APPENDIX I

GLOSSARY

ACCELEROMETER —A device that measures the acceleration to which it is subjected and develops a signal proportional to it.

AGONIC LINE—An imaginary line on the earth's surface passing through points where the magnetic declination is 0 degrees; that is, a line of longitude where the compass points to true north.

AMBIENT CONDITIONS —Physical conditions of the immediate environment, which may pertain to temperature, humidity, pressure, etc.

AMPERE —The basic unit of electrical current.

AMPERE-TURN —The magnetizing force produced by a current of 1 ampere flowing through a coil of 1 turn.

AMPLIDYNE —A rotary magnetic or dynamoelectric amplifier used in servomechanism and control applications.

AMPLIFICATION —(1) The process of increasing the strength (current, power, or voltage) of a signal. (2) The ratio of output magnitude to input magnitude in a device that is intended to produce an output that is an enlarged reproduction of its input.

AMPLIFIER —A device used to increase the signal voltage, current, or power, generally composed of solid-state circuitry called a stage. It may contain several stages in order to obtain a desired gain.

AMPLITUDE —The maximum instantaneous value of an alternating voltage or current, measured in either the positive or negative direction.

ANALOG COMPUTER —A type of computer that provides a continuous solution to a mathematical problem with continuously changing inputs. Inputs and outputs are represented by physical quantities that may be easily generated or controlled.

APPARENT DRIFT —The effect of the earth's rotation on a gyro that causes the spinning axis to appear to make one complete rotation in 1 day. Also called APPARENT PRECESSION or APPARENT ROTATION.

APPARENT PRECESSION —*See* APPARENT DRIFT.

APPARENT ROTATION —*See* APPARENT DRIFT.

ARC —A flash caused by an electric current ionizing a gas or vapor.

ARMATURE —(1) In a relay, the movable portion of the relay. (2) The windings in which the output voltage is generated in a generator or in which input current creates a magnetic field that interacts with the main field in a motor.

ATTENUATOR —A network of resistors used to reduce voltage, current, or power delivered to a load.

ATTRACTION —The force that tends to make two objects approach each other. Attraction exists between two unlike magnetic poles (north and south) or between two unlike static charges.

AUTOTRANSFORMER —A transformer in which the primary and secondary are connected together in one winding.

AVB —Avionic bulletin.

AVC —Avionic change.

AXIS —A straight line, either real or imaginary, passing through a body around which the body revolves.

AZIMUTH —Angular measurement in the horizontal plane in a clockwise direction.

BATTERY — A device for converting chemical energy into electrical energy, with two or more primary or secondary cells connected together electrically. The term does not apply to a single cell.

BATTERY CAPACITY —The amount of energy available from a battery. Battery capacity is expressed in ampere-hours.

BIAS —Difference of potential applied to a vacuum tube or transistor to establish a reference operating level.

BLOCK DIAGRAM —A diagram in which the major components of an equipment or a system are represented by squares, rectangles, or other geometric figures, and the normal order of progression of a signal or current flow is represented by lines.

BOLOMETER —A loading device that undergoes changes in resistance as changes in dissipated power occur.

BRIDGE CIRCUIT —The *electrical bridge circuit* is a term referring to any one of a variety of electric circuit networks, one branch of which (the *bridge* proper) connects two points of equal potential; therefore, it carries no current when the circuit is properly adjusted or balanced.

BRUSH —The conducting material, usually a block of carbon, bearing against the commutator or slip rings through which the current flows in or out.

BUS BAR —A primary power distribution point connected to the main power source.

CABLE HARNESS —A group of wires or ribbons of wiring used to interconnect electronic systems and subsystems.

CAGING (GYRO) —The act of holding a gyro so that it cannot precess or change its attitude with respect to the body containing it.

CAPACITOR —Two electrodes or sets of electrodes in the form of plates, separated from each other by an insulating material called the *dielectric.*

CAPACITOR-START MOTOR —A type of single-phase, ac induction motor in which a starting winding and a capacitor are placed in series to start the motor. The values of X_c and R are such that the main-winding and starting winding currents are nearly 90 degrees apart, and the starting torque is produced as in a two-phase motor.

CARDIOPULMONARY RESUSCITATION – Procedure designed to restore breathing after cardiac arrest. Includes clearing air passages to lungs and heart massage.

CELL —A single unit that transforms chemical energy into electrical energy. Batteries are made up of cells.

CHOKE COIL —A coil of low ohmic resistance and high impedance to alternating current.

CIRCUIT —The complete path of an electric current.

CIRCUIT BREAKER —An electromagnetic or thermal device that opens a circuit when the current in the circuit exceeds a predetermined amount. Circuit breakers can be reset.

CIRCULAR MIL —An area equal to that of a circle with a diameter of 0.001 inch. It is used for measuring the cross section of wires.

COAXIAL CABLE —A transmission line consisting of two conductors concentric with and insulated from each other.

COMMUTATION —The act of a commutator in converting generator output from an ac voltage to a dc voltage.

COMMUTATOR —The copper segments on the armature of a motor or generator. It is cylindrical in shape and is used to pass power into or from the brushes. This mechanical device reverses armature connections in motors and generators at the proper instant so that current continues to flow in only one direction. In effect, the commutator changes ac to dc.

COMPARATOR —A circuit that compares two signals or values, and indicates agreement or variance between them.

COMPENSATING WINDINGS —Windings embedded in slots in pole pieces, connected in series with the armature, whose magnetic field opposes the armature field and cancels armature reaction.

COMPOUND-WOUND MOTORS AND GENERATORS —Machines that have a series field in addition to a shunt field. Such machines have characteristics of both series- and shunt-wound machines.

CONDUCTANCE —The ability of a material to conduct or carry an electric current. It is the reciprocal of the resistance of the material, and is expressed in mhos.

CONDUCTIVITY —The ease with which a substance transmits electricity.

CONDUCTOR —Any material suitable for carrying electric current.

CORE —A magnetic material that affords an easy path for magnetic flux lines in a coil.

COUNTER EMF —Counter electromotive force; an EMF induced in a coil or armature that opposes the applied voltage.

COUNTING CIRCUIT —A circuit that receives uniform pulses representing units to be counted and produces a voltage in proportion to their frequency.

COVALENT BOND —A type of linkage between atoms in which the atoms share valence electrons.

CPR —*See* CARDIOPULMONARY RESUSCITATION.

CURRENT —The movement of electrons past a reference point. The passage of electrons through a conductor. Measured in amperes.

CURRENT LIMITER —A protective device similar to a fuse, usually used in high amperage circuits.

CYCLE —One complete positive and one complete negative alternation of a current or voltage.

D'ARSONVAL METER MOVEMENT —The permanent-magnet moving-coil movement used in most meters.

DEGREES OF FREEDOM (GYRO) —A term applied to gyros to describe the number of variable angles required to specify the position of the rotor spin axis relative to the case.

DELTA —(1) A three-phase connection in which windings are connected end to end, forming a closed loop that resembles the Greek letter delta. A separate phase wire is then connected to each of the three junctions. (2) A term that is also used to describe a difference between two quantities or measurements.

DEMODULATOR —A circuit used in servo systems to convert an ac signal to a dc signal. The magnitude of the dc output is determined by the magnitude of the ac input signal, and its polarity is determined by whether the ac input signal is in or out of phase with the ac reference voltage.

DIELECTRIC —An insulator; a term that refers to the insulating material between the plates of a capacitor.

DIFFERENTIAL —A mechanical computing device used to add or subtract two quantities.

DIGITAL COMPUTER —A type of computer in which quantities are represented in numerical form. It is generally made to solve complex mathematical problems by use of the fundamental processes of addition, subtraction, multiplication, and division. Its accuracy is limited only by the number of significant figures provided.

