Standards

on

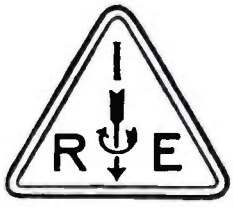
ANTENNAS

MODULATION SYSTEMS

TRANSMITTERS

DEFINITIONS OF TERMS

1948



PRICE, 75 CENTS

THE INSTITUTE OF RADIO ENGINEERS

Standards

on

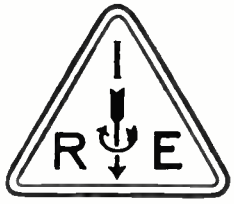
ANTENNAS

MODULATION SYSTEMS

TRANSMITTERS

DEFINITIONS OF TERMS

1948



THE INSTITUTE OF RADIO ENGINEERS
1 East 79 Street,
New York 21, N. Y.

CONTENTS

INTRODUCTION

These standards are the result of study by the 1947 and earlier Technical Committees on antennas, modulation systems, and transmitters carried on in frequent meetings and by correspondence under the general guidance of the Standards Committee. Published with the approval of the Board of Directors, the report embodies the Institute's official recommendations to its members and the industry at large.

Suggestions and comments will be welcomed as an aid to committees preparing future reports. Correspondence should be addressed to The Institute of Radio Engineers.

CONCERNING THE INSTITUTE AND ITS STANDARDS ACTIVITIES

The Institute appointed its first standards committee in 1912, and the next year published a report dealing with definitions of terms, letter and graphical symbols, and methods of testing and rating equipment. Expanded reports appeared in 1915, 1922, 1926, 1928, 1931, and 1933, each of which combined, in a single document, data on all branches of the art.

Publication of the current series of standards, of which this one is a part, was begun in 1938.* It differs from earlier reports in that each individual booklet deals with a separate field. Under present policies, subdivision is being carried even farther and separate booklets are being issued in each field for definitions of terms, for symbols, and for measuring and testing methods.

Beginning with 1942, all standards are being published in the 8x11-inch size to conform with the format for the PROCEEDINGS OF THE I.R.E.

Co-operation with Other Organizations

Throughout its life, the Institute has co-operated with other bodies in the establishment of standards. Last year, for instance, there were more than 50 official I.R.E. delegates to other standardization groups. The Institute is also the sponsor for the American Standards Association's Sectional Committee on Radio.

The Institute of Radio Engineers

The Institute of Radio Engineers was founded in 1912 to advance the theory and practice of radio and allied branches of engineering and of the related arts and sciences, their application to human needs, and the maintenance of a high professional standing among its members. Although mostly located in the United States of America, the Institute membership of over 21,000 persons has representation in approximately 70 countries throughout the world.

The PROCEEDINGS OF THE I.R.E., which has been published since 1913, is issued monthly and contains contributions from the leading workers in the theoretical and practical fields of radio communication.

Applications for membership are invited from those interested in radio. Full information may be obtained from the Executive Secretary.

* For a detailed list of current standards reports, see the inside back cover.

COMMITTEE PERSONNEL

Standards Committee, 1948

A. B. CHAMBERLAIN, *Chairman*

L. G. CUMMING, *Vice-Chairman*

G. M. K. Baker
G. P. Bosomworth
G. M. Brown
R. S. Burnap
W. G. Cady
P. S. Carter
M. G. Crosby
Eginhard Dietze
D. G. Fink
V. M. Graham
Keith Henney
J. V. L. Hogan
L. C. F. Horle
E. A. Laport
P. J. Larsen
A. V. Loughren
E. W. Schafer
S. A. Schelkunoff
W. O. Swinyard
H. M. Turner
H. A. Wheeler
L. E. Whittemore

Members who have served on the Technical Committees on Antennas, Modulation Systems, and Transmitters, respectively, are listed preceding each corresponding section of these standards.

Technical Committee on Antennas

Personnel

P. S. CARTER, *Chairman*

1945

Andrew Alford	Sidney Frankel	W. B. Lodge	D. B. Sinclair
W. L. Barrow	R. F. Guy	J. F. Morrison	George Sinclair
G. H. Brown	W. E. Jackson	D. C. Ports	Norman Snyder
Harry Diamond	E. C. Jordan	S. A. Schelkunoff	L. C. Van Atta
W. S. Duttera	R. W. P. King	J. C. Schelleng	

1946

Andrew Alford	Sidney Frankel	K. A. MacKinnon	George Sinclair
W. L. Barrow	George Grammer	D. C. Ports	Norman Snyder
T. M. Bloomer	R. F. Guy	M. W. Scheldorf	L. C. Van Atta
G. H. Brown	W. E. Jackson	S. A. Schelkunoff	J. W. Wright
Harry Diamond	E. C. Jordan	J. C. Schelleng	J. E. Young
W. S. Duttera	R. W. P. King	D. B. Sinclair	

1947

Andrew Alford	J. E. Eaton	E. C. Jordan	S. A. Schelkunoff
T. M. Bloomer	Sidney Frankel	W. E. Kock	J. C. Schelleng
G. H. Brown	George Grammer	K. A. MacKinnon	George Sinclair
L. J. Chu	R. F. Guy	W. W. Mieher	P. H. Smith
Harry Diamond	R. F. Holtz	D. C. Ports	L. C. Van Atta
W. S. Duttera	R. B. Jacques	M. W. Scheldorf	J. R. Whinnery
		J. W. Wright	

Subcommittees

AIR NAVIGATION

HARRY DIAMOND, *Chairman*

BROADCAST, COMMUNICATIONS, ETC.

W. S. DUTTERA, *Chairman*

W. B. Lodge

ANNUAL REVIEW

J. C. SCHELLENG, *Chairman*

G. H. Brown	Harry Diamond	W. S. Duttera	E. C. Jordan
		L. C. Van Atta	

THEORY AND FUNDAMENTALS

S. A. SCHELKUNOFF, *Chairman*

W. E. Kock

METHODS OF TESTING

GEORGE SINCLAIR, *Chairman*

E. C. Jordan	A. S. Meier	D. C. Ports	P. H. Smith
		O. A. Tyson	

MICROWAVE

L. C. VAN ATTA, *Chairman*

J. E. Eaton
H. J. Riblet

Antenna Definitions

Where a definition implies the use of a component in a transmitting system, its use in a *receiving system* is also implicit unless specifically stated to the contrary.

Adcock Antenna. A pair of vertical antennas separated by a distance of one-half wavelength or less, and connected in phase opposition to produce a radiation pattern having the shape of a figure of eight.

Antenna (Aerial). A means for radiating or receiving radio waves.

Antenna Array. A system of antennas coupled together for the purpose of obtaining directional effects.

Antenna Cross Talk. A measure of undesired power transfer through space from one antenna to another.

NOTE—Numerically, antenna cross talk is the ratio of the power received by one antenna to the power transmitted by the other, usually expressed in decibels.

Antenna Effect. (Old usage.) In a loop antenna, any spurious effect resulting from the capacitance of the loop to ground.

Antenna Resistance. The quotient of the power supplied to the entire antenna circuit by the square of the effective antenna current referred to a specified point.

NOTE—Antenna resistance is made up of such components as radiation resistance, ground resistance, radio-frequency resistance of conductors in the antenna circuit, and equivalent resistance due to corona, eddy currents, insulator leakage, and dielectric power loss.

Aperture (of a Unidirectional Antenna). That portion of a plane surface near the antenna, perpendicular to the direction of maximum radiation, through which the major part of the radiation passes.

Aperture Illumination. The field distribution in amplitude and phase over the aperture.

Artificial Antenna (Dummy Antenna). A device which has the necessary impedance characteristics of an antenna and the necessary power-handling capabilities, but which does not radiate or receive radio waves.

Back-Scattering Coefficient B (Echoing Area). For an incident plane wave B is 4π times the ratio of the reflected power per unit solid angle (Φ_r) in the direction of the source divided by the power per unit area (W_i) in the incident wave:

$$B = 4\pi \frac{\Phi_r}{W_i} = 4\pi r^2 \frac{W_r}{W_i}$$

where W_r is the power per unit area at distance r.

NOTE—For large objects, the back-scattering coefficient of an object is approximately the product of its interception area by its scattering gain in the direction of the source, where the interception area is the projected geometrical area and the scattering gain is the reradiated power gain relative to an isotropic radiator.

Bandwidth of an Antenna. The range of frequencies within which its performance, in respect to some characteristic, conforms to a specified standard.

Biconical Antenna. An antenna formed by two conical conductors, having a common axis and vertex, and excited at the vertex. When the vertex angle of one of the cones is 180°, the antenna is called a discone.

Broadside Array. An antenna array whose direction of maximum radiation is perpendicular to the line or plane of the array according as the elements lie on a line or plane. A uniform broadside array is a linear array whose elements contribute fields of equal amplitude and phase.

Cheese Antenna. A cylindrical parabolic reflector enclosed by two plates perpendicular to the cylinder, so spaced as to permit the propagation of more than one mode in the desired direction of polarization. It is fed on the focal line.

Circular Scanning. Scanning in which the direction of maximum radiation generates a plane or a right circular cone whose vertex angle is close to 180°.

Coaxial Antenna. An antenna comprised of a quarter wavelength extension to the inner conductor of a coaxial line and a radiating sleeve which in effect is formed by folding back the outer conductor of the coaxial line for approximately one-quarter wavelength.

Compound Horn. An electromagnetic horn of rectangular cross section, the four sides of which diverge in such a way as to coincide with or to approach four planes, with the provision that the line of intersection of two opposite planes does not intersect the line of intersection of the remaining planes. The electromagnetic field in such a horn is not simply expressed in terms of a family of cylindrical co-ordinates or a family of spherical co-ordinates.

Cone of Nulls. A conical surface formed by directions of negligible radiation.

Conical Scanning. Scanning in which the direction of maximum radiation generates a cone whose vertex angle is of the order of the beam width. Such scan-

ning may be either rotating or nutating, according as the direction of polarization rotates or remains unchanged.

Corner Reflector. A reflecting object consisting of two or three mutually intersecting conducting surfaces.

NOTE—Corner reflectors may be dihedral or trihedral. Trihedral reflectors may be used as radar targets.

