source resistor to stabilize a circuit's bias and operating point.

Delta loop — A full-wavelength loop, usually in the vertical plane, shaped like a triangle or delta.

Delta match — Center-feed technique used with antenna elements that are not split at the center in which the transmission line is spread apart and connected to the element symmetrically, forming a triangle or delta.

Depletion mode — An FET with a channel that conducts current with zero gate-to-source voltage and whose conductivity is progressively reduced as reverse bias is applied.

Depletion region — The narrow region at a PN junction in which majority carriers have been removed. (Also called spacecharge or transition region.)

DHCP — Dynamic Host Configuration Protocol. This functionality is incorporated into most routers and provides automatic assignment of IP addresses to computer devices on a LAN where fixed or static IP addresses are not required.

Dibit — A two-bit combination.

Dielectric constant (k) — Relative figure of merit for an insulating material used as a dielectric. This property determines how much electric energy can be stored in a unit volume of the material per volt of applied potential.

Dielectric strength — The rated ability of an insulator to withstand voltage.

Dielectrics — Various insulating materials used in antenna systems, such as found in insulators and transmission lines.

Differential mode — A signal that that is exists and is transmitted as a voltage between two conductors of a cable. At any instant, signal current on one conductor is equal to but of the opposite polarity to the current on the other conductor. Ordinary connections between equipment in systems are differential mode signals.

Diffraction — Bending of waves by an edge or corner.

Digital communication — Computer-based communication modes such as RTTY, PSK31, packet and other radio transmissions that employ an accepted digital code to convey speech or data.

Digital downconverter (DDC) — A device that translates a band of frequencies to baseband, typically at a lower sample rate.

Digital signal processing — The processing of sequences of digital numbers that represent signals.

Digital signal processor (DSP) — A device to do digital signal processing. The term normally is understood to refer to a microprocessor-type device with special capabilities for signal processing.

Digital upconverter (DUC) — A device that frequency-translates a baseband signal to a higher frequency, typically at a higher sample rate.

Digital-to-analog converter (DAC) — A device that converts digital numbers to an analog signal with an amplitude proportional to the digital numbers.

Diode — A two-element semiconductor with a cathode and an anode that conducts current in only one direction.

Diplexer — A device, typically a pair of filters, that allows antennas or transceivers for two different bands to share a single feed line.

Dipole — An antenna, usually one-half wavelength long, divided into two parts at a feed point. An off-center-fed (OCF) dipole has a feed point offset from the center.

Dipole antenna — Typically, a wire antenna with a feed line connected to its center and having two legs. Dipoles most often are used on the high-frequency (HF) amateur bands.

Direct current (dc) — A flow of charged particles through a conductor in one direction only.

Direct digital synthesis (DDS) — Generation of signals by using counters and accumulators to create an output waveform.

Directivity — The property of an antenna that concentrates the radiated energy to form one or more major lobes.

Director — An antenna element in a parasitic array that causes radiated energy from the driven element to be focused along the line from the driven element to the director.

Distributed — Circuit elements that are inherent properties of an extended structure, such as a transmission line.

Distributed element — Electronic component whose effects are spread out over a significant distance, area or volume.

Disturbance — The improper operation of a device as a result of interference.

Dithering — Randomly varying the amplitude or phase of a signal to overcome quantization effects.

Domino — A conversational HF digital mode similar in some respects to MFSK15.

Doublet — A more general name for a wire antenna fed in the center and that may or may not be resonant at the operating frequency.

DQPSK — Differential quadrature phase-shift keying.

Drain — The connection at one end of a field-effect-transistor channel from which electrons are removed.

Driven array — An array of antenna elements which are all driven or excited by means of a transmission line.

Driven element — An antenna element excited by means of a transmission line.

DRM — Digital Radio Mondiale. A consortium of broadcasters, manufacturers, research and governmental organizations which developed a system for digital sound broadcasting in bands between 100 kHzand 30 MHz.

DSL — Digital Subscriber Line. A technology for bringing high-bandwidth data to homes and small businesses over ordinary copper telephone lines.

DSP (digital signal processing) — Technology that allows software to replace electronic circuitry.

DTMF — Dual-Tone Multi-Frequency signaling. Keypad signaling system using the voice-frequency band over telephonelines between telephone equipment and other communications devices. Also known by the trade name Touch-Tone.

Duplexer — A device that allows transceivers, transmitters, or receivers operating on different frequencies within a single band to share a common antenna. The duplexer may be implemented with filters or other feed line components, such as a circulator or isolator.

Duty cycle — A device which is constantly "on" would normally be considered to have a 100% duty cycle. Morse code keying has spaces between the elements and the characters; therefore, the duty cycle would be less.

DV — Digital voice.

DX — A ham radio abbreviation that refers to distant stations, typically those in other countries.

DXCC — DX Century Club, a popular ARRL award earned for contacting amateur radio operators in 100 different countries or "entities."

DXpedition — A trip, often by a team of operators, to a location

Dynamic range — The range of signal levels over which a circuit operates properly. Usually refers to the range over which signals are processed linearly.

Dynamic resistance — The change in current in response to a small change in voltage.

E region — The second lowest ionospheric region, the E region (or layer) has its highest electron density during the day and falls to a much lower electron density during the night. The E region can refract radio waves enough to return them to Earth.

Earth-Moon-Earth (EME) or Moonbounce — A method of communicating with other stations by reflecting radio signals off the Moon's surface.

Efficiency (antenna) — The ratio of radiated power to input power.

Electric field — The field present between two or more conductive objects as a result of potential difference (voltage) between those objects. Put another way, an electric field exists in a region of space if an electrically charged object placed in the region is subjected to an electrical force.

Electromagnetic field — The combination of a magnetic field and electric field in which the fields are directly related to each other, are at right angles to each other, and move through space as radio waves in a direction that is mutually perpendicular to both fields. An electrical conductor designed to produce electromagnetic fields when carrying an RF current is called an antenna.

Electromagnetic wave — A wave of energy composed of an electric and magnetic field.

Electromotive force (EMF) — The source of energy that creates a force between charged particles or regions. Defined as the force of attraction or repulsion between electrically charged regions. (See also ***Voltage***.)

Electronic current — See ***Conventional Current***.

Elements — The conductive parts of an antenna system that determine the antenna's characteristics.

Elevation pattern — A radiation pattern in a plane perpendicular to the Earth's surface.

Elmer — A traditional term for a person who enjoys helping newcomers get started in ham radio; a mentor.

Embedded system — A system that includes a microprocessor for purposes other than general-purpose computing.

Emergency communication — Amateur radio communication during a disaster or emergency that support or supplants traditional means of telecommunication.

Emission — A signal transmitted over the air.

Emitter — The terminal of a bipolar transistor into which electrons are injected.

Encoding — Changing data into a form represented by a particular code.

Encryption — Process of using codes and encoding to obscure the meaning of a transmitted message.

End effect — The effect of capacitance at the end of an antenna element that acts to electrically lengthen the element.

End-fed Half Wave (EFHW) — A half-wavelength antenna fed at one end, usually with open-wire feed line.

Energy — Capability of doing work. It is usually measured in electrical terms as the number of watts of power consumed during a specific period of time, such as watt-seconds or kilowatt-hours.

Enhancement mode — An FET with a channel that does not conduct with zero gate-to-source voltage and whose conductivity is progressively increased as forward bias is applied.

E-plane — The plane in which the electric field of an electromagnetic wave is maximum.

Equalizing resistors — Equal-value bypassing resistors placed across capacitors connected in series for use in a high-voltage power supply to keep the voltages across the capacitors in the string relatively constant.

Equinoxes — One of two points in the orbit of the Earth around the Sun at which the Earth crosses a horizontal plane extending through the equator of the Sun. The vernal equinox marks the beginning of spring and the autumnal equinox marks the beginning of autumn.

Equipment ground — The connection of all exposed parts of electrical equipment to earth, or to a body that serves in place of earth.

Equiripple — Equalized ripple in a filter's magnitude response across the passband, stopband, or both.

Equivalent Series Inductance (ESL) — A capacitor's parasitic inductance.

ERC — Easy Rotator Control. Electronic interfaces for controlling rotators from a computer.

Error Correcting Code (ECC) — Code used to repair transmission errors.

ESR — Equivalent series resistance.

Exponent — The number of digits that the radix point must be moved to represent a number.

Eye pattern — An oscilloscope display in the shape of one or more eyes for observing the shape of a serial digital stream and any impairments.