DIODE —A material of either germanium or silicon that is manufactured to allow current to flow in only one direction. Diodes are used as rectifiers and detectors.

DIRECT CURRENT —An electric current that flows in one direction only.

DISCRIMINATOR —A dual-input circuit in which the output is dependent on the variation of one input from the other input or from an applied standard.

DOPPLER EFFECT —An apparent change in the frequency of a sound wave or electromagnetic wave reaching a receiver when there is relative motion between the source and the receiver.

EDDY CURRENT —Induced circulating currents in a conducting material that are caused by a varying magnetic field.

EFFICIENCY —The ratio of output power to input power, generally expressed as a percentage.

ELECTROLYSIS —A type of corrosion (chemical decomposition) caused by current flow resulting from contact of dissimilar metals.

ELECTROLYTE —A solution of a substance that is capable of conducting electricity. An electrolyte may be in the form of either a liquid or a paste.

ELECTROMAGNET —A magnet made by passing current through a coil of wire wound on a soft iron core.

ELECTROMOTIVE FORCE (EMF) —The force that produces an electric current in a circuit.

ELECTRON —A negatively charged particle of matter.

ELECTRON SHELL —A group of electrons that have a common energy level that forms part of the outer structure (shell) of an atom.

ENERGY —The ability or capacity to do work.

EQUIVALENT CIRCUIT —A diagrammatic arrangement of component parts representing, in simplified form, the effects of a more complicated circuit to permit easier analysis.

ERECTING (A GYRO) —The placing of a gyro into a desired position and the maintaining of that position.

ERROR SIGNAL —(1) In servo systems, the signal whose amplitude and polarity or phase are used to correct the alignment between the controlling and the controlled elements. (2) The name given to the electrical output of a control transformer.

E-TRANSFORMER —A magnetic device with an E configuration, used as an error detector.

FARAD —The unit of capacitance.

FEEDBACK —A transfer of energy from the output circuit of a device back to its input.

FIELD —The space containing electric or magnetic lines of force.

FIELD WINDING —The coil used to provide the magnetizing force in motors and generators.

FLUX —(1) In electrical or electromagnetic devices, a general term used to designate collectively all the electric or magnetic lines of force in a region. (2) A solution that removes surface oxides from metals being soldered.

FLUX DENSITY —The number of magnetic lines of force passing through a given area.

FLUX FIELD —All electric or magnetic lines of force in a given region.

FREE ELECTRONS —Electrons that are loosely held; consequently, they tend to move at random among the atoms of the material.

FREE GYRO —A gyro so gimbaled that it assumes and maintains any attitude in space. The free gyro has two degrees of freedom; torque cannot be applied to the rotor of a truly free gyro.

FREQUENCY —The number of complete cycles per second existing in any form of wave motion, such as the number of cycles per second of an alternating current.

FULL-WAVE RECTIFIER CIRCUIT —A circuit that uses both the positive and the negative alternations of an alternating current to produce a direct current.

FUSE —A protective device inserted in series with a circuit. It contains a metal that will melt or break when current is increased beyond a specific value for a definite period of time.

GAIN —The ratio of the output power, voltage, or current to the input power, voltage, or current, respectively.

GALVANOMETER —An instrument used to measure small dc currents.

GENERATOR —A machine that converts mechanical energy into electrical energy.

GIMBAL —A frame in which the gyro wheel spins, and that allows the gyro wheel to have certain freedom of movement. It permits the gyro motor to incline freely and retain that position when the support is tipped or repositioned.

GROUND —(1) A metallic connection with the earth to establish ground potential. (2) a common return to a point of zero potential.

GROUND POTENTIAL —Zero potential with respect to the ground or earth.

GYROSCOPE —A wheel or disk so mounted as to spin rapidly about one axis and be free to move about one or both of the two axes mutually perpendicular to the axis of spin.

HALF-WAVE RECTIFIER —A rectifier using only one-half of each cycle to change ac to pulsating dc.

HEAT SHUNT —A device (preferably a clip-on type) used to absorb heat and protect heat-sensitive components during soldering.

HERO —Hazardous electromagnetic radiation to ordnance.

HERTZ —A unit of frequency equal to one cycle per second.

HMI —Handbook maintenance instructions.

HORSEPOWER —The English unit of power, equal to work done at the rate of 550 foot-pounds per second. Equal to 746 watts of electrical power.

HYSTERESIS —A lagging of the magnetic flux in a magnetic material behind the magnetizing force that is producing it.

HZ —*See* HERTZ.

IMPEDANCE —The total opposition offered to the flow of an alternating current. It may consist of any combination of resistance, inductive reactance, and capacitive reactance.

INDUCED CURRENT —Current caused by the relative motion between a conductor and a magnetic field.

INDUCTANCE —The property of a circuit that tends to oppose a change in the existing current.

INDUCTION —The act or process of producing voltage by the relative motion of a magnetic field across a conductor.

INDUCTION MOTOR —A simple, rugged, ac motor with desirable characteristics. The rotor is energized by transformer action (induction) from the stator. Induction motors are used more than any other type.

INDUCTIVE REACTANCE —The opposition to the flow of alternating or pulsating current caused by the inductance of a circuit. It is measured in ohms.

INERTIA —The physical tendency of a body in motion to remain in motion and a body at rest to remain at rest unless acted upon by an outside force (Newton's first law of motion).

INFINITE —(1) Extending indefinitely, endless. (2) Boundless, having no limits. (3) An incalculable number.

IN PHASE —This term is applied to the condition that exists when two waves of the same frequency pass through their maximum and minimum values of like polarity at the same instant.

INSULATION —A material used to prevent the leakage of electricity from a conductor and to provide mechanical spacing or support as protection against accidental contact with the conductor.

INTEGRATING CIRCUIT —A circuit whose output voltage is proportional to the product of the instantaneous applied input voltages and their durations.

INTEGRATOR —A computing device used for summing up an infinite number of minute quantities.

INVERSELY —Inverted or reversed in position or relationship.

ISOGONIC LINE —An imaginary line drawn through points on the earth's surface where the magnetic variation is equal.

JOULE —Unit of energy or work. A joule of energy is liberated by 1 ampere flowing for 1 second through a resistance of 1 ohm.

JUNCTION —(1) The connection between two or more conductors. (2) The contact between two dissimilar metals or materials, as in a thermocouple.

JUNCTION BOX —A box with a cover that serves the purpose of joining different runs of wire or cable and provides space for the connection and branching of the enclosed conductors.

KINETIC ENERGY —Energy that a mass possesses by virtue of its motion.

KNEE (OF A CURVE) —An abrupt change in direction between two fairly straight segments of a curve.

LAG —The amount one wave is behind another in time; expressed in electrical degrees.

LAMINATED CORE —A core built up from thin sheets of metal and used in transformers and relays.

LEAD —(1) The opposite of LAG. (2) a wire or connection.

LEAD-ACID CELL —A cell in an ordinary storage battery in which electrodes are grids of lead containing an active material consisting of certain lead oxides that change in composition during charging and discharging. The electrodes or plates are immersed in an electrolyte of diluted sulfuric acid.

LINE OF FORCE —A line in an electric or magnetic field that shows the direction of the force.

LOAD —(1) The power that is being delivered by any power-producing device. (2) The equipment that uses the power from the power-producing device.

LOGIC CIRCUITS —Digital computer circuits used to store information signals and/or to perform logical operations on those signals.

MAGNETIC AMPLIFIER —A saturable reactor-type device that is used in a circuit to amplify or control.

MAGNETIC CIRCUIT —The complete path of magnetic lines of force.

MAGNETIC FIELD —The space in which a magnetic force exists.

MAGNETIC FLUX —The total number of lines of force issuing from a pole of a magnet.

MAGNETIZE —To convert a material into a magnet by causing the molecules to rearrange.