Corner-Reflector Antenna. An antenna consisting of a primary radiating element and a dihedral corner reflector.

Counterpoise. A system of wires or other conductors, elevated above and insulated from the ground, forming a lower system of conductors of an antenna.

Cross Polarization. The component of the electric field vector normal to the desired polarization component.

Cut Paraboloidal Reflector. A paraboloidal reflector which is not symmetrical with respect to its axis.

Cylindrical Reflector. A reflector which is a portion of a cylinder. This cylinder is usually parabolic, although other shapes may be used.

Dielectric Antenna. An antenna which employs dielectric as the major component in producing the required radiation pattern.

Dipole Antenna. A straight radiator, usually fed in the center, and producing a maximum of radiation in the plane normal to its axis. The length specified is the over-all length.

NOTE—Common usage in microwave antennas considers a dipole to be a metal radiating structure which supports a line current distribution similar to that of a thin straight wire, a half wavelength long, so energized that the current has two nodes, one at each of the far ends.

Directional Antenna. An antenna having the property of radiating or receiving radio waves more effectively in some directions than others.

Directive Gain. In a given direction, 4π times the ratio of the radiation intensity in that direction to the total power radiated by the antenna.

Directivity. The value of the directive gain in the direction of its maximum value.

Director. A parasitic element located in the general direction of the major lobe of radiation.

Effective Area. The square of the wavelength multiplied by the power gain (or directive gain) in that direction, and divided by 4π.

NOTE—When power gain is used, the effective area is that for power reception; when directive gain is used, the effective area is that for directivity.

Effective Height. (Former usage.) In low-frequency applications, as applied to loaded or nonloaded vertical antennas, the actual height of the vertical section multiplied by the ratio of the average current in that section to the input current.

Effective Height. (Present usage.) The height of the antenna center of radiation above the effective ground level.

NOTE—For an antenna with symmetrical current distribution, the center of radiation is the center of distribution. For an antenna with asymmetrical current distribution, the center of radiation is the center of current moments when viewed from directions near the direction of maximum radiation.

Electric Dipole. A pair of equal and opposite charges an infinitesimal distance apart.

NOTE—In electromagnetics, the term "dipole" is often applied to two equal and opposite oscillating charges an infinitesimal distance apart; in this sense, it is synonymous with an electric current element.

End-Fire Array. A linear array whose direction of maximum radiation is along the axis of the array.

Exciter. The portion of a transmitting array, of the type which includes a reflector, which is directly connected with the source of power.

Fanned-Beam Antenna. A unidirectional antenna so designed that transverse cross sections of the major lobe are approximately elliptical.

Fishbone Antenna. An antenna consisting of a series of coplanar elements arranged in collinear pairs, loosely coupled to a balanced transmission line.

Folded Dipole Antenna. An antenna composed of two parallel, closely spaced dipole antennas connected together at their ends with one of the dipole antennas fed at its center.

Fraunhofer Region. That region of the field in which the energy flow from an antenna proceeds essentially as though coming from a point source located in the vicinity of the antenna.

NOTE—If the antenna has a well-defined aperture D in a given aspect, the Fresnel region in that aspect is commonly taken to to exist at distances greater than $2D^2/\lambda$ from the aperture, λ being the wavelength.

Fresnel Region. The region between the antenna and the Fraunhofer region.

NOTE—If the antenna has a well-defined aperture D in a given aspect, the Fresnel region in that aspect is commonly taken to extend a distance $2D^2/\lambda$ in that aspect, λ being the wavelength.

Front-to-Rear Ratio. The ratio of the effectiveness of a directional antenna toward the front and toward the rear.

Gain of an Antenna. (Old usage.) The measured gain of one transmitting or receiving antenna over another is the ratio of the signal power one produces at the receiver input terminals to that produced by the other, the transmitting power level remaining fixed.

Grating Reflector. An open-work metal structure designed to provide a good reflecting surface.

Ground Equalizer Inductors. Coils of relatively low inductance, placed in the circuit connected to one or more of the grounding points of an antenna to distribute the current to the various points in any desired manner.

Ground System of an Antenna. That portion of an antenna, closely associated with and including an extensive conducting surface, which may be the earth itself.

Half-Power Width of a Radiation Lobe. In a plane containing the direction of the maximum of the lobe, the full angle between the two directions in that plane about the maximum in which the radiation intensity is one-half the maximum value of the lobe.

Horn Radiator. A radiating element having the shape of a horn.

J Antenna. A half-wave antenna, end fed by a parallel-wire quarter-wave section having the configuration of a J.

Lens. A structure transparent to radio waves and with a relative dielectric constant different from unity, designed in such manner as to produce a desired pattern. Such structures may employ dielectrics or metallic configurations.

Linear Array. An antenna array whose elements are equally spaced along a straight line.

Lobe Switching. A form of scanning in which the direction of maximum radiation is switched periodically through two or more directions.

Long-Wire Antenna. A linear antenna which, by virtue of its considerable length in comparison with the operating wavelength, provides a directional radiation pattern.

Loop Antenna. An antenna consisting of one or more complete turns of conductor and functioning by virtue of the circulatory current therein.

Major Lobe (Beam). The radiation lobe containing the direction of maximum radiation.

Minor Lobe. Any lobe except the major lobe.

Multiple-Tuned Antenna. A low-frequency antenna having a horizontal section with a multiplicity of tuned vertical sections.

Musa Antenna. A "multiple-unit steerable antenna" consisting of a number of stationary antennas, the composite major lobe of which is electrically steerable.

Omnidirectional Antenna. An antenna producing essentially constant field strength in azimuth and a directive radiation pattern in elevation.

Paraboloidal Reflector. A reflector which is a portion of a paraboloid of revolution.

Parasitic Element. A radiating element, not coupled directly to the feed line of the antenna, which materially affects the pattern of the antenna.

Pencil-Beam Antenna. A unidirectional antenna, so designed that cross sections of the major lobe by planes perpendicular to the direction of maximum radiation are approximately circular.

Phi (Φ) Polarization. The state of the wave in which the E vector is tangential to the lines of latitude of some given spherical frame of reference.

NOTE—The usual frame of reference has the polar axis vertical and the origin at or near the antenna. Under these conditions, a vertical dipole will radiate only theta (θ) polarization, and a horizontal loop will radiate only phi ($\varnothing$) polarization.

Pill-Box Antenna. A cylindrical parabolic reflector enclosed by two plates perpendicular to the cylinder, so spaced as to permit the propagation of only one mode in the desired direction of polarization. It is fed on the focal line.

Power Gain. In a given direction, 4π times the ratio of the radiation intensity in that direction to the total power delivered to the antenna.

Principal E Plane. A plane containing the direction of maximum radiation and in which the electric vector everywhere lies in the plane.

Principal H Plane. A plane containing the direction of maximum radiation and in which the electric vector is everywhere normal to the plane while the magnetic vector lies in the plane.

Pyramidal Horn. An electromagnetic horn, the sides of which form a pyramid. The electromagnetic field in such a horn would be expressed basically in a family of spherical co-ordinates.

Radiating Element. A basic subdivision of an antenna which in itself is capable of radiating or receiving radio-frequency energy.

Radiation Efficiency. The ratio of the power radiated to the total power supplied to the antenna at a given frequency.

Radiation Intensity. In a given direction, the power radiated from an antenna per unit solid angle in that direction.

Radiation Lobe. A portion of the radiation pattern bounded by one or two cones of nulls.

Radiation Pattern. A graphical representation of the radiation of the antenna as a function of direction. Cross sections in which radiation patterns are frequently given are vertical planes and the horizontal plane, or the principal electric and magnetic polarization planes.

Radiation Resistance. The quotient of the power radiated by an antenna by the square of the effective antenna current referred to a specified point.

Radome. A dielectric housing for an antenna.

Rectangular Scanning. A two-dimensional sector scan in which a slow sector scan in one direction is superimposed on a rapid sector scan in a perpendicular direction.

Reflector. A parasitic element located in a direction other than the general direction of the major lobe of radiation.

Resolving Power. In a unidirectional antenna, the reciprocal of its beam width measured in degrees.

NOTE—The resolution of a directional radio system can be different from the resolving power of its antenna, since the resolution is affected by other factors.

Rhombic Antenna. An antenna composed of long-wire radiators comprising the sides of a rhombus. The antenna usually is terminated in an impedance. The sides of the rhombus, the angle between the sides, the elevation, and the termination are proportioned to give the desired directivity.

Scanning. A periodic motion given to the major lobe of an antenna.

Scanning Antenna Mount. A mechanical support for an antenna which provides mechanical means for scanning or tracking with the antenna and means to take off information for indication and control.

Scanning Loss. In a radar system, the reduction in sensitivity expressed in decibels due to scanning across a target compared with that obtained when the beam is directed constantly at the target.

Sectionalized Vertical Antenna. A vertical antenna which is insulated at one or more points along its length. The insertion of suitable reactances or applications of a driving voltage across the insulated points results in a modified current distribution giving a more desired radiation pattern in the vertical plane.

Sectoral Horn. An electromagnetic horn, two opposite sides of which are parallel and the two remaining sides of which diverge. The electromagnetic field in such a horn would be expressed basically in a family of cylindrical co-ordinates.

Sector Scanning. Circular scanning in which but a portion of the plane or flat cone is generated.

Series-Fed Vertical Antenna. A vertical antenna which is insulated from ground and energized at the base.

Shaped-Beam Antenna (Phase-Shaped). A unidirectional antenna whose major lobe differs materially from that obtainable from an aperture of uniform phase.

NOTE—A $\csc^2\theta$ beam is a shaped beam whose intensity in some plane varies as $\csc^2\theta$ over a prescribed range, where θ is a polar angle in that plane. The half-power width in planes, perpendicular to this plane, is approximately constant for the prescribed range of θ.

Shunt-Fed Vertical Antenna. A vertical antenna connected to ground at the base and energized at a point suitably positioned above the grounding point.

Sleeve Stub. An antenna consisting of half of a sleeve-dipole antenna projecting from an extended metal surface.

Sleeve-Dipole Antenna. A dipole antenna surrounded in its central portion by a coaxial sleeve.