F region — A combination of the two highest ionospheric regions (or layers), the F1 and F2 regions. The F region refracts radio waves and returns them to Earth. Its height varies greatly depending on the time of day, season of the year and amount of sunspot activity.

Facsimile (fax) — A form of telegraphy for the transmission of fixed images, with or without half-tones, with a view to their reproduction in a permanent form.

Faraday rotation — A rotation of the polarization of radio waves when the waves travel through an ionized medium that is immersed in a magnetic field (for example, the Earth's ionosphere).

Fast Fourier transform (FFT) — (1) An algorithm that can calculate the discrete Fourier transform with an execution time proportional to nlog(n), instead of n^2 as is required by the straight-forward application of the Fourier transform equation. (2) An algorithm that produces the spectrum of a signal from the set of sampled value of the waveform.

Fast recovery rectifier — A specially doped rectifier diode designed to minimize the time necessary to halt conduction when the diode is switched from a forward-biased state to a reverse-biased state.

Fast-scan television — A mode of operation that amateur radio operators can use to exchange live TV images from their stations. Also called ATV (Amateur Television).

FCC (Federal Communications Commission) — The government agency that regulates non-government telecommunications, including amateur radio, in the US.

FCS — Frame check sequence. (See also ***Cyclic Redundancy Check (CRC)***.)

FDM — Frequency division multiplexing.

FDMA — Frequency division multiple access.

FEC — Forward error correction, an error-control technique in which the transmitted data is sufficiently redundant to permit the receiving station to correct some errors.

Feed line — See ***Transmission line***.

Feed point — (1) The point at which a feed line is electrically connected to an antenna. (2) Location at which a transmission line delivers power to an antenna.

Feed point impedance — The ratio of RF voltage to current at the feed point of an antenna.

Feedback — Routing a portion of an output signal back to the input of a circuit. Positive feedback causes the input signal to be reinforced. Negative feedback results in partial cancellation of the input signal.

Ferrite — A ceramic material with magnetic properties; a ferromagnetic ceramic.

Field Day — A popular, annual amateur radio activity sponsored by ARRL, during which hams set up radio stations, often outdoors, using emergency power sources to simulate an emergency situation.

Field Organization — A cadre of ARRL volunteers who perform various services for the amateur radio community at the state and local level.

Field-aligned irregularities (FAI) — A propagation mechanism observed at 50 and 144 MHz that occurs when irregularities in the distribution of free electrons in the ionosphere are aligned parallel to the Earth's magnetic field.

Field-effect transistor (FET) — An analog device with a semiconductor channel whose width can be modified by an electric field. (Also called ***Unipolar transistor***.)

Field-programmable gate array (FPGA) — An IC that contains a large array of complex logic blocks whose function and connections can be re-programmed in the field.

Filter coefficient — One of a series of numbers that define the transfer function of a filter.

Finite impulse response (FIR) — An impulse response that is zero for all time that is greater than some finite amount from the time of the impulse.

Firewall — Firmware or software capabilities in computers and routers that can be configured to minimize or completely block unauthorized users from access.

Flat — Refers to a filter's magnitude response that is constant across a range of frequencies.

Floating-point — Refers to a number whose value is represented by a mantissa and an exponent.

Flow — JavaScript based function module, part of the web browser-based visual programming environment that makes up the elements of a Node-Red project.

Flyback converter — A transformer-coupled version of the buck-boost converter.

FM (frequency modulation) — A method of transmitting voice commonly used on ham radio repeaters.

Foldback current limiting — A special type of current limiting used in linear power supplies, which reduces the current through the supply's regulator to a low value under short circuited load conditions to protect the series pass transistor from excessive power dissipation and possible destruction.

Forward bias — Voltage applied across a PN junction in the direction to cause current flow.

Forward converter — A buck converter with multiple isolated outputs at different voltage levels and polarities.

Forward voltage — The voltage required to cause forward current to flow through a PN junction.

Fourier transform — A mathematical operation that derives the frequency spectrum of a time-domain signal.

Fox hunt — A competitive radio direction-finding activity in which participants track down the one or more hidden transmitters.

Frame — Data set transmitted as one package or set.

Free electron — An electron in a semiconductor crystal lattice that is not bound to any atom.

Free-running — Oscillating without any form of external control.

Free-space attenuation — The dissipation of the energy of a radio wave that results from the spherical spreading of radio energy from its source.

Frequency (f) — The rate of change of an ac voltage or current, measured in cycles per second, or hertz (Hz).

Frequency response — A description of a circuit's gain (or other behavior) with frequency.

Front-to-back ratio — The ratio in dB of the radiation from an antenna in a favored direction to that in the opposite direction.

Front-to-rear ratio — The ratio in dB of the radiation from an antenna is a favored direction to an average of the radiation in the opposite direction across some specified angle.

Front-to-side ratio — The ratio in dB of the radiation from an antenna in a favored direction to that at right angles to the favored direction.

FSK — Frequency-shift keying.

Fundamental — The lowest frequency in a series of sine waves whose frequencies have an integer relationship, also the lowest frequency of natural vibration or oscillation.

Fundamental overload — (1) (Receiver Performance) Interference to a receiver caused by a signal at its input whose amplitude exceeds the maximum signal handling capabilities of one or more receiver stages. (2) (RF interference) — Any disruption to the function of any RFI victim caused by the fundamental component of a transmitted signal or intended in-band output of a transmitter.

Gain — The increase in radiated power with respect to a reference antenna in the desired direction of the major lobe. (See also ***Amplification***.)

Gain-bandwidth product — (1) The frequency at which a device's gain drops unity. (2) The relationship between amplification and frequency that defines the limits of the ability of a device to act as a linear amplifier. In many amplifiers, gain times bandwidth is approximately constant.

Gamma match — A matching system used with driven antenna elements in which a conductor is placed near the element and connected to the feed line with an adjustable capacitor at the end closest to the center and connected to the element at the other.

Gate — The control electrode of a field-effect transistor.

Gray code — A code that minimizes the number of bits that change between sequential numeric values.

Gray-line — A special form of long-path propagation that takes into account the unusual ionospheric configuration along the twilight region between night and day.

Ground — (1) A low impedance electrical connection to earth, or to a body that serves in place of earth. (2) A common signal connection in an electrical circuit.

Ground fault (circuit) interrupter (GFI or GFCI) — A safety device installed between the household power mains and equipment where there is a danger of personnel touching an earth ground while operating the equipment. The GFI senses any current flowing directly to ground and immediately switches off all power to the equipment to minimize electrical shock. GFCIs are now standard equipment in bathroom and outdoor receptacles.

Ground plane — A system of conductors configured to act as a substitute for an earth ground to an antenna element and connected to one side of the transmission line.

Ground-wave propagation — The method by which radio waves travel along the Earth's surface.

Group delay — The transit time of signals through a filter.

G-TOR — A digital communications system developed by Kantronics.

GUI — Graphical User Interface is a visual form of user interface that allows users to interact with electronic devices.

Hairpin match — A U-shaped inductor that is connected across the feed point of a driven element for the purpose of creating a match to a feed line.

Ham band — A range of frequencies in the radio spectrum on which ham radio communication is authorized.

Ham radio — Another name for amateur radio.

Ham radio operator — A radio operator holding a license granted by the FCC to operate on amateur radio frequencies.

HAMNET — Broadband-Hamnet (BBHN). A high-speed wireless computer network using commercial WiFi equipment with custom firmware on Amateur Radio frequencies.

Hardline — Coaxial cable with a solid metal outer conductor to reduce losses compared to flexible cables. Hardline may or may not be flexible.

Hardware-description languages (HDL) — A computer language to specify the circuitry of a digital device or system.

Harmonic — A sine wave whose frequency is an integer multiple of a fundamental frequency.

Harmonic sampling — The use of a sample rate that is less than twice the highest frequency of the signal to be sampled. The sample rate must be greater than two times the bandwidth of the signal.

Harvard architecture — A computer architecture in which the program and data are stored in separate memories.

HDLC — High-level data link control procedures as specified in ISO 3309.

Hellschreiber — A facsimile system for transmitting text.

HF — See ***High frequency (HF)***.

High frequency (HF) — The term used for the frequency range between 3 MHz and 30 MHz. The amateur HF bands are where you are most likely to make longdistance (worldwide) contacts.

High-pass — Filter response in which signals above the cutoff frequency are passed and rejected at lower frequencies.