MAGNETO —A generator that produces alternating current and has a permanent magnet as its field.

MATTER —Any physical entity that possesses mass.

METEOROLOGY AUTOMATED SYSTEM FOR UNIFORM RECALL AND REPORTING (MEASURE) —The Navy data processing system designed to provide a standardized system for the recall, scheduling, and documenting of test equipment into calibration facilities.

MEGGER. —A test instrument used to measure insulation resistance and other high resistances. It is a portable hand-operated dc generator used as an ohmmeter.

MEGOHM —A million ohms.

METER —A device used to measure a specific quantity, such as current, voltage, or frequency.

METER MOVEMENT —The part of the meter that moves to indicate some value.

METER SHUNT —A resistor placed in parallel with the meter terminals; used to provide increased range capability.

MICRO —A prefix meaning one-millionth.

MICROMETER —A unit of length equal to 10^{-6} meter. Formerly a micron.

MICRON —*See* MICROMETER.

MIL —The diameter of a conductor equal to 1/1000 (.001) inch.

MIL-FOOT —A unit of measurement for conductors (diameter of 1 mil, 1 foot in length).

MILITARY SPECIFICATIONS (MILSPEC) —Technical requirements and standards adopted by the Department of Defense (DoD) that must be met by vendors selling materials to the DoD.

MILITARY STANDARDS (MILSTD) —Standards of performance for components or equipment that must be met to be acceptable for military systems.

MILLI —A prefix meaning one-thousandth.

MILLIAMMETER —An ammeter that measures current in thousandths of an ampere.

MOTOR —A machine that converts electrical energy to mechanical energy. It is activated by ac or dc voltage, depending on the design.

MOTOR-GENERATOR —A motor and a generator with a common shaft used to convert line voltages to other voltages or frequencies.

MULTICONDUCTOR —More than one conductor, as in a cable.

MULTIMETER —A single meter combining the functions of an ammeter, a voltmeter, and an ohmmeter.

MULTIPHASE —*See* POLYPHASE.

MUTUAL INDUCTANCE —A circuit property existing when the relative position of two inductors causes the magnetic lines of force from one to link with the turns of the other.

NAMP —The Naval Aviation Maintenance Program.

NANOMETER —A unit of length equal to 10^{-9} meter. Formerly millimicron.

NEGATIVE CHARGE —The electrical charge carried by a body that has an excess of electrons.

NEGATIVE FEEDBACK —Feedback in which the feedback signal is out of phase with the input signal.

NEGATIVE TEMPERATURE COEFFICIENT—A characteristic of a semiconductor material, such as silver sulfide, in which resistance to electrical current flow decreases as temperature increases.

NEUTRON —A particle having the weight of a proton but carrying no electric charge. It is located in the nucleus of an atom.

NOISE —(1) Any undesired disturbance within the useful frequency band. (2) That part of the modulation of a received signal (or an electrical or electronic signal within a circuit) representing an undesirable effect of transient conditions.

NUCLEUS —The central part of an atom that is mainly made up of protons and neutrons. It is the part of the atom that has the most mass.

NULL —A point or position where a variable strength signal is at its minimum value (or zero).

OHM —The unit of electrical resistance. That value of electrical resistance through which a constant potential difference of 1 volt across the resistance will maintain a current flow of 1 ampere through the resistance.

OHM'S LAW —The current in an electrical circuit is directly proportional to the electromotive force in the circuit. The most common form of the law is E = IR, where E is the electromotive force or voltage across the circuit, I is the current flowing in the circuit, and R is the resistance of the circuit.

OVERLOAD —A load greater than the rated load of an electrical device.

PACKAGING —An all-inclusive term covering cleaning, preserving, packaging, packing, and marking required to protect items during every phase of shipment, handling, and storage.

PARAMETERS —In electronics, the design or operating characteristics of a circuit or device.

PERMALLOY —An alloy of nickel and iron having an abnormally high magnetic permeability.

PERMEABILITY —A measure of the ease with which magnetic lines of force can flow through a material as compared to air.

PHASE —The angular relationship between two alternating currents or voltages when the voltage or current is plotted as a function of time. When the two are in phase, the angle is zero; both reach their peak simultaneously. When out of phase, one will lead or lag the other; that is, at the instant when one is at its peak. The other phase will not be at peak value and (depending on the phase angle) may differ in polarity as well as magnitude.

PHASE DIFFERENCE —The time in electrical degree by which one wave leads or lags another.

PHOTON (hv) —An elementary quantity of radiant energy (quantum) whose value is equal to the product of Plank's constant and the frequency of the electromagnetic radiation.

PICKOFF —In gyros, a sensing device that measures the angle of the spin axis with respect to its reference and provides an error signal that indicates the direction and (in most cases) the magnitude of the displacement.

PLANCK'S CONSTANT —A constant that gives the unvarying ratio of the energy of a quantum of radiation to its frequency and that has an approximate value of 6.626×10^{-34} J·s —Symbol h.

POLARITY —The character of having magnetic poles, or electric charges.

POLYPHASE —A circuit that uses more than one phase of alternating current.

POSITIVE CHARGE —The electrical charge carried by a body that has become deficient in electrons.

POSITIVE FEEDBACK —Feedback in which the feedback signal is in phase with the input signal.

POSITIVE TEMPERATURE COEFFICIENT—The characteristic of a conductor in which the resistance increases as temperature increases.

POTENTIAL —The amount of charge held by a body as compared to another point or body. Usually measured in volts.

POTENTIOMETER —A variable voltage divider; a resistor that has a variable contact arm so that any portion of the potential applied between its ends may be selected.

POWER —The rate of doing work or the rate of expending energy. The unit of electrical power is the watt.

POWER FACTOR —The ratio of the actual power of an alternating or pulsating current, as measured by a wattmeter, to the apparent power, as indicated by ammeter and voltmeter readings. The power factor of an inductor, capacitor, or insulator is an expression of their losses.

POWER SUPPLY —A unit that supplies electrical power to another unit. It changes ac to dc and maintains a constant voltage output within limits.

PRECESSION —The reaction of a gyro to an applied torque, which causes the gyro to tilt itself at right angles to the direction of the applied torque in such a manner that the direction of spin of the gyro rotor will be in the same direction as the applied torque.

PRIMARY WINDING —The winding of a transformer connected to the electrical source.

PRIME MOVER —The source of the turning force applied to the rotor of a generator. This may be an electric motor, a gasoline engine, a steam turbine, and so forth.

PROTON —A positively charged particle in the nucleus of an atom.

RADAR —An acronym for radio detecting and ranging.

RADAR ALTIMETER —Airborne radar that measures the distance of the aircraft above the ground.

RADIAN —In a circle, the angle included within an arc equal to the radius of the circle. A complete circle contains 2 radians. One radian equals 57.3 degrees, and 1 degree equals 0.01745 radian.

RATE GYRO —A gyro with one degree of freedom that has an elastic restraint, with or without a damper, and whose output will be proportional to the rate of the applied torque.

RATIO —The value obtained by dividing one number by another, indicating their relative proportions.

REACTANCE —The opposition offered to the flow of an alternating current by the inductance, capacitance, or both, in any circuit.

RECTIFIERS —Devices used to change alternating current to unidirectional current. These may be vacuum tubes; semiconductors, such as germanium and silicon; and dry-disk rectifiers, such as selenium and copper oxide.

RELUCTANCE —A measure of the opposition that a material offers to magnetic lines of force.

RESISTANCE —The opposition to the flow of current caused by the nature and physical dimensions of a conductor.

RETENTIVITY —The measure of the ability of a material to hold its magnetism.

RHEOSTAT —A variable resistor.

RIGIDITY —In gyros, the characteristics of a spinning body that causes it to oppose all attempts to tilt it away from the axis in which it is spinning.