Slot Antenna. A radiating element formed by a slot in a metal surface.

Spiral Scanning. Scanning in which the direction of maximum radiation describes a portion of a spiral. The rotation is always in one direction.

Steerable Antenna. A directional antenna whose major lobe can be readily shifted in direction.

Tenth-Power Width. In a plane containing the direction of the maximum of a lobe, the full angle between the two directions in that plane about the maximum in which the radiation intensity is one-tenth the maximum value of the lobe.

Theta (θ) Polarization. The state of the wave in which the E vector is tangential to the meridian lines of some given spherical frame of reference.

NOTE—The usual frame of reference has the polar axis vertical and the origin at or near the antenna. Under these conditions, a vertical dipole will radiate only theta (θ) polarization and the horizontal loop will radiate only phi ($\varnothing$) polarization.

Top-Loaded Vertical Antenna. A vertical antenna so constructed that, because of its greater size at the top, there results a modified current distribution giving a more desirable radiation pattern in the vertical plane. A series reactor may be connected between the enlarged portion of the antenna and the remaining structure.

Tracking. A motion given to the major lobe of an antenna such that some pre-assigned moving target in space is always contained within the major lobe.

Turnstile Antenna. An antenna composed of two dipole antennas, normal to each other, with their axes intersecting at their midpoints. Usually, the currents are equal and in phase quadrature.

Unidirectional Antenna. An antenna which has a single well-defined direction of maximum gain.

Unipole (Isotropic Antenna). A hypothetical antenna radiating or receiving equally in all directions. A pulsating sphere is a unipole for sound waves. In the case of electromagnetic waves unipoles do not exist physically but represent convenient reference antennas for expressing directive properties of actual antennas.

V Antenna. A V-shaped arrangement of conductors, balanced-fed at the apex, and with included angle, length, and elevation proportioned to give the desired directivity.

Wave Antenna (Beverage Antenna). A directional antenna composed of a system of parallel, horizontal conductors from one-half to several wavelengths long, and terminated to ground at the far end in its characteristic impedance.

Zoning (Stepping). The displacement of various portions (called zones, or steps) of the lens or surface of the reflector so that the resulting phase front in the near field remains unchanged.

Technical Committee on Modulation Systems

Personnel

The Modulation Systems Committee was instituted as the "Frequency-Modulation Technical Committee" in 1940. The field of the committee included the various types of modulation such as amplitude, phase, and frequency modulation. In 1946, work was started on pulse-modulation definitions and the name of the Committee was changed to the "Modulation Systems Committee." The work of the present list of definitions was spread over a period from the inception of the Committee to the present time.

The following members served on the Committee during the course of the work:

Armstrong, E. H., '40-'41
Berg, R. A., '46
Black, H. S., '46-'47
Brown, J. E., '40-'47
Burroughs, F. L., '46-'47
Chamberlain, A. B., '40-'41
Chambers, C. C., '40-'47 [1]
Cotter, W. F., '40-'45
Crosby, M. G., '40-'47 [2]
De Mars, Paul, '46
Doolittle, F. M., '47
Everitt, W. L., '41-'45
Finnigan, C. W., '45-'47
Fredendall, G. L., '46
Goetter, W. F., '45-'47
Gilman, G. W., '40-'41
Goodnow, A. C., '45-'47
Grammer, George, '47
Grieg, D. D., '46-'47
Guy, R. F., '42-'47
Hill, D. M., '46-'47
Jaffe, D. L., '45
Jansky, Jr., C. M., '40-'45
Jennings, M. H., '45-'46
Jolliffe, C. B., '40-'41
Landon, V. D., '41-'47
Loughlin, B. D., '46-'47
Marvin, H. B., '40-'45
McCoy, C. T., '46-'47
Morris, R. M., '41
Miner, C. R., '47
Noble, D. E., '40-'45 [3]
Olive, G. W., '46-'47
Ostlund, E. M., '46-'47
Pollack, Dale, '47
Shackelford, B. E., '42-'45
Smith, D. B., '40-'46
Seeley, S. W., '47
Stearns, H. M., '46
Town, G. R., '46
Trevor, Bertram, '46-'47
Tuller, W. G., '46-'47
Worcester, J. A., '46
Wheeler, L. P., '40-'45
Wright, J. W., '46-'47
White, Warren, '42-'45
Young, J. E., '45-'46

[1] *Chairman* '44-'45
[2] *Chairman* '46-'47
[3] *Chairman* '40-'43

Modulation Systems Definitions

Amplitude Modulation or AM. Modulation in which the amplitude of a wave is the characteristic subject to variation.

Angle Modulation. Modulation in which the angle of a sine-wave carrier is the characteristic subject to variation.

NOTE—Phase and frequency modulation are particular forms of angle modulation.

Angle or Phase of a Sine Wave. The measure of the progression of the wave in time or space from a chosen instant or position.

NOTE—In the expression for a sine wave, the angle or phase is the value of the entire linear function.

NOTE—In the representation of a sine wave by a rotating vector, the angle or phase is the angle through which the vector has progressed.

Bidirectional Pulses. Pulses, some of which rise in one direction and the remainder in the other direction.

Carrier. A wave suitable for modulation by a modulating wave.

NOTE—Examples of carriers are a sine wave and a recurring series of pulses.

Carrier Frequency. In a periodic carrier, the reciprocal of its period.

NOTE—The frequency of a periodic pulse carrier often is called the pulse-repetition frequency (prf).

Carrier-to-Noise Ratio. The ratio of the value of the carrier to that of the noise after selection and before any nonlinear process such as amplitude limiting and detection.

Clipper. A transducer which gives output only when the input exceeds a critical value.

Clipper Limiter. A transducer which gives output only when the input lies above a critical value and a constant output for all inputs above a second higher critical value.

NOTE—This is sometimes called an amplitude gate, or slicer.

Crest Factor of a Pulse Carrier. The ratio of the peak pulse amplitude to the root-mean-square amplitude.

De-Emphasis Network. A network inserted in a system in order to restore the pre-emphasized frequency spectrum to its original form.

Detection. The process by which a wave corresponding to the modulating wave is obtained in response to a modulated wave.

Detector. A device to effect the process of detection.

Deviation Ratio. In a frequency-modulation system, the ratio of the maximum frequency deviation to the maximum modulating frequency of the system.

Differentiating Network. A network whose output is the time derivative of its input wave form.

NOTE—Such a network preceding a frequency modulator makes the combination a phase modulator; or, following a phase detector, it makes the combination a frequency detector. Its ratio of output amplitude to input amplitude is proportional to frequency, and its output phase leads its input phase by 90°.

Discriminator. A device in which amplitude variations are derived in response to frequency variations.

Duty Factor. In a pulse carrier composed of pulses that recur at regular intervals, the product of the pulse duration and the pulse-repetition frequency.

Frequency Deviation. In frequency modulation, the peak difference between the instantaneous frequency of the modulated wave and the carrier frequency.

Frequency-Division Multiplex. The process or device in which each modulating wave modulates a separate subcarrier and the subcarriers are spaced in frequency.

NOTE—Frequency division permits the transmission of two or more signals over a common path by using different frequency bands for the transmission of the intelligence of each message signal.

Frequency Modulation or FM. Angle modulation in which the instantaneous frequency of a sine-wave carrier is caused to depart from the carrier frequency by an amount proportional to the instantaneous value of the modulating wave.

Frequency-Shift Keying or FSK. That form of frequency modulation in which the modulating wave shifts the output frequency between predetermined values, and the output wave is coherent with no phase discontinuity.

Frequency Swing. In frequency modulation, the peak difference between the maximum and the minimum values of the instantaneous frequency.

Gating. The process of selecting those portions of a wave which exist during one or more selected time intervals or which have magnitudes between selected limits.

Improvement Threshold. In angle-modulation systems, the condition of unity for the ratio of peak carrier voltage to peak noise voltage after selection and before any nonlinear process such as amplitude limiting and detection.

Impulse Noise. Noise characterized by transient disturbances separated in time by quiescent intervals. The frequency spectrum of these disturbances must be substantially uniform over the useful pass band of the transmission system.

Instantaneous Frequency. The time rate of change of the angle of a wave which is a function of time.

NOTE—If the angle is measured in radians, the frequency in cycles is the time rate of change of the angle divided by 2π.

Instantaneous Sampling. The process for obtaining a sequence of instantaneous values of a wave. These values are called instantaneous samples.

Integrating Network. A network whose output wave form is the time integral of its input wave form.

NOTE—Such a network preceding a phase modulator makes the combination a frequency modulator; or, following a frequency detector, makes the combination a phase detector. Its ratio of output amplitude to input amplitude is inversely proportional to frequency, and its output phase lags its input phase by 90°.

Intelligence Bandwidth. The sum of the audio (or video) frequency bandwidths of the one or more channels.

Intermediate Subcarrier. A carrier which may be modulated by one or more subcarriers and which is used as a modulating wave to modulate a carrier or another intermediate subcarrier.

Keying. The forming of signals, such as those employed in telegraph transmission, by an abrupt modulation of the output of a direct-current or an alternating current source as, for example, by interrupting it or by suddenly changing its amplitude or frequency or some other characteristic.

Limiter. A transducer whose output is constant for all inputs above a critical value.

NOTE—A limiter may be used to remove amplitude modulation and transmit angle modulation.

Modulated Wave. A wave, some characteristic of which varies in accordance with the value of a modulating wave.

Modulating Wave. A wave which causes a variation of some characteristic of the carrier.

Modulation (of a Carrier).

(1) The process by which some characteristic of a carrier is varied in accordance with a modulating wave.

(2) The variation of some characteristic of a carrier.

Modulation Index. For a sinusoidal modulating wave, the ratio of the frequency deviation to the frequency of the modulating wave.

Modulator. A device to effect the process of modulation.

Multiple Modulation. A succession of processes of modulation in which the modulated wave from one process becomes the modulating wave for the next.

NOTE—In designating multiple-modulation systems by their letter symbols, the processes are listed in the order in which the signal intelligence encounters them. For example, PPM-AM means a system in which one or more signals are used to position-modulate their respective pulse subcarriers which are spaced in time and are used to amplitude-modulate a carrier.