High-side — A switch or controlling device connecting between a power source and load.

Hole — A positively charged carrier that results when an electron is removed from an atom in a semiconductor crystal structure.

Host — As used in packet radio, a computer with applications programs accessible by remote stations.

H-plane — The plane in which the magnetic field of an electromagnetic wave is maximum.

HSMM (high-speed multimedia) — A digital radio communication technique using spread spectrum modes primarily on UHF to simultaneously send and receive video, voice, text, and data.

Hybrid-pi — High-frequency model for a bipolar transistor.

Hysteresis — In a comparator circuit, the practice of using positive feedback to shift the input setpoint in such a way as to minimize output changes when the input signal(s) are near the setpoint.

IA5 — International Alphabet, designating a specific set of characters as an ITU standard.

IARU (International Amateur Radio Union) — The international organization made up of national amateur radio organizations or societies such as the ARRL.

Ideal filter — Filter that passes signals without loss or attenuates them completely. An ideal filter has no transition regions. (See also ***Brick wall response***.)

Image — Facsimile and television signals.

Imaginary number — A real number multiplied by the square root of minus one.

Immunity — The ability of a device to function properly in the presence of unwanted electromagnetic energy.

Impedance — The ratio of voltage to current in a feed line or along an antenna.

Impedance inversion — Dividing a characteristic impedance by the ratio of the impedance to be inverted to the characteristic impedance. For example, 25 Ω inverted about 50 Ω is 100 Ω and 200 Ω inverted about 50 Ω is 12.5 Ω.

Impedance match — To adjust impedances to be equal or the case in which two impedances are equal. Usually refers to the point at which a feed line is connected to an antenna or to transmitting equipment. If the impedances are different, that is a mismatch.

Impedance matcher — See ***Antenna tuner***.

Impedance matching (circuit) — A circuit that transforms impedance from one value to another. Adjustable impedance matching circuits are used at the output of transmitters and amplifiers to allow maximum power output over a wide range of load impedances.

Impedance transformer — A transformer designed specifically for transforming impedances in RF equipment.

Impulse — A pulse of finite energy with a width that approaches zero.

Impulse response — The response versus time of a filter to an impulse.

Impulse-invariant — A design technique for IIR filters in which the impulse response is the same as the impulse response of a certain analog filter.

In-circuit debugger (ICD) — A device that uses debugging features built into the microprocessor so that it can be tested while in the circuit.

In-circuit emulator (ICE) — A device that emulates the operation of a microprocessor while providing debugging tools to the operator. The ICE normally plugs into an IC socket that normally holds the microprocessor.

In-circuit programmable (ICP) — A programmable IC that can be programmed while it is connected to the application circuit.

In-circuit programmer (ICP) — A device to facilitate programming of programmable ICs while they are connected to the application circuit.

Infinite impulse response (IIR) — An impulse response that theoretically never goes to and remains at zero.

Information field — Any sequence of bits containing the intelligence to be conveyed.

In-phase (I) — The portion of a radio signal that is in phase with a reference carrier.

Input-output differential — The voltage drop appearing across the series pass transistor in a linear voltage regulator. This term is usually stated as a minimum value, which is that voltage necessary to allow the regulator to function and conduct current. A typical figure for this drop in most three-terminal regulator ICs is about 2.5 V. In other words, a regulator that is to provide 12.5 V dc will need a source voltage of at least 15.0 V at all times to maintain regulation.

Insertion loss (IL) — (1) The loss inherent in a circuit due to parasitic resistance. (2) The loss incurred by signals in a filter's passband.

Instantaneous value — the value of a waveform at a specific instant in time.

Insulator — Material through which it is difficult for electrons or ions to move.

Integrated circuit (IC) — A semiconductor device in which many components, such as diodes, bipolar transistors, field-effect transistors, resistors and capacitors are fabricated to make an entire circuit.

Integrated development environment (IDE) — An integrated collection of software and hardware tools for developing a microprocessor project.

Integrator — A low-pass filter whose output is approximately the integral of the input signal.

Intentional radiator — A device that uses radio waves to transmit information by antenna action. A radio transmitter, with its associated antenna, is an intentional radiator.

Inter-electrode capacitance — Capacitance between the internal elements of a semiconductor or vacuum tube.

Interference — (1) Disruption of a device's normal function as a result of an electromagnetic field, voltage, or current. (2) Disruption by a signal or noise of a receiver's ability to acquire and process a desired signal.

Interleave — Combine more than one data stream into a single stream or alter the data stream in such a way as to optimize it for the modulation and channel characteristics being used.

Intermodulation — Generation of distortion products from two signals interacting in a nonlinear medium, device, or connection.

International Morse code — A digital code in which alphanumeric characters are represented by a defined set of short and long transmission elements — called "dots and dashes" or "dits and dahs" — that many amateur radio operators use to communicate.

Internet Service Provider (ISP) — An organization that provides services for accessing and using the Internet.

Interpolation — Increasing the sample rate by an integer factor.

Interrupt service routine (ISR) — A software subroutine that is called automatically when the main routine is interrupted by some event.

Inverted-V — A dipole antenna supported at its mid-point with halves angled down toward the ground.

Inverter — A circuit for producing ac power from a dc source.

Ion — Atom or molecule with a positive or negative electrical charge.

Ionosphere — A region of electrically charged (ionized) gases high in the atmosphere. The ionosphere bends radio waves as they travel through it, returning them to Earth. (See also ***Sky-wave propagation***.)

IP — Internet Protocol. The communications protocol used to route packets of information between devices on the Internet. (See also ***TCP***.)

IP Address — Every computer or device accessible via the internet or a LAN has a unique numeric address, such as 192.168.1.1 assigned to it. The IP address is associated to the fixed MAC address of the device.

IPv4 — The fourth version of the Internet Protocol (IP), based on 32-bit (four-byte) decimal addressing.

IPv6 — The sixth and most recent version of the Internet Protocol (IP), based on 128-bit addressing, using eight groups of four hexadecimal digits.

ISO — International Organization for Standardization.

Isolation — Eliminating or reducing electrical contact between one portion of a circuit and another or between pieces of equipment. *Reverse isolation* refers to signal flow against the desired signal path.

Isotropic — An imaginary antenna that radiates and receives equally well in all directions.

ITU (International Telecommunication Union) — An agency of the United Nations that allocates the radio spectrum among the various radio services at the international level. (See **www.itu.int**.)

ITU-T — Telecommunication Standardization Sector of the ITU, formerly CCITT.

Jitter (phase jitter) — Random variations of a signal in timing or phase. Usually refers to random variations in the transition time of digital signals between states.

Joule — Measure of a quantity of energy. One joule is defined as one newton (a measure of force) acting over a distance of one meter.

Junction FET (JFET) — A field-effect transistor whose gate electrode forms a PN junction with the channel.

K index — A geomagnetic-field measurement that is updated every three hours at various observatories around the world. Changes in the K index can be used to indicate HF propagation conditions. Rising values generally indicate disturbed conditions while falling values indicate improving conditions.

kbps — Kilobits per second (one thousand bits per second). Typically used as a reference to bandwidth data rate capability or actual usage.

L network — A combination of two reactive components used to transform or match impedances. One component is connected in series between the source and load and the other shunted across either the source or the load. Most L networks have one inductor and one capacitor, but two-inductor and two-capacitor configurations are also used.

Ladder line — See ***Open-wire line*** and ***Balanced line***.

Lambda (λ) — Greek symbol used to represent wavelength.

LAN — Local Area Network. A home LAN enables multiple computers to connect to a single internet service.

Latency — The delays involved in data routing from one point to another, but also a factor in A/D conversion processes.

Layer — In communications protocols, one of the strata or levels in a reference model.

Least-significant bit (LSB) — The bit in a byte or word that represents the smallest value. When used as a measurement unit, the size of the smallest step of a digital number.

Level 1 — Physical layer of the OSI reference model.

Level 2 — Link layer of the OSI reference model.

Level 3 — Network layer of the OSI reference model.

Level 4 — Transport layer of the OSI reference model.

Level 5 — Session layer of the OSI reference model.

Level 6 — Presentation layer of the OSI reference model.

Level 7 — Application layer of the OSI reference model.

Li-ion — Lithium-ion, a type of rechargeable battery that is about 1⁄3 the weight and 1⁄2 the volume of a NiCd battery of the same capacity.

Line loss — The power dissipated by a transmission line as heat, usually expressed in decibels per unit of length.