ROTATING FIELD —The magnetic field in a multiphase ac motor that is the result of field windings being energized by out-of-phase currents. In effect, the magnetic field is made to rotate electrically rather than mechanically.

ROTOR —(1) The revolving part of a rotating electrical machine. The rotor may be either the field or the armature, depending on the design of the machine. (2) The rotating member of a synchro that consists of one or more coils of wire wound on a laminated core. Depending on the type of synchro, the rotor functions similarly to the primary or secondary winding of a transformer.

SATURABLE REACTOR —A control device that uses a small dc current to control a large ac current by controlling core flux density.

SATURATION —The condition existing in any circuit when an increase in the driving signal produces no further change in the resultant effect.

SCHEMATIC —A diagram that shows, by means of graphic symbols, the electrical connections and functions of a specific circuit arrangement.

SECONDARY —The output coil of a transformer.

SELF-INDUCTION —The process by which a circuit induces an EMF into itself by its own magnetic field.

SERIES CIRCUIT —An arrangement where electrical devices are connected so that the total current must flow through all the devices; electrons have one path to travel from the negative terminal to the positive terminal.

SERIES-WOUND —A motor or generator in which the armature is wired in series with the field winding.

SERVO —A device used to convert a small movement into one of greater movement or force.

SERVOMECHANISM —A closed-loop system that produces a force to position an object according to the information that originates at the input.

SERVOMOTOR —An ac or dc motor used in servo systems to move a load to a desired position or at a desired speed. The ac motor is usually used to drive light loads at a constant speed, while the dc motor is used to drive heavy loads at varying speeds.

SERVO SYSTEM —An automatic feedback control system that compares a required condition (desired value, position, etc.) with an actual condition and uses the difference to drive a control device to achieve the required condition.

SHIELDING —(1) A metallic covering used to prevent magnetic or electromagnetic fields from affecting an object. (2) A technique designed to minimize internal and external interference.

SHUNT —A resistive device placed in parallel with another component. Appreciable current may flow through it, and an appreciable voltage may exist across it.

SLIP RINGS —(1) Contacts that are mounted on the shaft of a motor or generator to which the rotor windings are connected and against which the brushes ride. (2) Devices for making electric connections between stationary and rotating contacts.

SOLENOID —An electromagnetic coil that contains a movable plunger.

SOLID-STATE DEVICE —An electronic device that operates by the movement of electrons within a solid piece of semiconductor material.

SOURCE —(1) The object that produces the waves or disturbance. (2) The name given to the end of a two-wire transmission line that is connected to a source. (3) The device that furnishes the electrical energy used by a load.

SPECIFIC GRAVITY —The ratio between the density of a substance and that of pure water at a given temperature.

STATOR —(1) The stationary part of a rotating electrical machine. The stator may be either the field or the armature, depending on the design of the machine. (2) The stationary member of a synchro that consists of a cylindrical structure of slotted laminations on which three Y-connected coils are wound with their axes 120 degrees apart. Depending on the type of synchro, the stator's functions are similar to the primary or secondary windings of a transformer.

STRANDED CONDUCTOR —A conductor composed of a group of wires. The wires in a stranded conductor are usually twisted together and not insulated from each other.

STRANDS —Fine metallic filaments twisted together to form a single wire.

SUBASSEMBLY —Two or more parts that form a portion of an assembly or a unit.

SUPPORT EQUIPMENT (SE) —All the equipment on the ground or ship needed to support aircraft in a state of readiness for flight.

SYNCHRO —A small motor-like analog device that operates like a variable transformer and is used primarily for the rapid and accurate transmission of data among equipments and stations.

SYNCHRO SYSTEM —An electrical system that gives remote indications or control by means of self-synchronizing motors.

TACHOMETER —An instrument for indicating revolutions per minute.

TEMPERATURE COEFFICIENT —The amount of change of resistance in a material per unit change in temperature.

TERTIARY WINDING —A third winding on a transformer or magnetic amplifier that is used as a second control winding.

THERMISTOR —A resistor that is used to compensate for temperature variations in a circuit. *See also* BOLOMETER.

THERMOCOUPLE —A junction of two dissimilar metals that produces a voltage when heated.

TINNING —The process of applying a thin coat of solder to materials prior to their being soldered; for example, application of a light coat of solder to the filaments of a conductor to hold the filaments in place prior to soldering of the conductor.

TOROID(AL) — (1) A surface generated by a closed plane curve rotated about a line that lies in the same plane as the curve but does not intersect it. (2) A body whose surface has the form of a toroid.

TOROIDAL —Of, relating to, or shaped like a torus or toroid: doughnut-shaped <a toroidal resistance coil>.

TORQUE —The turning effort or twist that a shaft sustains when transmitting power. A force tending to cause rotational motion; the product of the force applied times the distance from the force to the axis of rotation.

TOTAL RESISTANCE (R_T) —The equivalent resistance of an entire circuit. For a series circuit: $R_T = R_1 + R_2 + R_3 \ldots R_n$. For parallel circuits:

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots \frac{1}{R_n} \quad [1].$$

TRANSFORMER —A device composed of two or more coils, linked by magnetic lines of force, used to transfer energy from one circuit to another.

TRANSFORMER EFFICIENCY —The ratio of output power to input power, generally expressed as a percentage:

$$\text{Efficiency} = \frac{P_{out}}{P_{in}} \times 100.$$

TRANSFORMER, STEP-DOWN —A transformer constructed so that the number of turns in the secondary winding is less than the number of turns in the primary winding. This construction will provide less voltage in the secondary circuit than in the primary circuit.

TRANSFORMER, STEP-UP —A transformer constructed so that the number of turns in the secondary winding is more than the number of turns in the primary winding. This construction will provide more voltage in the secondary circuit than in the primary circuit.

TRUE BEARING —Angle between a target and true north measured clockwise in the horizontal plane.

TRUE NORTH —Geographic north.

TUMBLE (GYRO) —To subject a gyro to torque so that it presents a precession violent enough to cause the gyro rotor to spin end over end.

TURNS RATIO —The ratio of the number of turns in the primary winding to the number of turns in the secondary winding of a transformer.

VALENCE —The measure of the extent to which an atom is able to combine directly with other atoms. It generally depends on the number and arrangement of the electrons in the outermost shell of the atom.

VALENCE SHELL —The electrons that form the outermost shell of an atom.

VECTOR —A line used to represent both direction and magnitude.

VOLT —The unit of electromotive force or electrical pressure. One volt is the pressure required to send 1 ampere of current through a resistance of 1 ohm.

VOLTAGE —(1) The term used to signify electrical pressure. Voltage is a force that causes current to flow through an electrical conductor. (2) The voltage of a circuit is the greatest effective difference of potential between any two conductors of the circuit.

VOLTAGE DIVIDER —A series network in which desired portions of the source voltage may be tapped off for use in the circuit.

WATT —The unit of electrical power.

WHEATSTONE BRIDGE —An ac bridge circuit used to measure unknown values of resistance, inductance, or capacitance.

WIRING DIAGRAM —A diagram that shows the connections of an equipment or its component devices or parts. It may cover internal or external connections, or both, and contains such detail as is needed to make or trace connections that are involved.

WORK —The product of force and motion.

WYE (Y) —A three-phase connection in which one end of each phase winding is connected to a common ground.

X-AXIS —In a gyro, the spin axis of the gyro.