Noise. An undesired disturbance within the useful frequency band.

NOTE—Undesired disturbances within the useful frequency band produced by other services may be called interference.

Phase Deviation. The peak difference between the instantaneous angle of the modulated wave and the angle of the carrier.

Phase Modulation or PM. Angle modulation in which the angle of a sine-wave carrier is caused to depart from the carrier angle by an amount proportional to the instantaneous value of the modulating wave.

Pre-Emphasis Network. A network inserted in a system in order to emphasize one range of frequencies with respect to another.

Pulse. A single disturbance characterized by the rise and decay in time or space or both of a quantity whose value is normally constant.

NOTE—In these modulation definitions, a radio-frequency carrier, amplitude-modulated by a pulse, is not considered to be a pulse.

Pulse-Amplitude Modulation or PAM. Modulation in which the modulating wave is caused to amplitude-modulate a pulse carrier.

Pulse Carrier. A carrier consisting of a series of pulses.

NOTE—Usually, pulse carriers are employed as subcarriers.

Pulse Duration. The duration of a rectangular pulse whose energy and peak power equal those of the pulse in question.

NOTE—When determining the peak power, any transients of relatively short duration are frequently ignored.

Pulse-Duration Modulation or PDM. Pulse-time modulation in which the value of each instantaneous sample of the modulating wave is caused to modulate the duration of a pulse.

NOTE—The terms "pulse-width modulation" and "pulse-length modulation" also have been used to designate this system of modulation.

NOTE—In pulse-duration modulation, the modulating wave may vary the time of occurrence of the leading edge, the trailing edge, or both edges of the pulse.

Pulse-Position Modulation or PPM. Pulse-time modulation in which the value of each instantaneous sample of a modulating wave is caused to modulate the position in time of a pulse.

Pulse-Time Modulation or PTM. Modulation in which the values of instantaneous samples of the modulating wave are caused to modulate the time of occurrence of some characteristic of a pulse carrier.

NOTE—Pulse-duration modulation and pulse-position modulation are particular forms of pulse-time modulation.

Random (or Fluctuation) Noise. Noise characterized by a large number of overlapping transient disturbances occurring at random.

Sidebands. All of the frequencies produced by modulation.

NOTE—In a modulation system with a sine-wave carrier, the upper sideband includes those frequencies which are higher than the carrier frequency; the lower sideband includes those frequencies which are lower than the carrier frequency.

Side Frequency. One of the frequencies of a sideband.

Signal-to-Noise Ratio. The ratio of the value of the signal to that of the noise.

NOTE—This ratio is usually in terms of peak values in the case of impulse noise and in terms of the root-mean-square values in the case of the random noise.

NOTE—Where there is a possibility of ambiguity, suitable definitions of the signal and noise should be associated with the term; as, for example: peak-signal to peak-noise ratio; root-mean-square signal to root-mean-square noise ratio; peak-to-peak signal to peak-to-peak noise ratio, etc.

NOTE—This ratio is often expressed in decibels.

NOTE—This ratio may be a function of the bandwidth of the transmission system.

Sine Wave. A wave which can be expressed as the sine of a linear function of time, or space, or both.

Single-Sideband Modulation or SS. Modulation whereby the spectrum of the modulating wave is translated in frequency by a specified amount either with or without inversion.

Single-Tone Keying. That form of keying in which the modulating wave causes the carrier to be modulated with a single tone for one condition, which may be either "marking" or "spacing," and the carrier is unmodulated for the other conditions.

Subcarrier. A carrier which is applied as a modulating wave to modulate another carrier or an intermediate subcarrier.

Synchronous Gate. A time gate wherein the output intervals are synchronized with an incoming signal.

Time-Division Multiplex. The process or device in which each modulating wave modulates a separate pulse subcarrier, the pulse subcarriers being spaced in time so that no two pulses occupy the same time interval.

NOTE—Time division permits the transmission of two or more signals over a common path by using different time intervals for the transmission of the intelligence of each message signal.

Time Gate. A transducer which gives output only during chosen time intervals.

Transducer. A device by means of which energy can flow from one or more transmission systems to one or more other transmission systems.

NOTE—The energy transmitted by these systems may be of any form (for example, it may be electric, mechanical, or acoustical), and it may be of the same form or different forms in the various input and output systems.

Two-Source Frequency Keying. That form of keying in which the modulating wave abruptly shifts the output frequency between predetermined values, where the values of output frequency are derived from independent sources and, therefore, the output wave is not coherent and, in general, will have a phase discontinuity.

Two-Tone Keying. That form of keying in which the modulating wave causes the carrier to be modulated with a single tone for the "marking" condition and modulated with a different single tone for the "spacing" condition.

Unidirectional Pulses. Single-polarity pulses which all rise in the same direction.

Wave. A disturbance which is a function of time or space or both.

Wide-Band Improvement. The ratio of the signal-to-noise ratio of the system in question to the signal-to-noise ratio of a reference system.

NOTE—In comparing frequency-modulation and amplitude-modulation systems, the reference system usually is a double-sideband amplitude-modulation system with a carrier power, in the absence of modulation, which is equal to the carrier power of the frequency-modulation system.

Wide-Band Ratio. The ratio of the occupied frequency bandwidth to the intelligence bandwidth.

Technical Committee on Radio Transmitters

Personnel

EDMUND A. LAPORT, *Chairman*

1946

M. R. Briggs	F. A. Gunther	L. A. Looney	J. C. Schelleng
Cledo Brunetti	W. E. Jackson	C. H. Meyer	Robert Serrell
H. R. Butler	J. B. Knox	J. F. Morrison	I. R. Weir
Harry Diamond	W. W. Lindsay, Jr.	R. L. Robbins	J. E. Young

1947

L. T. Bird	H. R. Butler	L. A. Looney	R. L. Robbins
M. R. Briggs	A. E. Kerwien	C. H. Meyer	Robert Serrell
Cledo Brunetti	J. B. Knox	J. C. R. Punchard	I. R. Weir

Subcommittees

CIRCUITS AND ADVANCED DEVELOPMENT

CLEDO BRUNETTI, *Chairman*

R. Bateman	E. M. McCormick
W. J. Cronin	W. K. Roberts
Joseph Kaufman	V. R. Simpson

J. D. Wallace

AMPLITUDE-MODULATED TRANSMITTERS

I. R. WEIR, *Chairman*

M. R. Briggs	J. B. Knox
H. R. Butler	L. A. Looney

C. H. Meyer

FREQUENCY-MODULATED TRANSMITTERS

L. T. BIRD, *Chairman*

J. B. Knox	J. C. R. Punchard

TELEVISION TRANSMITTERS

ROBERT SERRELL, *Chairman*

T. J. Buzalski	A. A. McDonald

N. H. Young

Transmitter Definitions

Absorption Modulation. A system for producing amplitude modulation of the output of a radio transmitter by means of a variable-impedance device inserted in or coupled to the output circuit.

Alternator Transmitter. A radio transmitter which utilizes power generated by a radio-frequency alternator.

Ambient Temperature. The temperature of the surrounding medium, such as gas or liquid, which comes into contact with the apparatus.

Amplifier. A device whose output is an enlarged reproduction of the essential features of an input wave and which draws power therefor from a source other than the input signal.

Amplitude Distortion. A type of distortion that occurs in an amplifier or other device when the amplitude of the output is not exactly a linear function of the input amplitude.

Amplitude versus Frequency Response Characteristic. The variation with frequency of the gain or loss of a device or a system.

Amplitude-Modulated Transmitter. A transmitter which transmits an amplitude-modulated wave.

NOTE—In most amplitude-modulated transmitters, the frequency is stabilized.

Amplitude-Modulation Noise Level. The noise level produced by undesired amplitude variations of a radio-frequency signal in the absence of any intended modulation.

Arc Converter. A form of oscillator utilizing an electric arc as the generator of alternating or pulsating current.

Artificial Line. A network designed to simulate some or all of the characteristics of a transmission line.

Artificial Load. A dissipative but essentially nonradiating device having the impedance characteristics of an antenna, transmission line, or other practical utilization circuit.

Audio Frequency. A frequency corresponding to a normally audible sound wave.

NOTE—Audio frequencies range roughly from 20 to 15,000 cycles per second.

Audio-Frequency Harmonic Distortion. The generation in a system of integral multiples of a single audio-frequency input signal.

Audio-Frequency Peak Limiter. A circuit used in an audio-frequency system to cut off peaks that exceed a predetermined value.

Aural Transmitter. The radio equipment used for the transmission of the aural (sound) signals from a television broadcast station.

Automatic Frequency Control. An arrangement whereby the frequency of an oscillator is automatically maintained within specified limits.

Automatic Grid Bias. Grid-bias voltage provided by the difference of potential across resistance(s) in the grid or cathode circuit by grid or cathode current or both.

Average Power Output of an Amplitude-Modulated Transmitter. The radio-frequency power delivered to the transmitter output terminals averaged over a modulation cycle.

Babble. The aggregate cross talk from a large number of disturbing channels.

Background Noise. Noise due to audible disturbances of periodic and/or random occurrence.

Back-Shunt Keying. A method of keying a transmitter in which the radio-frequency energy is fed to the antenna when the telegraph key is closed and to an artificial load when the key is open.

Back Wave. A signal emitted from a radiotelegraph transmitter during spacing portions of the code characters.

Balanced (Push-Pull) Amplifier. An amplifier circuit in which there are two identical signal branches connected so as to operate in phase opposition and with input and output connections each balanced to ground.

Balanced Modulator. A modulator, specifically a push-pull circuit, in which the carrier and modulating signal are so introduced that after modulation takes place the output contains the two sidebands without the carrier.

Balanced Oscillator. Any oscillator in which the impedance centers of the tank circuits are at ground potential and the voltages between either end and their centers are equal in magnitude and opposite in phase.

Bandwidth. The number of cycles per second expressing the difference between the limiting frequencies of a frequency band.

Barkhausen-Kurz Oscillator. An oscillator of the retarding-field type in which the frequency of oscillation depends solely upon the electron-transit time within the tube.

Baud. The unit of telegraph signaling speed, derived from the duration of the shortest signaling pulse. A telegraphic speed of one baud is one pulse per second.