Linear phase — Refers to a system in which the delay is constant at all frequencies, which means that the phase is linear with frequency.

Linearity — Processing and combining of analog signals independently of amplitude.

Linearization — Creation of a linear amplification or frequency characteristic through corrections supplied by an external system.

Line-of-sight propagation — The term used to describe VHF and UHF propagation in a straight line directly from one station to another.

Load — (noun) The component, antenna, or circuit to which power is delivered; (verb) to apply a load to a circuit or a transmission line.

Load line — A line drawn through a family of characteristic curves that shows the operating points of an analog device for a given load or circuit component values.

Loading — The process of a transferring power from its source to a load. The effect a load has on a power source. The condition that occurs when the output behavior of a circuit is affected by the connection of another circuit to that output.

Lobe — A region of increased radiation in an antenna's radiation pattern between two nulls. A main lobe is the largest lobe in the pattern and all other lobes are side lobes.

Long-path propagation — Propagation between two points on the Earth's surface that follows a path along the great circle between them, but in a direction opposite from the shortest distance between them.

Loop gain — The total gain applied to a signal traveling around a feedback control loop.

Lossless (compression) — Method of compression that results in an exact copy of the original data.

Lossy (compression) — Method of compression in which some of the original data is lost

Low dropout regulator — A three-terminal regulator designed to work with a low minimum input-output differential value.

Lowest usable frequency (LUF) — The frequency below the maximum usable frequency (MUF) at which ionospheric absorption and noise at the receiving location make the received signal-to-noise ratio too low to be usable.

Low-pass — Filter response in which signals below the cutoff frequency are passed and rejected at higher frequencies.

Low-side — A switch or controlling device connected between a load and ground.

Lumped element(s) — (1) Circuit elements whose electrical functions are concentrated at one point in the form of an electronic component. (2) Discrete inductors and capacitors; a lumped-element filter made from discrete inductors and capacitors.

MAC address — Media Access Control address. A unique address given to network interface devices such as Ethernet or WiFi interface cards.

Magnetic field — (1) A region through which a magnetic force will act on a magnetic object. (2) The field produced by a permanent magnet or current flow through a conductor.

Magnitude response — Graph of a filter's output amplitude versus frequency.

Mantissa — The decimal or binary part of a logarithm or floating-point number.

Marine — A battery designed to retain significant energy over long periods of time without being continuously charged.

MARS — Military Auxiliary Radio System, a volunteer adjunct communication program that supports the mission of the US Department of Defense. Most MARS operators are amateur radio operators.

Match — Equal values of impedance.

Matched-line loss — The line loss in a feed line terminated by a load equal to its characteristic impedance.

Matching — The process of effecting an impedance match between two electrical circuits of unlike impedance. One example is matching a transmission line to the feed point of an antenna. Maximum power transfer to the load (antenna system) will occur when a matched condition exists.

Maximum usable frequency (MUF) — The highest-frequency radio signal that will reach a particular destination using ***sky-wave propagation***, or ***skip***. The MUF may vary for radio signals sent to different destinations.

Mbps — Megabits per second (one million bits per second). Typically used as a reference to bandwidth data rate capability or actual usage.

Metal-oxide semiconductor (MOSFET) — A field-effect transistor whose gate is insulated from the channel by an oxide layer. (Also called *insulated gate FET* or *IGFET*)

Meteor-scatter communication — A method of radio communication that uses the ionized trail of a meteor that burned up in the Earth's atmosphere to reflect, refract, or scatter radio signals back to Earth.

M-factor — The ratio between the maximum usable frequency (MUF) and the critical frequency.

MFSK16 — A multi-frequency shift communications system.

Microstrip — A type of transmission line made from a strip of metal separated from a ground plane by a layer of insulating material, such as on a printed-circuit board. Used primarily at UHF and microwave frequencies.

Microwave — Radio waves or signals with frequencies greater than 1000 MHz (1 GHz). This is not a strict definition, just a conventional way of referring to those frequencies.

Mix — The chemical composition of a ferrite or powdered-iron material (also called *type*).

Mode — A type of ham radio communication, such as frequency modulation (FM voice), slow-scan television (SSTV), SSB (single sideband voice), CW (Morse code), or digital (e.g., PSK-31, FT8, or JT65).

Modem — Modulator-demodulator, a device that connects between a data terminal and communication line (or radio). Also called data set.

Modulus — The number of states of a digital counter or divider.

Monopole — An antenna with a single element that functions in concert with a ground-plane.

Moonbounce — A common name for EME communication in which signals are bounced off the Moon before being received.

Morse code — A communication mode characterized by on/off keying of a radio signal to convey intelligence. Hams use the International Morse Code.

Most significant bit (MSB) — The bit in a byte or word that represents the greatest value.

Motional capacitance (inductance) — The electrical effect of a crystal's mechanical properties, modeled as a capacitance (inductance).

ms — Milliseconds. The unit of time typically used for measuring latency.

MSK — Frequency-shift keying where the shift in Hz is equal to half the signaling rate in bit/s.

MT63 — A keyboard-to-keyboard mode similar to PSK31 and RTTY.

Multicast — A protocol designed to distribute packets of data to many users without communications between the user and data source.

Multihop propagation — Long-distance radio propagation using several skips or hops between the Earth and the ionosphere.

Multipath — A fading effect caused by the transmitted signal traveling to the receiving station over more than one path.

Multiplier-accumulator (MAC) — A device that can multiply two numbers and add the result to a previous result all in one operation.

Multi-rate — Refers to a system with more than one sample rate.

Multivibrator — A circuit that oscillates between two states.

Natural frequency (wn) — Frequency at which a system oscillates without any external control.

Near Vertical Incidence Skywave (NVIS) propagation — A propagation mechanism that allows stations located within the ***Skip zone***, but too far apart for ground wave propagation, to maintain communications by going to a lower frequency.

Net — An on-the-air meeting of hams at a set time, day and radio frequency, usually for a specific purpose.

Netbook — A portable computer smaller than a traditional laptop or notebook. Many netbooks now use solid-state instead of rotating hard drives.

Network — General name for any type of circuit.

Nibble — A four-bit quantity. Half a byte.

NiCd — Nickel cadmium, a type of rechargeable battery.

NiMH — Nickel metal hydride, a type of rechargeable battery that does not contain toxic substances.

NMOS — N-channel MOSFET.

Node — A point within a network, usually where two or more links come together, performing switching, routine, and concentrating functions.

Noise — Any unwanted signal. Usually refers to signals of natural origins or random effects resulting from interfering signals.

Noise bandwidth — The width of an ideal rectangular filter that would pass the same noise power from white noise as the filter being compared (also called equivalent noise bandwidth).

Noise factor (F) — The amount by which noise at the output of a device is greater than that at the input multiplied by the gain of the device. A measure of how much noise is generated by a device.

Noise figure (NF) — 10 log (noise factor).

Noise gain — Circuit output noise power divided by the available input noise power. This is not always equal to signal gain, depending on the source of the noise and the location of the noise source in the circuit.

Nonideal — Behavior that deviates from that of an ideal component. (See also ***Parasitic***.)

Nonlinear — A component that acts on a signal differently depending on the signal's amplitude.

Normalize — The technique of converting numeric values to their ratio with respect to some reference value. (To denormalize is to reverse the normalization, converting the ratios back to the original values.)

Notch filter — See ***Band-stop***.

N-type impurity — A doping atom with an excess of valence electrons that is added to semiconductor material to act as a source of free electrons.

Null — A point of minimum radiation in an antenna's radiation pattern.

Nyquist criterion — The requirement that the sample rate must be at least twice the bandwidth of the signal.

Nyquist frequency — One half the sample rate.

Nyquist rate — Twice the signal bandwidth.

Octave — A ratio of two in frequency. (See also ***Decade***.)

OFDM — Orthogonal Frequency Division Multiplex. A method of using spaced subcarriers that are phased in such a way as to reduce the interference between them.

Ohm — Unit of resistance. One ohm is defined as the resistance that will allow one ampere of current when one volt of EMF is impressed across the resistance.

Ohm's Law — The expression that describes resistance (R) as the proportional relationship between voltage (E) and current (I); R = E / I. Named for Georg Ohm who first described the relationship.

One-time programmable (OTP) — A programmable device that may not be re-programmed.

Open-loop — Operation without controlling feedback.

Open-loop gain — Gain of an amplifier with no feedback connection.