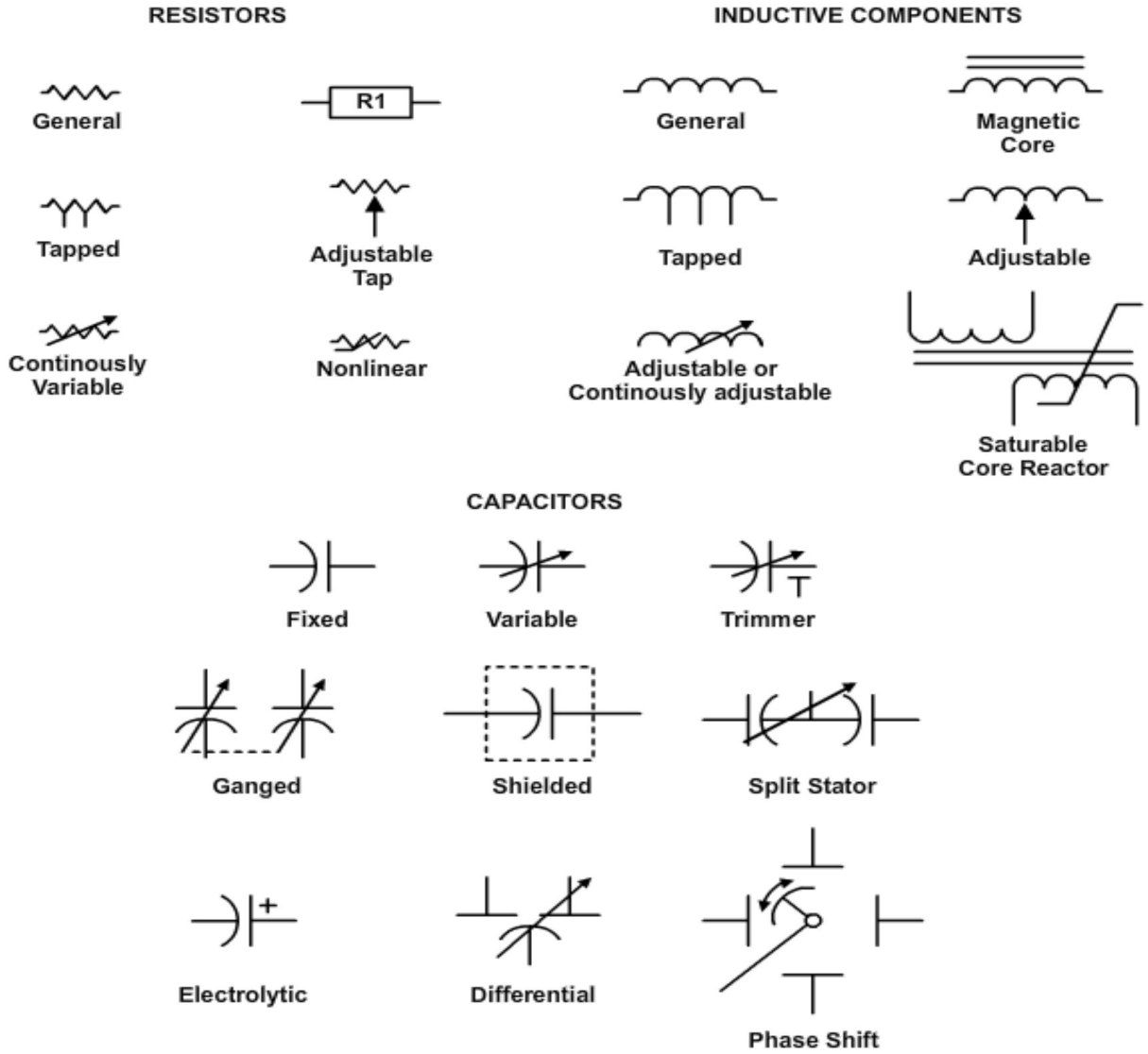
Y-AXIS —In a gyro, an axis through the center of gravity and perpendicular to the spin axis.

Z-AXIS —In a gyro, an axis through the center of gravity and mutually perpendicular to both the X (spin) and Y axes.

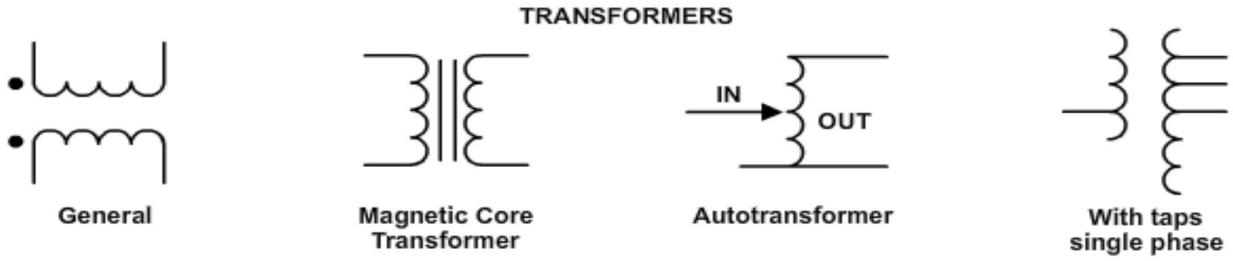
ZENER DIODE —A p-n junction diode designed to operate in the reverse-bias breakdown region.

APPENDIX II

SYMBOLS

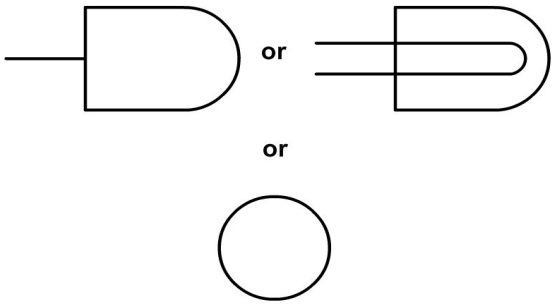


Note: When capacitor electrode identification is necessary, the curved element represents the outside electrode in fixed paper-dielectric and ceramic-dielectric capacitors, the moving element in variable and adjustavble capacitors, and the low potential element in feed-through capacitors.



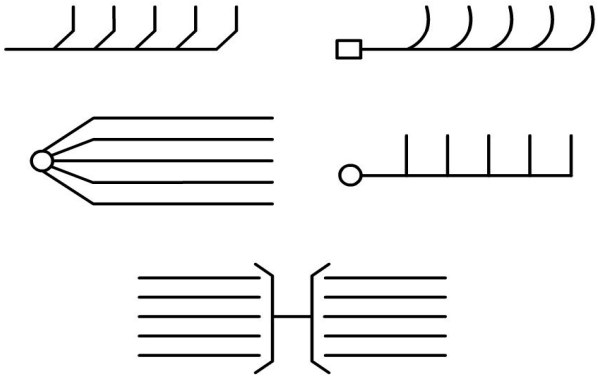
Note: A dot, representing instantaneous polarity, may be placed near one end of each coil or winding symbol

INDICATOR LAMPS



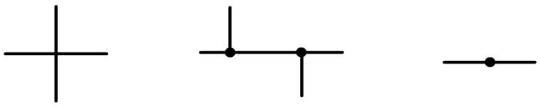
May have applicable identification for circuit usage or color.

GROUPING OF WIRES IN BUNDLES



Grouping leads. - - (Bend in line indicates where other end of lead can be found).

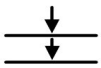
PATH, TRANSMISSION



Crossing not connected

Junction connected

Splice



Twister Pair

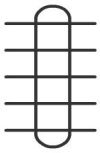
Shielded

Air or space path

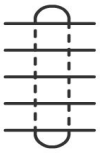
Coaxial

GROUPING OF WIRES IN CABLES

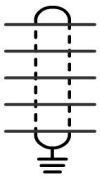
Cables



Five-conductor cable



Shielded five-conductor cable



Grounded shield

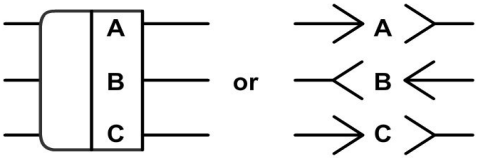
Number of conductors may be one or more as necessary

DISCONNECTING DEVICES

Male (Pin contact) | Female (Socket contact) | Engaged (Pin-to-socket) | Coaxial (Male) | Coaxial connectors mated | Coaxial connectors to single conductor

Note: The connector symbol is not an arrowhead. It is larger and the lines are draw at a 90° angle.