NOTE—The term "unit pulse" is often used for the same meaning as the baud. A related term, the "dot cycle," refers to an on-off or mark-space cycle in which both mark and space intervals have the same length as the unit pulse.

Bel. The fundamental division of a logarithmic scale for expressing the ratio of two amounts of power, the number of bels denoting such a ratio being the logarithm to the base 10 of this ratio.

NOTE—With P_1 and P_2 designating two amounts of power and N the number of bels denoting their ratio, $N = \log_{10} (P_1/P_2)$ bels.

Bias Telegraph Distortion. Distortion in which all mark pulses are lengthened (positive bias) or shortened (negative bias). It may be measured with a steady stream of "unbiased reversals," square waves having equal-length mark and space pulses. The average lengthening or shortening gives true bias distortion only if other types of distortion are negligible.

Blocking (Squegging) Oscillator. An electron-tube oscillator operating intermittently with grid bias increasing during oscillation to a point where oscillations stop, then decreasing until oscillation is resumed.

NOTE—Squegge rhymes with wedge.

Bootstrap Circuit. A single-stage amplifier in which the output load is connected between the negative end of the plate supply and the cathode, the signal voltage being applied between the grid and the cathode. The name "bootstrap" arises from the fact that a change in grid voltage changes the potential of the input source with respect to ground by an amount equal to the output signal.

Break-In Keying. A method of operating a radiotelegraph communication system in which the receiver is capable of receiving signals during transmission spacing intervals.

Bridge Rectifier. A full-wave rectifier with four rectifying elements or groups of elements connected as in a bridge circuit.

Buffer Amplifier. An amplifier in which the reaction of output-load-impedance variation on the input circuit is reduced to a minimum for isolation purposes.

Carrier-Amplitude Regulation. The change in amplitude of the carrier wave in an amplitude-modulated transmitter when modulation is applied under conditions of symmetrical modulation.

NOTE—The term "carrier shift," often applied to this effect, is deprecated.

Carrier-Frequency Range of a Transmitter. The continuous range of frequencies within which the transmitter may be adjusted for normal operation. A transmitter may have more than one carrier-frequency range.

Carrier-Frequency Stability of a Transmitter. A measure of the ability of a transmitter to maintain an assigned average frequency.

Carrier Noise Level (Residual Modulation). The noise level produced by undesired variations of a radio-frequency signal in the absence of any intended modulation.

Carrier Suppression. That method of operation in which the carrier wave is not transmitted.

Cathode Follower. A circuit in which the output load is connected in the cathode circuit of an electron tube and the input is applied between the control grid and the remote end of the cathode load.

NOTE—The circuit is characterized by low output impedance, high input impedance, and gain less than unity.

Cathode Modulation. Amplitude modulation accomplished by application of the modulating voltage to the cathode circuit.

Cathode Pulse Modulation. Modulation produced in an amplifier or oscillator by application of externally generated pulses to the cathode circuit.

Cavity Resonator. A space normally bounded by an electrically conducting surface in which oscillating electromagnetic energy is stored, and whose resonant frequency is determined by the geometry of the enclosure.

Center Frequency. The average frequency of the emitted wave when modulated by a symmetrical signal.

Characteristic Telegraph Distortion. Distortion which does not affect all signal pulses alike, the effect on each transition depending upon the signal previously sent, due to remnants of previous transitions or transients which persist for one or more pulse lengths. Lengthening of the mark pulse is positive, and shortening, negative. Characteristic distortion is measured by transmitting "biased reversals," square waves having unequal mark and space pulses. The average lengthening or shortening of mark pulses, expressed in per cent of unit pulse length, gives a true measure of characteristic distortion only if other types of distortion are negligible.

Class-A Amplifier. An amplifier in which the grid bias and alternating grid voltages are such that plate current in a specific tube flows at all times.

NOTE—To denote that grid current does not flow during any part of the input cycle, the suffix 1 may be added to the letter or letters of the class identification. The suffix 2 may be used to denote that grid current flows during some part of the cycle.

Class-A Modulator. A Class-A amplifier which is used specifically for the purpose of supplying the necessary signal power to modulate a carrier.

Class-AB Amplifier. An amplifier in which the grid bias and alternating grid voltages are such that plate current in a specific tube flows for appreciably more than half but less than the entire electrical cycle.

NOTE—To denote that grid current does not flow during any part of the input cycle, the suffix 1 may be added to the letter or letters of the class identification. The suffix 2 may be used to denote that grid current flows during some part of the cycle.

Class-B Amplifier. An amplifier in which the grid bias is approximately equal to the cutoff value so that the plate current is approximately zero when no exciting grid voltage is applied, and so that plate current in a specific tube flows for approximately one-half of each cycle when an alternating grid voltage is applied.

NOTE—To denote that grid current does not flow during any part of the input cycle, the suffix 1 may be added to the letter or letters of the class identification. The suffix 2 may be used to denote that grid current flows during some part of the cycle.

Class-B Modulator. A Class-B amplifier which is used specifically for the purpose of supplying the necessary signal power to modulate a carrier.

Class-C Amplifier. An amplifier in which the grid bias is appreciably beyond the cutoff so that the plate current in each tube is zero when no alternating grid voltage is applied, and so that plate current flows in a specific tube for appreciably less than one-half of each cycle when an alternating grid voltage is applied.

NOTE—To denote that grid current does not flow during any part of the input cycle, the suffix 1 may be added to the letter or letters of the class identification. The suffix 2 may be used to denote that grid current flows during some part of the cycle.

Colpitts Oscillator. An oscillator in which the parallel-tuned tank circuit is connected between grid and plate, with the tank capacitance containing two voltage-dividing capacitors in series, with their common connection at cathode potential and the necessary feedback voltage being obtained across the grid-cathode capacitor. When the two voltage-dividing capacitances are the plate-to-cathode and the grid-to-cathode capacitances of the tube, the circuit is known as the ultra-audion oscillator.

Constant-Current (Heising) Modulation. A system of amplitude modulation wherein the output circuits of the signal amplifier and the carrier-wave generator or amplifier are directly and conductively coupled by means of a common inductor which has ideally infinite impedance to the signal frequencies and which, therefore, maintains the common plate-supply current of the two devices constant. The signal-frequency voltage thus appearing across the common inductor appears also as modulation of the plate supply to the carrier generator or amplifier with corresponding modulation of the carrier output.

Contact Rectifier. A rectifier consisting of two different solids in contact, in which rectification is due to greater conductivity across the contact in one direction than in the other.

Continuous-Duty Rating. The rating applying to operation for an indefinitely long time.

Continuous Waves or CW. Waves, the successive oscillations of which are identical under steady-state conditions.

Controlled (Variable or Floating) Carrier. A system of compound modulation wherein the carrier is amplitude-modulated by the signal frequencies in any conventional manner but, in addition, the carrier is also amplitude-modulated in accordance with the envelope of the signal, so that the percentage of modulation, or modulation factor, remains relatively constant regardless of the amplitude of the signal.

Cross Modulation. A type of intermodulation due to modulation of the carrier of the desired signal by an undesired signal.

Cross Neutralization. A method of neutralization used in push-pull amplifiers whereby a portion of the plate-cathode alternating-current voltage of each tube is applied to the grid-cathode circuit of the other tube through a neutralizing capacitor.

Cross Talk. The sound heard in a receiver associated with a given communication channel from communication currents in another channel.

Crystal-Controlled Transmitter. A transmitter whose carrier frequency is directly controlled by the electromechanical characteristics of a piece of material of crystalline structure.

Crystal Oscillator. A generator of alternating-current energy, the frequency of which is determined by the mechanical properties of a piezoelectric crystal.

Crystal-Stabilized Transmitter. A transmitter employing automatic frequency control, in which the reference frequency is that of a crystal oscillator.

Current Amplification. The ratio of the current produced in the output circuit of an amplifier, as a result of the current supplied to the input circuit, to the current supplied to the input circuit.

Damped Waves. Waves of which the amplitude of successive cycles, at the source, progressively diminishes.

Decibel. The decibel is one-tenth of a bel, the number of decibels denoting the ratio of the two amounts of power being ten times the logarithm to the base 10 of this ratio. The abbreviation db is commonly used

for the term decibel.

NOTE—With P_1 and P_2 designating two amounts of power and n the number of decibels denoting their ratio,

$$n = 10 \log_{10} (P_1/P_2) \text{ decibels.}$$

When the conditions are such that ratios of currents or ratios of voltages (or analogous quantities in other fields) are the square roots of the corresponding power ratios, the number of decibels by which the corresponding powers differ is expressed by the following equations:

$$n = 20 \log_{10} (I_1/I_2) \text{ decibels,}$$
$$n = 20 \log_{10} (V_1/V_2) \text{ decibels}$$

where I_1/I_2 and V_1/V_2 are the given current and voltage ratios, respectively. By extension, these relations between numbers of decibels and ratios of currents or voltages are sometimes applied where these ratios are not the square roots of the corresponding power ratios; to avoid confusion, such usage should be accompanied by a specific statement of this application.

Decineper. One-tenth of a neper.

Degeneration. Same as negative feedback.

Delay Distortion. Distortion due to variation of the propagation time of the system with frequency.

Diplex Radio Transmission. The simultaneous transmission of two signals using a common carrier wave.

Direct-Current Amplifier. An amplifier capable of of amplifying waves of infinitesimal frequency.

Distortion. A change in wave form.

Doherty Amplifier. A particular arrangement of a radio-frequency linear power amplifier wherein the amplifier is divided into two sections whose inputs and outputs are connected by quarter-wave (90°) networks and whose operating parameters are so adjusted that, for all values of the input signal voltage up to one-half maximum amplitude, Section No. 2 is inoperative and Section No. 1 delivers all the power to the load, which presents an impedance at the output of Section No. 1 that is twice the optimum for maximum output. At one-half maximum input level, Section No. 1 is operating at peak efficiency, but is beginning to saturate. Above this level, Section No. 2 comes into operation, thereby decreasing the impedance presented to Section No. 1, which causes it to deliver additional power into the load until, at maximum signal input, both sections are operating at peak efficiency and each section is delivering one-half the total output power to the load.