Open-wire line — Parallel-conductor feed line with parallel insulators at regular intervals to maintain the line spacing. The dielectric is principally air, making it a low-loss type of line. Also known as ladder line or window line. (See also ***Balanced line***.)

Operating point — Values of a set of circuit parameters that specify a device's operation at a particular time.

Operational amplifier (op amp) — An integrated circuit amplifier with high open-loop gain, high input impedance, and low output impedance.

Optoisolator — A device in which current in a light-emitting diode controls the operation of a phototransistor without a direct electrical connection between them.

Orthogonal — Perpendicular. In analogy with the mathematics of perpendicular geometrical vectors, the term is used in communications to refer to two signals that produce zero when convolved.

Oscillation — Repetitive mechanical motion or electrical activity created by the application of positive feedback.

Oscillator — A circuit whose output varies continuously and repeatedly, usually at a single frequency.

OSI-RM — Open Systems Interconnection Reference Model specified in ISO 7498 and ITU-T Recommendation X.200.

Output impedance — The equivalent impedance of a signal source.

Oversampling — Use of a sample rate higher than required by the Nyquist criterion to improve the signal-to-noise ratio.

Overshoot — The condition in which the output of a circuit, in responding to a change in its input, temporarily exceeds the steady-state value that the input should cause.

Overtone — Vibration mode at a higher frequency than the fundamental mode, usually harmonically related.

Packet — (1) Radio: communication using the AX.25 protocol. (2) Data: transmitted data structure for a particular protocol, for example all information sent via the internet is first converted into packets for transmission. (See also ***Frame***.)

Packet radio — A computer-to-computer radio communication mode in which information is encapsulated in short groups of data called packets. These packets contain addressing and error-detection information.

PACTOR — Trade name of digital communications protocols offered by Special Communications Systems GmbH & Co KG (SCS).

Panadapter — A device similar to a spectrum analyzer that allows you to visually see the RF spectrum received by the radio.

Parallel-conductor line — A type of transmission line that uses two parallel wires spaced from each other by insulating material. Also known as open-wire, ladder or window line.

Parasitic — Unintended characteristic related to the physical structure of a component.

Parasitic array — A set of elements that form a radiation pattern through coupling and re-radiation of energy from one or more driven elements.

Parity (parity check) — Number of bits with a particular value in a specific data element, such as a byte or word or packet. Parity can be odd or even. A parity bit contains the information about the element parity.

Passband — The range of frequencies passed by a filter.

Passive — A device that does not require power to operate.

Passive filter — A filter that does not require power to perform its function. (See also ***Lumped element***.)

Path — The route by which electromagnetic energy is transferred from a transmitter to a receiver or from a source to a victim.

Path loss — The total signal loss between transmitting and receiving stations relative to the total radiated signal energy.

Pathping — A hybrid utility of the path and tracert functions which requires more time for analysis between two internet connection points, but results in a more detailed analysis.

Peak (voltage or current) — The maximum value relative to zero that an ac voltage or current attains during any cycle.

Peak inverse voltage (PIV) — (1) The maximum reverse-biased voltage that a semiconductor is rated to handle safely. Exceeding the peak inverse rating can result in junction breakdown and device destruction. (2) The highest voltage that can be tolerated by a reverse biased PN junction before current is conducted. (See also ***Avalanche breakdown***.)

Peak-to-peak (voltage or current) — The value of the total swing of an ac voltage or current from its peak negative value to its peak positive value, ordinarily twice the value of the peak voltage or current.

Pedersen ray — A high-angle radio wave that penetrates deeper into the F region of the ionosphere, so the wave is bent less than a lower-angle wave, and thus for some distance parallels the Earth's surface in the F region, returning to Earth at a distance farther than normally expected for single-hop propagation.

Period (T) — The duration of one ac voltage or current cycle, measured in seconds (s).

Permeability — The ability of a material to support a magnetic field.

Permeability tuning — Varying the permeability of the core of an inductor used to control an oscillator's frequency.

Phase noise — Random variations of a signal in time, expressed as variations in phase of a sinusoidal signal.

Phase response — Graph of the difference in angular units (degrees or radians) between a filter's input and output versus frequency.

Phase-lock — Maintain two signals in a fixed phase relationship by means of a control system.

Phasing dots (•) — Phasing dots on transformer windings indicate the end of the winding at which ac voltages will have the same phase.

Phasing lines — Sections of transmission line that are used to ensure the correct phase relationship between the elements of a driven array, or between bays of an array of antennas. Also used to effect impedance transformations while maintaining the desired phase.

Phasor — Representation of a sinusoidal signal as an amplitude and phase, often drawn as a vector.

Phone — Emissions carrying speech or other sound information, such as FM, SSB, or AM.

Photoconductivity — Phenomenon in which light affects the conductivity of semiconductor material.

Photoelectricity — Phenomenon in which light causes current to flow in semiconductor material.

Pinch-off — The condition in an FET in which the channel conductivity has been reduced to zero.

Ping — A utility used to ascertain the availability of another computer device over the internet or LAN and also measure the round trip time required for the connection.

Pixel — Abbreviation for "picture element."

PMOS — P-channel MOSFET.

PN junction — The structure that forms when P-type semiconductor material is placed in contact with N-type semiconductor material.

Polarity — The direction of EMF or voltage, from positive to negative.

Polarization — The orientation of an antenna or the electrical-field of a radio wave. An antenna that is parallel to the surface of the Earth, such as a dipole, produces horizontally polarized waves. One that is perpendicular to the Earth's surface, such as a quarter-wave vertical, produces vertically polarized waves. An antenna that has both horizontal and vertical polarization is said to be circularly polarized.

Pole — Frequency at which a circuit's transfer function becomes infinite.

Port — A pair of terminals through which a signal is applied to or output from a circuit.

Port forwarding — Functionality most commonly used in routers to direct or re-direct incoming internet traffic to specific destinations on a local network.

Potential — See ***Voltage***.

POTS — Plain Old Telephone Service. This generally refers to the use of a regular analog telephone system for purposes of remote audio and control signal routing in lieu of the internet.

Power (P) — (1) The rate of electrical-energy use, measured in watts (W). (2) Power is the rate at which work is done. One watt of power is equal to one volt of EMF causing a current of one ampere through a resistor.

Power converter — Another term for a power supply.

Power density — Amount of power per unit of frequency, usually specified as dBc/Hz or as RMS voltage/√Hz.

Power processor — Another term for a power supply.

Prescaler — A frequency divider used to reduce the frequency of an input signal for processing by slower circuitry.

Preselector — Filters applied at a receiver's input to reject out-of-band signals.

Primary battery — A battery intended for one-time use and then discarded.

Primitive — An instruction for creating a signal or data set, such as in a drawing or for speech.

Project 25 — Digital voice system developed for APCO, also known as P25.

Propagation — The process by which radio waves travel.

Protocol — A formal set of rules and procedures for the exchange of information.

PSK — Phase-shift keying.

PSK31 — A narrow-band digital communications system developed by Peter Martinez, G3PLX.

P-type impurity — A doping atom with a shortage of valence electrons that is added to semiconductor material to create an excess of holes.

Public service — Activities involving amateur radio that hams perform to benefit their communities.

Pull — Change the frequency at which a crystal oscillates by changing reactance of the circuit in which it is installed.

Q section — Term used in reference to transmission-line matching transformers and phasing lines. For example, a quarter-wavelength section of transmission line used for impedance matching purposes.

QAM — Quadrature Amplitude Modulation. A method of simultaneous phase and amplitude modulation. The number that precedes it, for example, 64QAM, indicates the number of discrete stages in each symbol.

QoS — Quality of Service. The overall performance of a telephony or computer network. Performance can be enhanced by prioritizing services on the network.

QPSK — Quadrature phase-shift keying in which there are four different combinations of signal phase that represent symbols.

QRP — An abbreviation for low transmitter power.

QSL bureau — A system for sending and receiving amateur radio verification or "QSL" cards.

QSL cards — Cards that provide written confirmation of a communication between two hams.

QSO — A contact between amateurs.

QST — The monthly journal of the ARRL. QST means "calling all radio amateurs."

Quad — A directive antenna based on the Yagi with elements that consist of one wavelength loops.

Quadrature — A 90° phase difference maintained between two signals.

Quiescent (Q-) point — Circuit or device's operating point with no input signal applied. (Also called bias point.)

RACES (Radio Amateur Civil Emergency Service) — A radio service that uses amateur stations for civil defense communication during periods of local, regional or national civil emergencies.