Splice

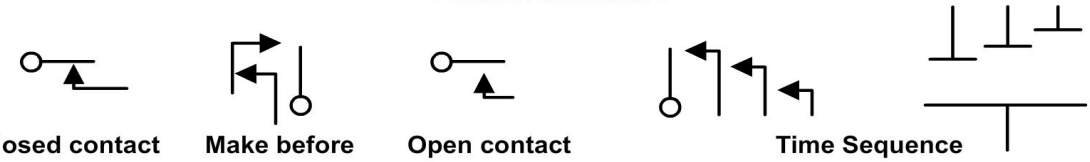


Connector assembly (General)

CONTACTS (ELECTRICAL)

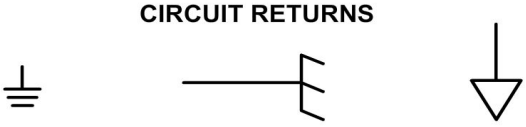
Switch | Momentary Switch | Locking | Non-locking | For jack, key, relay, etc.

Contact Assemblies



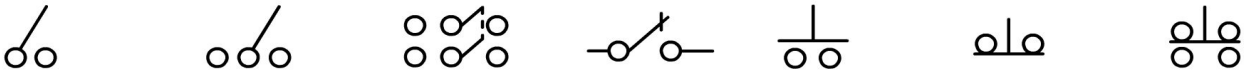
Closed contact (Break) | Make before break | Open contact (Make) | Time Sequence Closing

CIRCUIT RETURNS

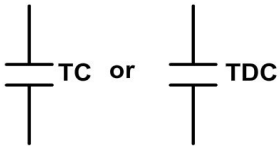


Ground | (The chassis or frame is not necessarily at ground potential) | Chassis connections

SWITCHES

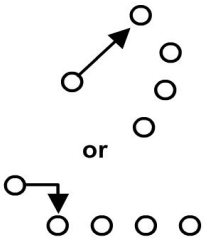


General (Single throw) | General (Double throw) | Two Pole Double Throw Switch | Knife Switch | Pushbutton (Make) | Pushbutton (Break) | Pushbutton two circuit



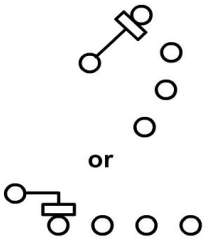
Time closing (TC) or time-delay closing (TDC)

SELECTOR OR MULTIPOSITION SWITCHES

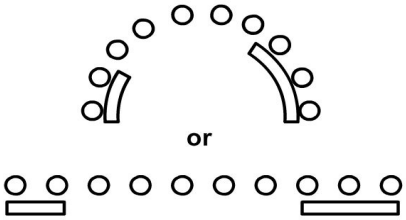


Break-before-make, nonshorting (nonbridging), during contact transfer

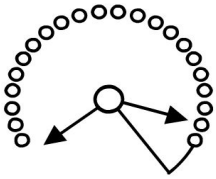
Note: The position in which the switch is shown may be indicated by a note or designation of switch position.



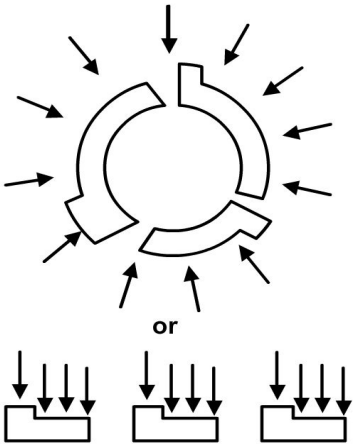
Make-before-break, shorting (bridging), during contact transfer



Segmental contact



22-Point selector switch

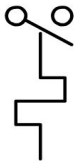


Rotary (section-, deck-, or water-type) switch.

Viewed from end opposite control knob or actuator unless otherwise indicated. For more that one section, the first section is the one nearest control knob or actuator. When contacts are on both sides, front contacts are nearest control knob.

TEMPERATURE-ACTUATED SWITCHES

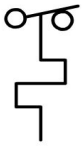
or



Thermostat

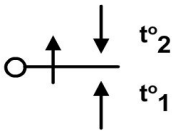
Closes on rising temperaute

or



Thermostat

Opens on rising temperature



Transfer, with intended central-off (neutral) position

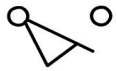
Note: The T° symbol will be shown or be replaced by data giving the nomimal or specific operating temperature of the device.

Note: If clarification or direction of contact operation is needed, a directional arrow may be added. The arrowhead will point in the direction of raising temperature operation. A directional arrow will always be shown for central-off (neutral) position devices.

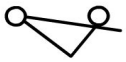
TEMPERATURE-ACTUATED SWITCHES CONT.

Flasher self-interrupting switch

LIMIT SWITCHES, DIRECTLY ACTUATED, SPRING RETURN

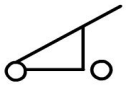


Normally open



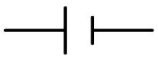
Normally open-held closed

Normally closed



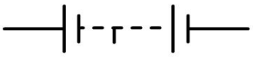
Normally closed-held open

BATTERIES



One cell

Multi-cell



Tapped multi-cell

(Long line is always positive)

CIRCUIT PROTECTORS

Fuse

Push Pull
or Push

Ganged

Circuit Breakers

THERMAL ELEMENTS

Thermal relay with normally closed contact.

Flasher; thermal cutout

General

Linear

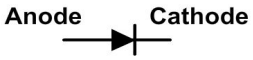
Non-linear

Thermistor

With integral
heating element

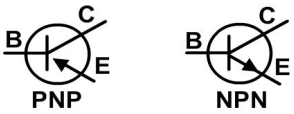
Temperature-measuring
thermocouple
(dissimilar metal device)

SEMICONDUCTOR DEVICES



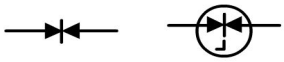
Electron flow is against the arrow.

Diode



PNP NPN

Transistors



Breakdown diode, bidirectional

Breakdown diode, undirectional (also backward diode)

Photodiode

Temperature dependent diode

PNPN switch

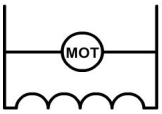
Tunnel diode

ROTATING MACHINES

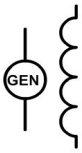
Motor AC | Motor DC | Generator DC | Generator AC

TYPE OF WINDINGS

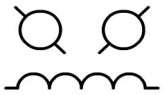
Series



Shunt



Separately Excited



Dynamotor

WINDING SYMBOLS

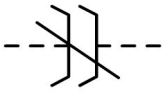
Single-phase

Two-phase

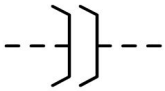
Three-phase (WYE)

Three-phase (Delta)

CLUTCH / BRAKE



Engaged

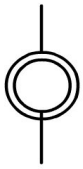


Disengaged

METERS

A	Ammeter
AH	Ampere-hour meter
CRO	Oscilloscope
DB	DB (Decibel) meter audio level / meter
DBM	DBM (Decibel referred to 1 milliwatt) meter
F	Frequency meter
μA or UA	Microammeter
MA	Milliammeter
OHM	Ohmmeter
PF	Power factor meter
PH	Phasemeter
PI	Position indicator
REC	Recording meter
SY	Synchroscope
t°	Temperature meter
TT	Toral time meter elapsed time meter
C	Voltmeter
VA	Volt-ammeter
VAR	Varmeter
W	Wattmeter
WH	Watthour meter

SYNCHROS

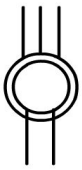


CDX	Control-differential transmitter	TDX	Torque-differential transmitter
CT	Control Transformer	TR	Torque receiver
CX	Control Transmitter	TX	Torque Transmitter
TDR	Torque-differential receiver	RS	Resolver

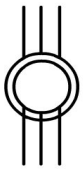
(If the outer winding ID rotatable in bearings, the suffix B shall be added to the above letter combinations)

(Complete symbols may also be formed by using a winding symbol)

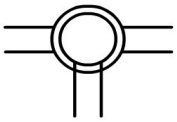
SYNCHROS CONT.