Double-Sideband Transmitter. A transmitter which transmits the carrier frequency and both sidebands resulting from the modulation of the carrier by the modulating signal.

Duplex Operation. The operation of associated transmitting and receiving apparatus in which the processes of transmission and reception are concurrent.

Duty Cycle. The time interval occupied by a device on intermittent duty in starting, running, stopping, and idling.

Dynatron Oscillation. Oscillation produced by negative resistance due to secondary emission.

Dynatron Oscillator. A negative-resistance oscillator with negative resistance derived between plate and cathode of a screen-grid tube operating such that secondary electrons produced at the plate are attracted to the higher-potential screen grid.

Effective Bandwidth. For a band-pass filter, the width of an assumed rectangular band-pass filter having the same transfer ratio at a reference frequency and passing the same mean-square value of a hypothetical current and voltage having even distribution of energy over all frequencies.

Effective Percentage Modulation. For a single, sinusoidal input component, the ratio of the peak value of the fundamental component of the envelope to the direct-current component in the modulated conditions, expressed in per cent.

NOTE—It is sometimes convenient to express percentage modulation in decibels below 100 per cent modulation.

Electrical Noise. Unwanted electrical energy other than cross talk present in a transmission system.

Electron-Coupled Oscillator. An oscillator employing a multigrid tube with the cathode and two grids operating in any conventional manner as an oscillator, and in which the plate-circuit load is coupled to the oscillator through the electron stream.

Electronic Keying. A method of keying whereby the control is accomplished solely by electronic means.

Excitation (Drive). A signal voltage applied to the control electrode of an electron tube.

Facsimile Transmission. The transmission of signals produced by the scanning of fixed graphic material, including pictures for reproduction in record form.

Feedback. In a transmission system or a section thereof, the returning of a fraction of the output to the input.

Feedback Oscillator. An oscillating circuit, including an amplifier, in which the output is coupled in phase with the input, the oscillation being maintained at a frequency determined by the parameters of the amplifier and the feedback circuits such as *L-C*, *R-C*, and other frequency-selective elements.

Fidelity. The degree with which a system, or a portion of a system, accurately reproduces at its output the essential characteristics of the signal which is impressed upon its input.

Fixed-Frequency Transmitter. A transmitter designed for operation on a single carrier frequency.

Fixed Transmitter. A transmitter that is operated in a fixed or permanent location.

Fortuitous Telegraph Distortion. Distortion which includes those effects that cannot be classified as bias or characteristic distortion, and is defined as the departure, for one occurrence of a particular signal pulse, from the average combined effects of bias and characteristic distortion. Fortuitous distortion varies from one signal to another and is measured by a process of elimination over a long period. It is expressed in per cent of unit pulse.

Free Oscillations. Oscillations that continue in a circuit or system after the applied force has been removed, the frequency of the oscillations being determined by the parameters in the system or circuit, commonly referred to as shock-excited oscillations.

Frequency Band. A continuous range of frequencies extending between two limiting frequencies.

Frequency Band of Emission (Communication Band). The band of frequencies effectively occupied by that emission, for the type of transmission and the speed of signaling used.

Frequency Departure. The amount of variation of a carrier frequency or center frequency from its assigned value.

NOTE—The term "frequency deviation," which has been used for this meaning, is in conflict with this essential term as applied to phase and frequency modulation and is, therefore, deprecated for future use in the above sense.

Frequency Distortion. A term commonly used for that form of distortion in which the relative magnitude of the different frequency components of a complex wave are changed in transmission. When referring to the distortion of the phase versus frequency characteristic, it is recommended that a more specific term such as "phase-frequency distortion" or "delay distortion" be used.

Frequency Divider. A device delivering output voltage at a frequency that is a proper fraction of the input frequency. Usually the output frequency is an integral submultiple or an integral proper fraction of the input frequency.

Frequency Doubler. A device delivering output voltage at a frequency that is twice the input frequency.

Frequency-Modulated Transmitter. One which transmits a frequency-modulated wave.

Frequency Multiplier. A device delivering output voltage at a frequency that is an exact integral multiple of the input frequency.

Frequency Stabilization. The process of controlling the center frequency so that it differs from that of a reference source by not more than a prescribed amount.

Frequency Tolerance of a Radio Transmitter. The extent to which the carrier frequency of a transmitter may be permitted to depart from the frequency assigned.

Frequency Tripler. A device delivering output voltage at a frequency that is three times the input frequency.

Fundamental Frequency. The greatest common divisor of the component frequencies of a periodic wave or quantity. The fundamental frequency of the applied wave or quantity is usually taken as a reference.

Gill-Morrell Oscillator. An oscillator of the retarding-field type in which the frequency of oscillation is dependent not only on electron-transit time within the tube, but also on associated circuit parameters.

Grid-Controlled Mercury-Arc Rectifier. A mercury-arc rectifier in which one or more electrodes are employed exclusively to control the starting of the discharge.

Grid Modulation. Modulation produced by the introduction of the modulating signal into the control-grid circuit of any tube in which the carrier is present.

Grid Neutralization. The method of neutralizing an amplifier in which a portion of the grid-cathode alternating-current voltage is shifted 180° and applied to the plate-cathode circuit through a neutralizing capacitor.

Grid Pulse Modulation. Modulation produced in an amplifier or oscillator by application of one or more pulses to a grid circuit.

Grounded-Cathode Amplifier. An electron-tube amplifier with the cathode at ground potential at the operating frequency, with input applied between the control grid and ground, and the output load connected between plate and ground. (This is the conventional amplifier circuit.)

Grounded-Grid Amplifier. An electron-tube amplifier circuit in which the control grid is at ground potential at the operating frequency, with input applied between cathode and ground, and output load connected between plate and ground. The grid-to-plate impedance of the tube is in parallel with the load instead of acting as a feedback path.

Grounded-Plate Amplifier (Cathode Follower). An electron-tube amplifier circuit in which the plate is at ground potential at the operating frequency, with input applied between control grid and ground, and

the output load connected between cathode and ground.

Harmonic. A sinusoidal component of a periodic wave or quantity having a frequency which is an integral multiple of the fundamental frequency. For example, a component the frequency of which is twice the fundamental frequency is called the second harmonic.

Hartley Oscillator. An oscillator in which the parallel-tuned tank circuit is connected between grid and plate, the inductive element of the tank having an intermediate tap at cathode potential, and the necessary feedback voltage obtained across the grid-cathode portion of the inductor.

High-Level Modulation. Modulation produced at a point in a system where the power level approximates that at the output of the system.

ICW. (An abbreviation for "interrupted continuous wave.") A continuous wave that is interrupted at a constant audio-frequency rate.

Impulse Excitation. A method of producing oscillator current in a circuit in which the duration of the impressed voltage is relatively short compared with the duration of the current produced.

Inductive (Shunt, Coil) Neutralization. A method of neutralizing an amplifier whereby the feedback susceptance due to the plate-to-grid capacitance is cancelled by the equal and opposite susceptance of an inductor.

Instantaneous Power Output. The rate at which energy is delivered to a load at a particular instant.

Interference Guard Bands. The two bands of frequencies additional to, and on either side of, the communication band and frequency tolerance, which may be provided in order to minimize the possibility of interference.

Intermittent-Duty Rating. The specified output rating of a device when operated for specified intervals of time other than continuous duty.

Intermodulation. The modulation of the components of a complex wave by each other, as a result of which waves are produced which have frequencies equal to the sums and differences of integral multiples of those of the components of the original complex wave.

Keyer. A device which changes the output of a transmitter from one value of amplitude or frequency to another in accordance with the intelligence to be transmitted.

NOTE—This applies generally to telegraphic keying.

Leakage Radiation. In a transmitting system, radiation from anything other than the intended radiating system.

Linear Power Amplifier. A power amplifier in which the signal output voltage is directly proportional to the signal input voltage.

Linear Rectifier. A rectifier, the output current or voltage of which contains a wave having a form identical with that of the envelope of an impressed signal wave.

Load Circuit. The complete circuit required to transfer power from a source, such as an electron tube, to a load.

Load-Circuit Efficiency. The ratio between useful power delivered by the load circuit to the load and the load- (anode-) circuit power input.

Load-Circuit Power Input. The power delivered to the load circuit. It is the product of the alternating component of the voltage across the load circuit, the alternating component of the current passing through it (both root-mean-square values), and the power factor associated with these two quantities.

Local Control. A system or method of radio-transmitter control whereby the control functions are performed directly at the transmitter.

Low-Level Modulation. Modulation produced at a point in a system where the power level is low compared with the power level at the output of the system.

Magnetostriction Oscillator. An oscillator with the plate circuit inductively coupled to the grid circuit through a magnetostrictive element, the frequency of oscillation being determined by the magneto-mechanical characteristics of the coupling element.

Magnetron Oscillator. An electron tube in which electrons are accelerated by a radial electric field between the cathode and one or more anodes and by an axial magnetic field that provides a high-energy electron stream to excite the tank circuits.

Marking Wave (Keying Wave). In telegraphic communication, the emission which takes place while the active portions of the code characters are being transmitted.

Master Oscillator. An oscillator so arranged as to establish the carrier frequency of the output of an amplifier.

MCW. (An abbreviation for "modulated continuous wave.") A form of emission in which the carrier is modulated by a constant audio-frequency tone. In

telegraphic service, it is understood that the carrier is keyed.

Meissner Oscillator. An oscillator in which the grid and plate circuits are inductively coupled through an independent tank circuit which determines the frequency.

Mobile Transmitter. A radio transmitter designed for installation in a vessel, vehicle, or aircraft, and normally operated while in motion.

Modulated Amplifier. An amplifier stage in a transmitter in which the modulating signal is introduced and modulates the carrier.

Modulation Capability. The maximum percentage modulation that is possible without objectionable distortion.

Modulation Factor. In an amplitude-modulated wave, the ratio of half the difference between the maximum and minimum amplitudes to the average amplitude.

NOTE—In linear modulation, the average amplitude of the envelope is equal to the amplitude of the unmodulated wave, provided there is no zero-frequency component in the modulating signal wave (as in telephony). For modulating signal waves having unequal positive and negative peaks, positive and negative modulation factors may be defined as the ratios of the maximum departures (positive and negative) of the envelope from its average value, to its average value.