Radian — Unit of angular measurement equal to $1/2\pi$ of a circle, equal to $360 / 2\pi$ degrees

Radiated RFI — RFI received through radiation.

Radiation inversion — A weather condition that affects propagation at VHF and above. Radiation inversions form only over land after sunset as a result of progressive cooling of the air near the Earth's surface.

Radiation pattern — The characteristics of an antenna's distribution of energy in a single plane. (See also ***Elevation pattern*** and ***Azimuth pattern***.)

Radiation resistance — A resistance that represents the work done by the current in an antenna to radiate power.

Radio (or ham) shack — Slang term that refers to an amateur station, regardless of where it is actually located.

Radio frequency (RF) signals — (1) RF signals are generally considered to be any electrical signals with a frequency higher than 20,000 Hz, up to 300 GHz. (2) Electromagnetic radiation in the form of radio waves.

Radio horizon — The position at which a direct wave radiated from an antenna becomes tangent to the surface of the Earth. Note that as the wave continues past the horizon, the wave gets higher and higher above the surface.

Radiotelegraphy — See ***Morse code***.

Rail — Power supply voltage(s) for a circuit.

Rain scatter — A special case of tropospheric scatter practical in the 3.3 to 24 GHz range that is caused by scatter from raindrops.

Range — The total span of analog values that can be processed by an analog-to-digital conversion.

Raster (image) — Images represented as individual data elements, called pixels.

RC (reserve capacity) — A measure of a battery's ability to deliver current over long periods.

RDP — Remote Desktop Protocol. A proprietary protocol developed by Microsoft, which provides a user with a graphical interface to connect to another computer over a network connection.

Reactance (X) — Opposition to alternating current by storage in an electrical field (by a capacitor) or in a magnetic field (by an inductor), measured in ohms (Ω).

Receiver — A device that converts radio signals into a form that can be heard or viewed.

Reciprocal mixing — Noise in a mixer's output due to the LO's noise sidebands mixing with those of the desired signal.

Recombination — The process by which free electrons and holes are combined to produce current flow across a PN junction.

Recovery time — The amount of time required for carriers to be removed from a PN junction device's depletion region, halting current flow.

Rectify — Convert ac to pulsating dc.

Reflection — Signals that travel by line-of-sight propagation are reflected by large objects like buildings.

Reflection coefficient (ρ) — The ratio of the reflected voltage at a given point on a transmission line to the incident voltage at the same point. The reflection coefficient is also equal to the ratio of reflected and incident currents. The Greek letter rho (ρ) is used to represent reflection coefficient.

Reflectometer — See **SWR bridge**.

Reflector — An antenna element in a parasitic array that causes radiated energy from the driven element to be focused along the line from the driven element away from the reflector.

Refraction — Bending waves by changing the velocity of propagation. Radio waves refract as they travel through the ionosphere. If the radio waves refract enough they will return to Earth. This is the basis for long-distance communication on the HF bands.

Regulator — A device (such as a Zener diode) or circuitry in a power supply for maintaining a constant output voltage over a range of load currents and input voltages.

Relaxation oscillation — Oscillation produced by a cycle of gradual accumulation of energy followed by its sudden release.

Remote Client — The remote location from which the operator will be controlling the host station site. This could be a home location or hotel room, but can be anywhere connectivity to the host station site is available.

Repeater — A typically unattended amateur station, typically located on a mountaintop, hilltop, or tall building, that automatically and simultaneously receives and retransmits the signals of other stations on a different channel or channels for greater range. Repeaters allow radio amateurs using low-power handheld transceivers to transmit over greater distances.

Resistance (R) — Opposition to current by conversion into other forms of energy, such as heat, measured in ohms (Ω).

Resolution — Smallest change in an analog value that can be represented in a conversion between analog and digital quantities. (Also called step size.)

Resonance — (1) The condition in which a system's natural response and the frequency of an applied or emitted signal are the same. (2) The frequency at which a circuit's capacitive and inductive reactances are equal and cancel.

Resonant converter — A form of dc-dc converter characterized by the series pass switch turning on into an effective series-resonant load. This allows a zero current condition at turn-on and turn-off. The resonant converter normally operates at frequencies between 100 kHz and 500 kHz and is very compact in size for its power handling ability.

Resonant frequency — The frequency at which the maximum response of a circuit occurs. In an antenna, the resonant frequency is one at which the feed point impedance is purely resistive.

Resonator — Circuit or structure whose resonance acts as a filter.

Return loss (RL) — (1) The absolute value of the ratio in dB of the power reflected from a load to the power delivered to the load. (2) The difference in dB between forward and reflected power at a network port.

Reverse bias — Voltage applied across a PN junction in the direction that does not cause current flow.

Reverse breakdown — The condition in which reverse bias across a PN junction exceeds the ability of the depletion region to block current flow. (See also ***Avalanche breakdown***.)

RF (radio frequency) — See ***Radio frequency (RF) signals***.

Ringing — The condition in which the output of a circuit, in responding to a change in its input, exhibits a damped alternating sequence of exceeding and falling below the steady-state value that the input should cause before settling at the steady-state value.

Ripple — The residual ac left after rectification, filtration, and regulation of the input power. For example, a regular variation with frequency in a filter's magnitude response.

Rise time — The time it takes for a waveform to reach a maximum value.

RMS (voltage or current) — Literally, "root mean square," the square root of the average of the squares of the instantaneous values for one cycle of a waveform. A dc voltage or current that will produce the same heating effect as the waveform. For a sine wave, the RMS value is equal to 0.707 times the peak value of ac voltage or current.

Rolloff or Roll-off — (1) The rate of change in a filter's magnitude response in the transition region and stopband. (2) Change in a circuit's amplitude response per octave or decade of frequency.

Router — (1) A network packet switch. (2) A device that allows traffic on a single internet service line to be selectively distributed to multiple computer devices on a LAN. Many routers provide for assignment of local IP addresses as well as automatically via DHCP. (3) In packet radio, a network level relay station capable of routing packets.

RTTY (radioteletype) — Narrow-band direct-printing radioteletype that uses a digital code.

Safe operating area (SOA) — The region of a device's characteristic curve in which it can operate without damage.

Sample — Convert an analog signal to a set of digital values.

Saturation (region) — The region in the characteristic curve of an analog device in which the output signal can no longer be increased by the input signal. (See also ***Clipping***.)

Scaling — Changing a filter's impedance or frequency characteristics through multiplication or division by a constant.

Scattering — Radio wave propagation by means of multiple reflections in the layers of the atmosphere or from an obstruction. Scatter propagation also occurs in the ionosphere when there is not enough ionization for refraction or reflection, but enough to send weak electromagnetic waves off into varied directions.

Schottky barrier — A metal-to-semiconductor junction at which a depletion region is formed, similarly to a PN junction.

Scintillation fading — Fading that occurs when a signal arrives at the receiver by two or more different paths simultaneously, causing addition or partial cancellation depending on the relative phases and amplitudes of the paths.

SDR — Software Defined Radio. A radio communication system where components that have been typically implemented in hardware (e.g., mixers, filters, amplifiers, modulators/demodulators, detectors, etc.) are instead implemented by means of software on a personal computer or embedded system.

Secondary battery — A battery that may be recharged many times. Also called a storage battery.

Secondary breakdown — A runaway failure condition in a transistor, occurring at higher collector-emitter voltages, where hot spots occur due to (and promoting) localization of the collector current at that region of the chip.

Selective fading — A variation of radio wave intensity that changes over small frequency changes. It may be caused by changes in the medium through which the wave is traveling or changes in transmission path, among other things.

Self-resonant — Resonance of a component due to parasitic characteristics.

Semiconductor — (1) An element such as silicon with bulk conductivity between that of an insulator and a metal. (2) An electronic device whose function is created by a structure of chemically modified semiconductor materials.

Sense Antenna — An antenna added to a bidirectional array or loop that samples the incoming signal's phase for comparison to that of the main receiving antenna.

Serial Port Server — A device that transfers data between a computer or device serial port (COM port) and an Ethernet local area network (LAN).

Series pass transistor, or pass transistor — The transistor(s) that control(s) the passage of power between the unregulated dc source and the load in a regulator. In a linear regulator, the series pass transistor acts as a controlled resistor to drop the voltage to that needed by the load. In a switch-mode regulator, the series pass transistor switches between its ON and OFF states.