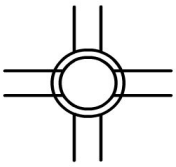
Transmitter receiver, or control transformer



Differential transmitter or receiver



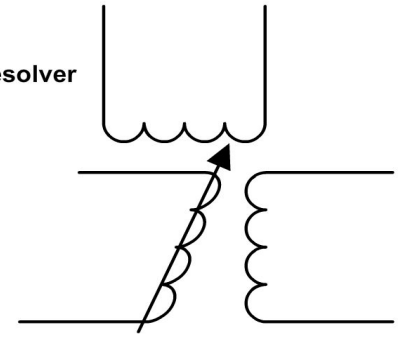
Singly-wound rotor



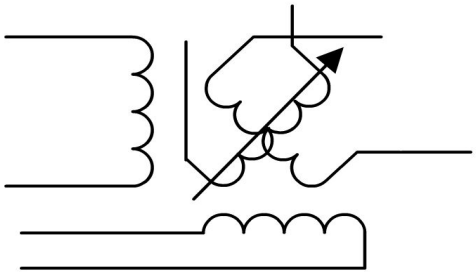
Doubly-wound rotor

Resolver (Synchro)

Resolver

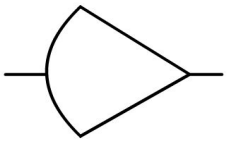


Singly-wound rotor

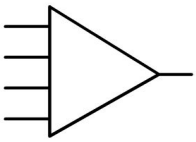


Doubly-wound rotor

AMPLIFIERS

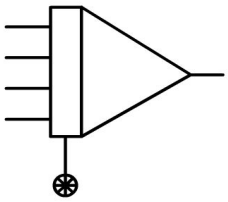


Operational



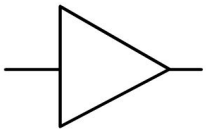
Summing amplifier

(4 inputs and 1 output shown)

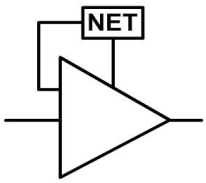


Intergrator (amplifier)

(4 inputs and 1 output shown)

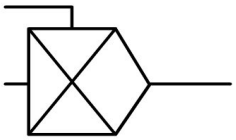


Triangle points in direction of transmission (signal flow)

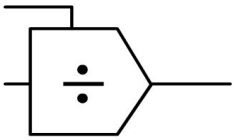


Amplifier with external feedback path

Basic symbol indicates any method of amplification except that operating on the principle of rotating machinery.



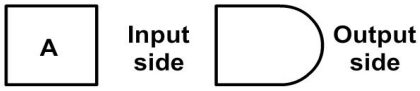
Electronic multiplier



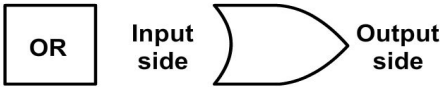
Electronic divider

LOGIC FUNCTIONS

And Functions



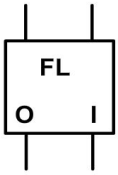
Inclusive or Functions



Exclusive or Functions

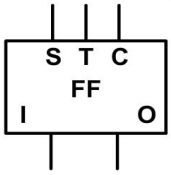
Flip-flops

Latch



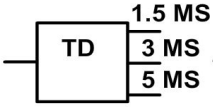
S-Set

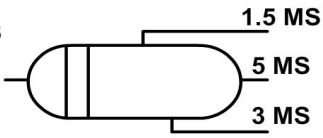
Complementary



T-Trigger C-Clear

Time Delay





APPENDIX III

REFERENCES

NOTE

Although the following references were current when this NRTC was published, their continued currency cannot be assured. When consulting these references, keep in mind that they may have been revised to reflect new technology or revised methods, practices, or procedures; therefore, you need to ensure that you are studying the latest references.

If you find an incorrect or obsolete reference, please use the Rate Training Manual User Update Form provided at the end of each chapter to contact the CNATT Rate Training Manager.

Chapter 1

Navy Electricity and Electronics Training Series (NEETS), Module 1, *Introduction to Matter, Energy, and Direct Current,* NAVEDTRA 14173, Naval Education and Training Professional Development and Technology Center (NETPDTC), Pensacola, FL, January 2003.

Chapter 2

Engineering Change Proposal ECP-MDC-F/A-18-06313 for AN/APN/-194 RADAR Altimeter Mounting Tray Modification, Navy Model FA-18E/F and EA-18G, Commander, Naval Air Systems Command, Washington, DC, 22 April 2009.

Fluke Model 8808A Digital Multimeter User's Manual, Fluke Corporation, P.O. Box 9090, Everett, WA 98206, USA, December 2009.

Fluke Model Series IVDigital Multimeter User's Manual, Fluke Corporation, P.O. Box 9090, Everett, WA 98206, USA, September 2006.

Handbook, Operation, Service and Overhaul Instructions with Illustrated Parts Breakdown, Tachometer Indicator-Generator Test Set Part Number TTU-27/E, NAVWEPS 17-15CM-3, Direction of the Chief of the Bureau of Naval Weapons, 15 April, 1965.

NEETS, Module 16, *Introduction to Test Equipment,* NAVEDTRA 14188, NETPDTC, Pensacola, FL, September 1998.

Navy Safety and Occupational Health Program Manual, OPNAVINST 5100.23G, CH-1, Chief of Naval Operations, Washington, DC, 21 July 2011.

Navy Training System Plan, A/F 37T-21 Aircraft Engine Test Stand, N88-NTSP-A-50-0005/A, Commander, Naval Air Systems Command, Washington, DC, 1 October 2002.

Organizational Maintenance with Illustrated Parts Breakdown, Operating Instructions Test Set, Air Data TS-4508/U, NSN 4920-01-449-8072, NAVAIR 17-15CA-62, Naval Air Systems Command, Washington, DC, 15 January 1998.

Technical Manual, Cleaning and Corrosion Control, NAVAIR 01-1A-509 (series), Naval Air Systems Command, Washington, DC, 1 July 2009.

Technical Manual, Installation and Repair Practices, NAVAIR 01-1A-505 (series), Naval Air Systems Command, Washington, DC, 15 September 2009.

Technical Manual, Intermediate Maintenance Instructions with Illustrated Parts Breakdown, Test Set, Air Data TS-4508/U, NAVAIR 17-15CA-62.1, Naval Air Systems Command, Washington, DC, 1 December 2010.

Technical Manual, Intermediate Maintenance Instructions with Illustrated Parts Breakdown, Propeller Synchronizer Tester TTK-512/E24T-204(v), Part Number 1383AS200-1, AG-240AB-OMP-000, Commander, Naval Air Systems Command, Washington, DC, 1 September 1992.

Technical Manual, Maintenance Instructions, Organizational, Flight Instruments, Navy Model P-3C Aircraft, NAVAIR 01-75PAC-2-13.1.3, Commander, Naval Air Systems Command, Washington, DC, 1 June 2011.

Technical Manual, Maintenance Instructions, Organizational, Power Plant Related Electrical Systems, Navy Model P-3C Aircraft, NAVAIR 01-75PAC-2-13.1.2, Commander, Naval Air Systems Command, Washington, DC, 1 January 2004.