Multichannel Radio Transmitter. A radio transmitter having two or more complete radio-frequency portions capable of operating on different frequencies, either individually or simultaneously.

Multifrequency Transmitter. A radio transmitter capable of operating on two or more selectable frequencies, one at a time, using preset adjustments of a single radio-frequency portion.

Multiplex Radio Transmission. The simultaneous transmission of two or more signals using a common carrier wave.

Multivibrator. A relaxation oscillator employing two electron tubes to obtain the in-phase feedback voltage by coupling the output of each to the input of the other through, typically, resistance-capacitance elements. The fundamental frequency is determined by the time constants of the coupling elements and may be further controlled by an external voltage. When such circuits are normally in a nonoscillating state and a trigger signal is required to start a single cycle of operation, the circuit is commonly called a one-shot, a flip-flop, or a start-stop multivibrator.

Negative Feedback. Feedback which results in decreasing the amplification.

Negative-Resistance Oscillator. An oscillator produced by connecting a parallel-tuned resonant circuit to a two-terminal negative-resistance device. (One in which an increase in voltage results in a decrease in current.) Dynatron and transitron oscillators are examples.

Negative-Transconductance Oscillator. An electron-tube oscillator in which the output of the tube is coupled back to the input without phase shift, the phase condition for oscillation being satisfied by the negative transconductance of the tube.

Neper. The fundamental division of a logarithmic scale for expressing the ratio between two currents or voltages, the number of nepers denoting such a ratio being the natural logarithm of this ratio. 1 neper equals 0.8686.... bels.

NOTE—With V_1 and V_2 designating two voltages and N the number of nepers denoting their ratio,

$$N = \ln (V_1/V_2) \text{ nepers.}$$

Neutralization. A method of nullifying the voltage feedback from the output to the input circuits of an amplifier through the tube interelectrode impedances. Its principal use is in preventing oscillation in an amplifier by introducing a voltage into the input equal in magnitude but opposite in phase to the feedback through the interelectrode capacitance.

Neutralizing Indicator. An auxiliary device for indicating the degree of neutralization of an amplifier. (For example, a lamp or detector coupled to the plate tank circuit of an amplifier.)

Neutralizing Voltage. The alternating-current voltage specifically fed from the grid circuit to the plate circuits (or vice versa), deliberately made 180° out of phase with and equal in amplitude to the alternating-current voltage similarly transferred through undesired paths, usually the grid-to-plate tube capacitance.

Nonlinear Distortion. That form of distortion which occurs in a system when the ratio of voltage to current therein (or analogous quantities in other fields) is a function of the magnitude of either.

Oscillator. A nonrotating device for producing alternating current, the output frequency of which is determined by the characteristics of the device.

Overload Capacity. The current, voltage, or power level beyond which permanent damage occurs to the device considered. This is usually higher than the rated load capacity.

Parasitic Oscillations. Unintended self-sustaining oscillations, or transient impulses.

Peak Power Output. The output power averaged over the radio-frequency cycle having the maximum peak value which can occur under any combination of signals transmitted.

Percentage Modulation. The modulation factor expressed in per cent.

Per Cent Ripple. The ratio of the effective (root-mean-square) value of the ripple voltage to the average value of the total voltage, expressed in per cent.

Phase-Modulated Transmitter. A transmitter which transmits a phase-modulated wave.

Phase-Shift Oscillator. An oscillator produced by connecting any network having a phase shift of an odd multiple of 180° (per stage) at the frequency of oscillation, between the output and the input of an amplifier. When the phase shift is obtained by resistance-capacitance elements, the circuit is an *R-C phase-shift oscillator.*

Phase versus Frequency Response Characteristic. A graph or tabulation of the phase shifts occurring in an electrical transducer at several frequencies within a band.

Pierce Oscillator. An oscillator in which a piezoelectric crystal is connected between the plate and the grid of a tube, in what is basically a Colpitts oscillator with voltage division provided by the grid-to-cathode and the plate-to-cathode capacitances of the circuit.

Plate (Anode) Efficiency. The ratio of load circuit power (alternating current) to the plate power input (direct current).

Plate Keying. Keying effected by interrupting the plate-supply circuit.

Plate (Anode) Load Impedance. The total impedance between anode and cathode exclusive of the electron stream.

Plate (Anode) Modulation. Modulation produced by introducing the modulating signal into the plate circuit of any tube in which the carrier is present.

Plate Neutralization. The method of neutralizing an amplifier in which a portion of the plate-cathode alternating-current voltage is shifted 180° and applied to the grid-cathode circuit through a neutralizing capacitor.

Plate (Anode) Power Input. The direct-current power delivered to the plate (anode) of an electron tube by the source of supply. It is the product of the mean anode voltage and the mean anode current.

Plate (Anode) Pulse Modulation. Modulation produced in an amplifier or oscillator by application of externally generated pulses to the plate circuit.

Portable Transmitter. (Commonly used at present for "transportable transmitter," q.v.). Preferred use of this term covers a transmitter which can be readily carried on a person and may or may not be operated while in motion.

NOTE—This includes the class of so-called "walkie-talkies," "handy-talkies," and "personal" transmitters.

Positive Feedback. Feedback which results in increasing the amplification.

Power Amplification. The ratio of the power level at the output terminals of an amplifier to that at the input terminals. Also called "power gain."

Power Level. An expression of the power being transmitted past any point in a system.

Pulse Modulator. A device which applies pulses to the element in which modulation takes place.

Pulse Repeater (Transponder). A device used for receiving pulses from one circuit and transmitting corresponding pulses into another circuit. It may also change the frequency and wave forms of the pulses and perform other functions.

Pulse Transmitter. A pulse-modulated transmitter whose peak power-output capabilities are usually large with respect to average power-output rating.

Pulsed Oscillator. An oscillator which is made to operate during recurrent intervals by self-generated or externally applied pulses.

Push-Pull Oscillator. A balanced oscillator employing two similar tubes in phase opposition.

Push-Push Circuit. A circuit employing two similar tubes with grids connected in phase opposition and plates in parallel to a common load, and usually used as a frequency multiplier to emphasize even-order harmonics.

Radar Transmitter. The transmitter portion of a radio detecting and ranging system.

Radio Broadcasting. Radio transmission intended for general reception.

Radio Channel. A band of frequencies of a width sufficient to permit its use for radio communication. The width of a channel depends upon the type of transmission and the tolerance for the frequency of emission.

Radio Communication Circuit. A radio system for carrying out one communication at a time in either direction between two points.

Radio-Frequency Alternator. A rotating-type generator for producing radio-frequency power.

Radio Proximity Fuze. A radio device contained in a missile to detonate it within predetermined limits of distance from a target by means of electromagnetic interaction with the target.

Radiosonde. An automatic radio transmitter in the meteorological-aids service, usually carried on an aircraft, free balloon, kite, or parachute, which transmits meteorological data.

Radio Transmitter. A device for producing radio-frequency power, for purposes of radio transmission.

R-C Oscillator. Any oscillator in which the frequency is determined by resistance-capacitance elements.

Reactance Modulator. A device, used for the purpose of modulation, whose reactance may be varied in accordance with the instantaneous amplitude of the modulating electromotive force applied thereto. This is normally an electron-tube circuit and is commonly used to effect phase or frequency modulation.

Rectifier. A device having an asymmetrical conduction characteristic which is used for the conversion of an alternating current into a current having a unidirectional component.

Regeneration. Same as positive feedback.

Relaxation Oscillator. Any oscillator whose fundamental frequency is determined by the time of charging or discharging of a capacitor or inductor through a resistor, producing wave forms which may be rectangular or sawtooth.

Remote Control. A system or method of radio-transmitter control whereby the control functions are performed from a distance, electrically, over intervening wire or radio circuits.

Resonant-Line Oscillator. An oscillator in which one or more sections of transmission line are employed as tanks.

Retarding-Field (Positive-Grid) Oscillator. An oscillator employing an electron tube in which the electrons oscillate back and forth through a grid maintained positive with respect to the cathode and the plate. The frequency depends on the electron-transit time and may also be a function of the associated circuit parameters. The field in the region of the grid exerts a retarding effect which draws electrons back after passing through it in either direction. Barkhausen-Kurz and Gill-Morell oscillators are examples.

Ring Oscillator. An arrangement of two or more pairs of tubes operating as push-pull oscillators around a ring, usually with alternate successive pairs of grids and plates connected to tank circuits. Adjacent tubes around the ring operate in phase opposition. The load is supplied by coupling to the plate circuits.

Ripple Voltage. The alternating component of the unidirectional voltage from a rectifier or generator used as a source of direct-current power.

Screen-Grid Modulation. Modulation produced by introduction of the modulating signal into the screen-grid circuit of any multigrid tube in which the carrier is present.

Self-Pulse Modulation. Modulation effected by means of an internally generated pulse. For example, see "blocking oscillator."

Semiremote Control. A system or method of radio-transmitter control whereby the control functions are performed near the transmitter by means of devices connected to but not an integral part of the transmitter.

Service Band. A band of frequencies allocated to a given class of radio service.

Shock Excitation. The type of excitation supplied by a voltage or current variation of relatively short duration.

Sideband Attenuation. That form of attenuation in which the transmitted relative amplitude of some component(s) of a modulated signal (excluding the carrier) is smaller than that produced by the modulation process.

Simplex Operation of a Radio System. A method of operation in which communication between two stations takes place in one direction at a time.

NOTE—This includes ordinary transmit-receive operation, press-to-talk operation, voice-operated carrier, and other forms of manual or automatic switching from transmit to receive.

Singing. An undesired self-sustained oscillation existing in a transmission system.

Singing Point. In a closed transmission system, that adjustment of gain or phase, or both, at which singing will start.

Single-Ended Amplifier. An amplifier in which each stage normally employs only one tube, or, if more than one tube is used, in which they are connected in parallel so that operation is asymmetric with respect to ground.

Single-Sideband Transmission. That method of operation in which one sideband is transmitted and the other sideband is suppressed. The carrier wave may be either transmitted or suppressed.

Single-Sideband Transmitter. A transmitter in which one sideband is transmitted and the other is effectively eliminated.