Series-input network — A network such as a filter or impedance matching circuit in which the input current flows through a component in series with the input.

Shape factor — The ratio of a filter's bandwidth between the points at which its magnitude response is 6 dB and 60 dB below the response in the filter's passband.

Shielding — A conductive barrier or enclosure interposed between two regions of space with the intent of preventing a field in one region from reaching the other region.

Shift — (1) The difference between mark and space frequencies in an FSK or AFSK signal. (2) To change between character sets, such as between LTRS and FIGS in RTTY.

Short path — The shorter of the two great circle paths between two stations.

Shunt-input network — A network such as a filter or impedance matching circuit with a component connected directly across the input.

Signal-to-noise ratio (SNR) — The ratio of the strength of the desired signal to that of the unwanted signal (noise), usually expressed in dB.

Simulate — Model using numerical methods, usually on a computer.

Simulation — Calculate a circuit's behavior based on mathematical models of the components.

Skin depth — The depth of the layer at the surface of a conductor to which ac current flow is restricted. (See ***Skin effect***.)

Skin effect — The phenomenon in which ac current at high frequencies flows in a thin layer near the surface of a conductor.

Skip — Propagation by means of ionospheric refraction. Traversing the distance to the ionosphere and back to the ground is called a hop.

Skip zone — A ring-shaped area of poor radio communication, too distant for ground waves and too close for sky waves.

Sky-wave propagation — The method by which radio waves travel through the ionosphere and back to Earth. Sometimes called ***skip***, sky-wave propagation has a far greater range than line-of-sight and ground-wave propagation.

Slew rate — The maximum rate at which a device can change the amplitude of its output.

SLI (starter, lights, ignition) — An automotive battery designed to start the vehicle and provide power to the lighting and ignition systems.

Small-signal — Conditions under which the variations in circuit parameters due to the input signal are small compared to the quiescent operating point and the device is operating in its active region.

Smartphone — A generic term for portable cellular phones with integrated computer capabilities.

Smith chart — A coordinate system developed by Phillip Smith to represent complex impedances graphically. This chart makes it easy to perform calculations involving antenna and transmission-line impedances and SWR.

SOA (Safe Operating Area) — The range of permissible collector current and collector-emitter voltage combinations where a transistor may be safely operated without danger of device failure.

Solar cycle — The approximate 11-year period of variation in solar activity.

Solar flare — An eruption on the surface of the Sun that launches a wide spectrum of electromagnetic energy into space, disrupting communications on Earth. A large flare can also release relativistic protons that cause additional absorption in the polar cap.

Solar wind — Electrically charged particles emitted by the Sun and traveling through space. Variations in the solar wind may have a sudden impact on radio communications when they arrive at the atmosphere of the Earth.

Source — (1) A device that produces an electromagnetic, electric, or magnetic field, voltage, or current. If RFI is the result, the source is an RFI source. (2) The connection at one end of the channel of a field-effect transistor into which electrons are injected.

Space station — An amateur station located more than 50 kilometers above Earth's surface.

Spectral Power Density — The amount of power per unit of bandwidth, usually "root-Hz" or √Hz, the square root of the measurement bandwidth.

Sporadic E — A form of enhanced radio wave propagation that occurs when radio signals are reflected from small, thin and dense ionization patches in the E region of the ionosphere. Sporadic E is observed on the 15-, 10-, 6- and 2-meter bands, and occasionally on the 1.25-meter band.

Spurious (spur) — A signal at an undesired frequency, usually unrelated to the frequency of a desired frequency.

Spurious emission — An emission outside the bandwidth needed for transmission of the mode being employed, the level of which may be reduced without reducing the quality of information being transmitted. Spurious emissions are most commonly the products of distortion (harmonics, intermodulation), of circuit instability (oscillation, including RF feedback), or of digital transmission with excessively fast rise times (including key clicks). Phase noise, such as that produced by a frequency synthesizer is also a spurious emission.

Squegg (squeeg) — Chaotic or random jumps in an oscillator's amplitude and/or frequency.

SSB (single sideband) — A common amateur radio voice mode of transmission.

SSID — Secondary station identifier. In AX.25 link-layer protocol, a multipurpose octet to identify several packet radio stations operating under the same call sign.

SSTV (slow-scan television) — An operating mode used to exchange still pictures.

Stacking — Arranging two or more directive antennas such that their radiation pattern characteristics reinforce each other. Frequently, similar directive antennas are stacked atop or beside one another, forming a "stacked array." Stacking provides more gain or directivity than a single antenna can achieve.

Stage — One of a series of sequential signal processing circuits or devices.

Standing-wave ratio (SWR) — Sometimes called voltage standing-wave ratio (VSWR). A measure of the impedance match between a feed line's characteristic impedance and the attached load (usually an antenna). VSWR is the ratio of maximum voltage to minimum voltage along the feed line, or of antenna impedance to feed line impedance.

Start (stop) bit — Symbol used to synchronize receiving equipment at the beginning (end) of a data byte.

State — Particular combination of signal attributes used to represent data, such as amplitude or phase.

Static (synthesizer) — A synthesizer designed to output a signal whose frequency does not change or that is not changed frequently.

Static IP — A fixed IP address in a computer or device.

Station site — The actual physical location of the transmitter, host computer, antennas and related equipment necessary to generate an RF signal on the HF bands. Some have used the term Remote Base.

Stopband — The range of frequencies that are rejected by a filter.

Stray — See ***Parasitic***.

Stripline — A transmission line consisting of a metal strip suspended between two ground planes.

Stub — A section of transmission line used to perform impedance matching or filtering.

Substrate — Base layer of material on which the structure of a semiconductor device is constructed.

Sunspot cycle — The number of sunspots increases and decreases in a somewhat predictable cycle that lasts about 11 years.

Sunspots — Dark spots on the surface of the Sun. When there are few sunspots, long-distance radio propagation is poor on the higher-frequency bands. When there are many sunspots, long-distance HF propagation improves.

Superposition — Process in which two or more signals are added together linearly.

Surge — A moderate-duration perturbation on a power line, usually lasting for hundreds of milliseconds to several seconds.

Surge impedance — See ***Characteristic impedance***.

Susceptibility — The capability of a device to respond to unwanted electromagnetic energy.

Switch — A network device that allows multiple computers or devices to share the same internet or LAN connection.

Switching regulator — Another name for a ***Switchmode converter***.

Switchmode converter — A high-efficiency switching circuit used for dc-dc power conversion. Switching circuits are usually much smaller and lighter than conventional 60 Hz, transformer-rectifier circuits because they operate at much higher frequencies — from 25 to 400 kHz or even higher.

SWL (shortwave listener) — A person who enjoys listening to shortwave radio broadcasts or amateur radio conversations. (A BCL is someone who listens for distant AM stations on the Standard Broadcast Band. Some SWLs also are BCLs.)

SWR — See ***Standing-wave ratio***.

SWR bridge — Device for measuring SWR in a transmission line. Also known as an SWR meter or reflectometer.

Symbol — Specific state or change in state of a transmission representing a particular signaling event. Symbol rate is the number of symbols transmitted per unit of time. (See also ***Baud***.)

Synthesis (frequency) — The generation of variable-frequency signals by means of nonlinear combination and filtering (direct synthesis) or by using phase-lock or phase-control techniques (indirect synthesis).

System ground — A bond between one current-carrying conductor of the power system and earth.

Tap — One processing block, consisting of a coefficient memory, signal register, multiplier and adder, of an FIR filter.

TAPR — Tucson Amateur Packet Radio Corporation, a nonprofit organization involved in digital mode development.

TCP — Transport Control Protocol. An internet protocol (see ***IP***), usually combined with IP to transfer data between devices over networks.

TCP Client — Software designed for remotely connecting to and processing data from equipment through a TCP Server over a home network or the internet.

TCP Server — Host software used for providing TCP Client software remote access to a computer or device.

TCXO — Temperature-compensated crystal oscillator. A digitally temperature-compensated oscillator (DTCXO) is controlled by a microcontroller or computer to maintain a constant frequency. Oven-controlled crystal oscillators (OCXO) are placed in a heated enclosure to maintain a constant temperature and frequency.

TDM — Time division multiplexing.

TDMA — Time division multiple access.

TE mode — Transverse electric field mode. Condition in a waveguide in which the E-field component of the traveling electromagnetic energy is oriented perpendicular to (transverse) the direction the energy is traveling in the waveguide.

TEM — Transverse electromagnetic mode in which the electric and magnetic fields of electromagnetic energy are aligned perpendicularly to the direction of motion.

Temperature coefficient (tempco) — The amount of change in a component's value per degree of change in temperature.

Temperature compensation — Causing a circuit's behavior to change with temperature in such as way as to oppose and cancel the change with temperature of some temperature-sensitive component, such as a crystal.

Temperature inversion — A condition in the atmosphere in which a region of cool air is trapped beneath warmer air.

Thermal runaway — The condition in which increasing device temperature increases device current in a positive feedback cycle.

Three-terminal regulator — A device used for voltage regulation that has three leads (terminals) and includes a voltage reference, a high-gain error amplifier, temperature-compensated voltage sensing resistors and a pass element.

Throb — A multi-frequency shift mode like MFSK15.

Time constant (ℑ) — The time required for the voltage in an RC circuit or the current in an RL circuit to rise from zero to approximately 63.2% of its maximum value or to fall from its maximum value 63.2% toward zero.

TIS (Technical Information Service) — A service of the ARRL that helps hams solve technical problems (**www.arrl.org/tis**).

TM mode — Transverse magnetic field mode. Condition in a waveguide in which the H-field (magnetic field) component of the traveling electromagnetic energy is oriented perpendicular to (transverse) the direction the energy is traveling in the waveguide.

T-match — A symmetrical version of the gamma match for a balanced antenna system.

TNC — Terminal node controller, a device that assembles and disassembles packets (frames).

Top loading — Addition of a reactance, usually capacitive, at the top of a ground-plane antenna to increase its electrical length.

Topology — The arrangement of connections of components in the filter. For example, "capacitor-input" and "inductor-input" are two different topologies.

Toroid (toroidal) — A ring-shaped continuous core.

Total harmonic distortion (THD) — A measure of how much noise and distortion are introduced by a signal processing function.

Tracert — A CMD utility for tracing the path taken by packets across the internet and latency assessing analysis along the route.

Transceiver — A radio transmitter and receiver integrated into a single package. Most hams use transceivers.

Transconductance — Ratio of output current to input voltage, with units of Siemens (S).

Transequatorial propagation — A form of F layer ionospheric propagation, in which signals of higher frequency than the expected MUF are propagated across the Earth's magnetic equator.

Transfer characteristics — A set of parameters that describe how a circuit or network behaves at and between its signal interfaces.

Transfer function — A mathematical expression of how a circuit modifies an input signal.

Transient — A short perturbation or "spike" on a power line, usually lasting for microseconds to tens of milliseconds.

Transition region — Range of frequencies between a filter's passband and stopband.

Transmatch — See ***Antenna tuner***.

Transmission line — The wires or cable used to connect a transmitter or receiver to an antenna. Also called feed line.

Transmitter — A device that produces radio-frequency (RF) signals.

Trap — A parallel LC-circuit used to isolate sections of an antenna.

Trellis — The set of allowed combination of signal states that represent data. (See also ***Constellation***.)

Triplexer — See ***Diplexer***. The triplexer operates on three different bands.

Troposphere — The region in Earth's atmosphere just above the Earth's surface and below the ionosphere.

Tropospheric bending — When radio waves are bent in the troposphere, they return to Earth farther away than the visible horizon, 100 to 500 kilometers (60 to 310 miles), depending on frequency.

Tropospheric ducting — A type of VHF propagation that can occur when warm air overruns cold air (a temperature inversion).

Tropospheric scatter — A method of radio communication at VHF and above that takes advantage of scattering in the troposphere to allow contacts beyond the radio horizon out to a working distance of 60 to 310 miles.

Turnaround time — The time required to reverse the direction of a half-duplex circuit, required by propagation, modem reversal and transmit-receive switching time of transceiver.

Twin-lead — Parallel-conductor transmission line in which both conductors are completely embedded in continuous strip of insulating material. (See also ***Balanced line***.)

Two-port network — A network with four terminals organized in two pairs, each pair called a port.

Two-port parameters — A set of four parameters that describe the relationship between signals at the network's two ports.

UHF (ultra-high frequency) — The term used for the frequency range between 300 MHz and 3000 MHz (3 GHz). Technician licensees have full privileges on all Amateur UHF bands.

Unbalanced feed line — A transmission line such as coaxial cable with conductors that have different impedances with respect to a reference potential, usually an earth connection. One conductor is usually connected directly to the reference. (See also ***Balanced line***.)

Unbalanced line — Feed line with one conductor at dc ground potential, such as coaxial cable.

Unicast — A protocol in which information is exchanged between a single pair of points on a network.

Unintentional radiator — A device that produces RF as part of its normal operation but does not intentionally radiate it.

Unipolar transistor — See ***Field-effect transistor (FET)***.

Unipole — See ***Monopole***.

Universal stub system — A matching network consisting of a pair of transmission line stubs that can transform any impedance to any other impedance.

Unun — A device that transfers power between two unbalanced systems, usually performing an impedance transformation. (See also ***balun***.)

Varactor (Varicap) — Reverse-biased diode used as a tunable capacitor.

Varicode — A code in which the different data values are represented by codes with different lengths.

Varistor — A surge suppression device used to absorb transients and spikes occurring on the power lines, thereby protecting electronic equipment plugged into that line. Frequently, the term MOV (Metal Oxide Varistor) is used instead.

VCO — Voltage-controlled oscillator (also called voltage-tuned oscillator).

VE (Volunteer Examiner) — An amateur radio operator who is qualified to administer amateur radio licensing examinations.

Vector — Image represented as a collection of drawing instructions.

Velocity factor (VF) — The speed at which an electromagnetic wave will travel through a material or feed line stated as a fraction of the speed of the wave in free space (where the wave would have its maximum velocity).

VFO — Variable-frequency oscillator.

VHF (very-high frequency) — The radio frequencies from 30 to 300 MHz.

Victim — A device that receives interference from a source.

Virtual ground — Point in a circuit maintained at ground potential by the circuit without it actually being connected to ground.

Visible horizon — The most distant point one can see by line of sight.

VNC — Virtual Network Computing. A graphical desktop sharing system that uses the Remote Frame Buffer protocol (RFB) to remotely control another computer.

Voltage — The general term for the difference in electrical potential energy between two points. Measured in volts or joules/coulomb.

Voltage multiplier — A type of rectifier circuit that is arranged to charge a capacitor or capacitors on one half-cycle of the ac input voltage waveform, and then to connect these capacitors in series with the rectified line or other charged capacitors on the alternate half-cycle. The voltage doubler and tripler are commonly used forms of the voltage multiplier.

Voltage regulation — The change in power supply output voltage with load, expressed as a percentage.

Voltage source — Device or system that creates a voltage difference at its terminals.

Volt-Amperes (VA) — The product obtained by multiplying the current times the voltage in an ac circuit without regard for the phase angle between the two. This is also known as the apparent power delivered to the load as opposed to the actual or real power absorbed by the load, expressed in watts.

VPN — Virtual Private Network. Allows you to create a secure connection to another network over the internet.

VSWR — Voltage standing-wave ratio. (See **Standing-wave ratio (SWR)**.)

VXO — Variable crystal oscillator, whose frequency is adjustable around that of the crystal.

WAS (Worked All States) — An ARRL award that is earned when an amateur radio operator confirms two-way radio contact with other stations in all 50 US states.

Waterfall — A graphical display that shows a continually updating sequence of RF spectra.

Waveguide — A hollow conductor through which electromagnetic energy flows. Usually used at UHF and microwave frequencies instead of coaxial cable.

Wavelength — A means of designating a frequency band, such as the 80-meter band.

WiFi — A form of network connectivity without a physical wired connection, although with limited range. Also known by its controlling standard, IEEE 802.11.

Window line — See ***Open-wire line***.

Wireless bridge — Low powered transmitter-receiver devices for providing point-to-point digital communications, usually Ethernet, such as for interfacing Internet services to areas without traditional means.

Word — Set of bits larger than a byte.

Work — To contact another ham.

WWV/WWVH — Radio stations run by the US NIST (National Institute of Standards and Technology) to provide accurate time and frequencies.

Yagi — Short for Yagi-Uda antenna. A parasitic array consisting of a driven element and one or more director and reflectors.

Zener diode — A heavily-doped PN-junction diode with a controlled reverse breakdown voltage, used as a voltage reference or regulator.

Zepp — See ***End-fed Half Wave***.

Zero — Frequency at which a circuit's transfer function becomes zero.