Slug Tuning. A means for varying the frequency of a resonant circuit by introducing a slug of ma-

terial into either the electric or magnetic fields or both.

Spacing Wave (Back Wave). In telegraphic communication, the emission which takes place between the active portions of the code characters or while no code characters are being transmitted.

Spark-Gap Modulation. A modulation process which produces one or more pulses or energy by means of a controlled spark-gap breakdown for application to the element in which modulation takes place.

Spark Transmitter. A radio transmitter which utilizes the oscillatory discharge of a capacitor through an inductor and a spark gap as the source of its radio-frequency power.

Spurious Radiation. Any emission from a radio transmitter at frequencies outside of its communication band.

Stabilized Feedback. Feedback employed in such a manner as to stabilize the gain of a transmission system or section thereof with respect to time or frequency or to reduce noise or distortion arising therein.

NOTE—The section of the transmission system may include amplifiers only, or it may include modulators.

Stage Efficiency. The ratio of useful power delivered to the load (alternating current) and the plate power input (direct current).

Subharmonic. A sinusoidal quantity having a frequency which is an integral submultiple of the frequency of some other sinusoidal quantity to which it is referred. For example, a wave, the frequency of which is half the fundamental frequency of another wave, is called the second subharmonic of that wave.

Tank Circuit. A circuit capable of storing electrical energy over a band of frequencies continuously distributed about a single frequency at which the circuit is said to be resonant, or tuned. The selectivity of the circuit is proportional to the ratio of energy stored in the circuit to the energy dissipated. This ratio is often called the Q of the circuit.

Television Transmitter. The aggregate of such radio-frequency and modulating equipment as is necessary to supply to an antenna system modulated radio-frequency power by means of which all the component parts of a complete television signal (including audio, video, and synchronizing signals) are concurrently transmitted.

Total Telegraph Distortion. Telegraph transmission impairment, expressed in terms of time displacement of mark-space and space-mark transitions from their proper positions relative to one another, in per cent of the shortest perfect pulses called the unit pulse. (Time lag affecting all transitions alike does not cause distortion.) Telegraph distortion is specified in terms of its effect on code and terminal equipment. *"Total Morse telegraph distortion"* for a particular mark or space pulse is expressed as the algebraic sum of time displacements of space-mark and mark-space transitions determining the beginning and end of the pulses, measured in per cent of unit pulse. Lengthening of mark is positive, and shortening, negative. *"Total start-stop telegraph distortion"* refers to the time displacement of selecting-pulse transitions from the beginning of the start pulse expressed in per cent of unit pulse.

Transitron Oscillator. A negative-transconductance oscillator employing a screen-grid tube with negative transconductance produced by a retarding field between the negative screen grid and the control grid which serves as the anode.

Transmission Level. The level of the signal power at any point in a transmission system which is the ratio of the power at that point to the power at some point in the system chosen as a reference point. This ratio is usually expressed in decibels.

Transportable Transmitter. A transmitter designed to be readily carried or transported from place to place, but which is not normally operated while in motion.

NOTE—This has been commonly called a "portable" transmitter, but the term transportable transmitter is preferred.

Tuned-Grid Oscillator. An oscillator with frequency determined by a parallel-tuned tank in the grid circuit coupled to the plate to provide the required feedback.

Tuned-Grid Tuned-Plate Oscillator. An oscillator having parallel-tuned tanks in both plate and grid circuits, the necessary feedback being obtained by the plate-to-grid interelectrode capacitance.

Tuned-Plate Oscillator. An oscillator with frequency determined by a parallel-tuned tank in the plate circuit coupled to the grid to provide the required feedback.

Vacuum-Tube Amplifier. An amplifier employing electron tubes to effect the control of power from the local source.

Vacuum-Tube Transmitter. A radio transmitter in which electron tubes are utilized to convert the applied electric power into radio-frequency power.

Velocity-Modulated Oscillator. An electron-tube structure in which the velocity of an electron stream is varied (velocity-modulated) in passing through a resonant cavity called a buncher. Energy is extracted from the bunched electron stream at a higher energy

level in passing through a second cavity resonator called the catcher. Oscillations are sustained by coupling energy from the catcher cavity back to the buncher cavity.

Vestigial-Sideband Transmitter. A transmitter in which one sideband and a portion of the other are intentionally transmitted.

Video-Frequency Amplifier. A device capable of amplifying such signals as comprise periodic visual presentation.

Visual Transmitter. All parts of a television transmitter which handle picture signals, whether exclusively or not.

Voltage Amplification. The ratio of the voltage produced at the output terminals of an amplifier, as a result of the voltage impressed at the input, to the voltage impressed at the input.

Volume-Limiting Amplifier. An amplifier containing an automatic device which functions when the input volume exceeds a predetermined level, and so reduces the gain that the output volume is thereafter maintained substantially constant notwithstanding further increase in the input volume. The normal gain of the amplifier is restored when the input volume returns below the predetermined limiting level.

Weighting. The artificial adjustment of measurements in order to account for factors which, in the normal use of the device, would otherwise be different from the conditions during measurement. For example, background noise measurements may be weighted by applying factors or by introducing networks to reduce measured values in inverse ratio to their interfering effects.

INDEX

Current I. R. E. Standards

In addition to the material published in the PROCEEDINGS OF THE I.R.E., Standards on various subjects have been printed. These are available at the prices listed below.

	Price
1) **Standards on Electroacoustics, 1938 Definitions of Terms, Letter and Graphical Symbols, Methods of Testing Loud Speakers.** (vi + 37 pages, 6 x 9 inches)	$0.50
2a) **Standards on Electronics: Definitions of Terms, Symbols, 1938.** A Reprint (1943) of the like-named section of "Standards on Electronics, 1938." (viii + 8 pages, 8½ x 11 inches)	$0.20
2b) **Standards on Electronics: Methods of Testing Vacuum Tubes, 1938.** A Reprint (1943) of the like-named section of "Standards on Electronics, 1938." (viii + 8 pages, 8½ x 11 inches)	$0.50
3a) **Standards on Transmitters and Antennas: Definitions of Terms, 1938.** A Reprint (1942) of the like-named section of "Standards on Transmitters and Antennas, 1938." (vi + 10 pages, 8½ x 11 inches)	$0.20
3b) **Standards on Transmitters and Antennas: Methods of Testing, 1938.** A Reprint (1942) of the like-named section of "Standards on Transmitters and Antennas, 1938." (vi + 10 pages, 8½ x 11 inches)	$0.50
4a) **Standards on Radio Receivers: Definitions of Terms, 1938.** A Reprint (1942) of the like-named section of "Standards on Radio Receivers, 1938." (vi + 6 pages, 8½ x 11 inches)	$0.20
4b) **Standards on Radio Receivers: Methods of Testing Broadcast Radio Receivers, 1938.** A Reprint (1942) of the like-named section of "Standards on Radio Receivers, 1938." (vi + 20 pages, 8½ x 11 inches)	$0.50
4c) **Standards on Radio Receivers: Methods of Testing Frequency-Modulation Broadcast Receivers, 1947.** (vi + 15 pages, 8½ x 11 inches)	$0.50
5a) **Standards on Radio Wave Propagation: Definitions of Terms, 1942.** (vi + 8 pages, 8½ x 11 inches)	$0.20
5b) **Standards on Radio Wave Propagation: Measuring Methods, 1942.** Methods of Measuring Radio Field Intensity, Methods of Measuring Power Radiated from an Antenna, Methods of Measuring Noise Field Intensity. (vi + 16 pages, 8½ x 11 inches)	$0.50
5c) **Standards on Radio Wave Propagation: Definitions of Terms Relating to Guided Waves, 1945.** (iv + 4 pages, 8½ x 11 inches)	$0.20
6a) **Standard on Facsimile: Definitions of Terms, 1942.** (vi + 6 pages, 8½ x 11 inches)	$0.20
6b) **Standards on Facsimile: Temporary Test Standards, 1943.** (iv + 8 pages, 8½ x 11 inches)	$0.20
7) **Standards on Piezoelectric Crystals: Recommended Terminology, 1945.** (iv + 4 pages, 8½ x 11 inches)	$0.20
8) **Standards on Television: Methods of Testing Television Transmitters, 1947.** (vi + 18 pages, 8½ x 11 inches)	$0.75
8b) **Standards on Television: Methods of Testing Television Receivers, 1948.** (vi + 40 pages, 8½ x 11 inches)	$1.00
9) **Standards on Antennas, Modulation Systems, and Transmitters: Definitions of Terms, 1948.** (vi + 25 pages, 8½ x 11 inches)	$0.75
Normas Sobre Receptors de Radio, 1938.* A Spanish-language translation of "Standards on Radio Receivers, 1938," by the Buenos Aires Section of the Institute of Radio Engineers. (vii + 64 pages, 6 x 9 inches)	Two Argentine Pesos (Postpaid)

** Not carried in stock at I.R.E. Headquarters in New York. Obtainable only from Señor Domingo Arbó, Editor of Revista Telegrafica, Peru, 165, Buenos Aires, Argentina.*

ASA STANDARDS

(Sponsored by the I.R.E.)

	Price
ASA1) **American Standard: Standard Vacuum-Tube Base and Socket Dimensions.** (ASA C16.2-1939.) (8 pages, 7¾ x 10⅝ inches)	$0.20
ASA2) **American Standard: Manufacturing Standards Applying to Broadcast Receivers.** (ASA C16.3-1939.) (16 pages, 7¾ x 10⅝ inches)	$0.20
ASA3) **American Standard: Loudspeaker Testing.** (ASA C16.4-1942.) (12 pages, 7¾ x 10⅝ inches)	$0.25
ASA4) **American Standard: Volume Measurements of Electrical Speech and Program Waves.** (ASA C16.5-1942.) (8 pages, 7¾ x 10⅝ inches)	$0.20

PRICES ARE NET AND INCLUDE POSTAGE TO ANY COUNTRY.
INCLUDE REMITTANCE WITH ORDER AND ADDRESS.

THE INSTITUTE OF RADIO ENGINEERS, INC.
1 East 79 Street, New York 21, N. Y.

PRINTED IN U.S.A.