Technical Manual, Maintenance Instructions, Organizational , Utility Systems, Navy Models P-3A, P-3B, and P-3C Aircraft, NAVAIR-01-75PAA-2-2.4, Commander, Naval Air Systems Command, Washington, DC, 15 July 2011.

Technical Manual, Operation and Intermediate Maintenance with Illustrated Parts Breakdown, Temperature Control System Test Set, Part Number BR-61-103, AG-513SA-OMP-000, Naval Air Systems Command, Washington, DC, 1 January 2005.

Technical Manual, Operation and Maintenance Instructions with Illustrated Parts Breakdown, Test Set Indicator TTU-378A/E 361-046-001, NAVAIR 17-15BD-46, Naval Air Systems Command, Washington, DC, CH-1, 1 July 1993.

Technical Manual, Operation and Service Instructions with Illustrated Parts Breakdown, JetCal® Analyzer, BH112J-46 4920-00-090-3409, NAVAIR 17-15A-503, Commander, Naval Air Systems Command, Washington, DC, 1 December 1991.

Technical Manual, Organizational and Intermediate Maintenance with Illustrated Parts Breakdown, Fuel Control Test Set Assembly (TTU-597/E), Part Number BC849A6010-000, NAVAIR 17-15MT-4, Naval Air Systems Command, Washington, DC, 1 October 2010.

Technical Manual, Organizational and Intermediate Maintenance, Wiring Repair with Parts Data General Wiring Repair Procedures, Navy Model F/A-18A and F/A-18B, 161353 and Up, A1-F18AC-WRM-001 (series), Commander, Naval Air Systems Command, Washington, DC, 1 August 2009.

Technical Manual, Organizational Maintenance, General Aircraft Information (GAI), Navy Model F/A-18A/B/C/D, 161353 and Up, A1-F18AC-GAI-000, Commander, Naval Air Systems Command, Washington, DC, 1 November 2009.

Technical Manual, Organizational Maintenance, Principles of Operation, Electrical System, Navy Model F/A-18A/B/C/D, 161353 and Up, A1-F18AC-420-100, Commander, Naval Air Systems Command, Washington, DC, CH-18, 1 August 2008.

Technical Manual, Organizational Maintenance, System Maintenance with Illustrated Parts Breakdown, Electrical System, Navy Model F/A-18A/B/C/D, 161353 and Up, A1-

F18AC-420-300, Commander, Naval Air Systems Command, Washington, DC, CH-22, 1 April 2010.

Technical Manual, Organizational Maintenance, Wiring Diagrams, Navy Model F/A-18A, 161353 thru 163175, A1-F18AC-WDM-000 (series), Commander, Naval Air Systems Command, Washington, DC, 15 May 2010.

Technical Manual, Standard Maintenance Practices, Miniature/Microminiature (2M) Electronic Assembly Repair, Organizational/Intermediate/Depot Level, NAVAIR-01-1A-23, Revision 3, Commander, Naval Air Systems Command, Washington, DC, 1 October 2006.

The Naval Aviation Maintenance Program, COMNAVAIRFORINST 4790.2 (series), Commander Naval Air Forces, Washington, DC, 10 November 2009.

Tools and Their Uses, NAVEDTRA 14256, NETPDTC, Pensacola, FL, June 1992.

Chapter 3

Handbook, Operation and Service Instructions, Inverter, Type DMZ3508M-PM3508G-X, AN 03-5HE-1, Secretary of the Air Force and Chief of the Bureau of Aeronautics, 1 December 1952.

Interactive Electronic Technical Manual (IETM), A1-F18E/F/G, Buno 166817, Lot 30, OFP H5E, *Electrical System, AC Power.*

Interactive Electronic Technical Manual (IETM), A1-F18E/F/G, Buno 166817, Lot 30, OFP H5E, *Electrical System, DC Power.*

Interactive Electronic Technical Manual (IETM), A1-F18E/F/G, Buno 166817, Lot 30, OFP H5E, *Electrical System, Ground Power System.*

Interactive Electronic Technical Manual (IETM), A1-F18E/F/G, Buno 166817, Lot 30, OFP H5E, *Electrical System, Power Distribution System.*

NEETS, Module 5, *Introduction to Generators and Motors,* NAVEDTRA 14177, NETPDTC, Pensacola, FL, March 2003.

Technical Manual, Maintenance Instructions, Organizational, Electrical System, Navy Model P-3A/B Aircraft, NAVAIR 01-75PAA-2-29, Commander, Naval Air Systems Command, Washington, DC, 15 March 1985.

Technical Manual, Operation and Maintenance Instructions with Illustrated Parts Breakdown, Navy and Air Force Aircraft and Aircraft Support Equipment Storage Batteries, NAVAIR 17-15BAD-1, Naval Surface Warfare Center Crane, Indiana, Commander, Naval Air Systems Command, Washington, DC, 15 September 2011.

Technical Manual, Organizational Maintenance, Auxiliary Power Unit, Navy Models P-3A, P-3B, and P-3C Aircraft, NAVAIR 01-75PAA-2-4.4, Commander, Naval Air Systems Command, Washington, DC, 1 May 2009.

Technical Manual, Organizational Maintenance, Electrical Power and Lighting Systems, Navy Model EA-6B Aircraft, NAVAIR 01-85ADC-2-12, Commander, Naval Air Systems Command, Washington, DC, 1 March 2010.

Technical Manual, Organizational Maintenance System Schematics, Electrical System, Navy Model F/A-18E/F and EA-18G, 165533 and Up, A1-F18EA-420-500, Naval Air Systems Command, Washington, DC, 15 March 2011.

Chapter 4

Interactive Electronic Technical Manual (IETM), A1-F18E/F/G, Buno 166817, Lot 30, *Air Data System.*

Interactive Electronic Technical Manual (IETM), A1-F18E/F/G, Buno 166817, Lot 30, *Environmental Control System.*

Interactive Electronic Technical Manual (IETM), A1-F18E/F/G, Buno 166817, Lot 30, *Interior Lighting System, Exterior Lighting System, Inflight Refueling System.*

NATOPS Flight Manual, Navy Model F/A-18E/F, 165533 and Up Aircraft, A1-F18EA-NFM-000, Naval Air Systems Command, Washington, DC, 1 February 2011.

NATOPS Flight Manual, Navy Model P-3C Aircraft, NAVAIR 01-75PAC-1, Commander, Naval Air Systems Command, Washington, DC, 15 March 2010.

Organizational Maintenance, Principles of Operation, Exterior Lighting System, Effectivity: HH-60H Helicopter Serial No. 163783 and Subsequent HH-60J Helicopter Serial No. 163801 and Subsequent, A1-H60HA-420-100, Commander, Naval Air Systems Command, Washington, DC, 30 July 2004.

Organizational Maintenance, Principles of Operation, Stability Augmentation System (SAS 1), Effectivity: HH-60H Helicopter Serial No. 163783 and Subsequent HH-60J Helicopter Serial No. 163801 and Subsequent, A1-H60HA-560-100, Commander, Naval Air Systems Command, Washington, DC, 27 February 2009.

Technical Manual, Maintenance Instructions, Organizational, Airframe Related Electrical Systems, Navy Models P-3C Aircraft, NAVAIR 01-75PAA-2-13-1-1, Commander, Naval Air Systems Command, Washington, DC, 15 June 2011.

Technical Manual, Maintenance Instructions, Organizational, Integrated Flight Station Systems Navy Model P-3C Aircraft, NAVAIR 01-75PAC-2-9, Commander, Naval Air Systems Command, Washington, DC, 15 April 2011.

Technical Manual, Organizational Maintenance, Instrument Systems, Navy Model EA-6B Aircraft, NAVAIR 01-85ADC-2-10, Commander, Naval Air Systems Command, Washington, DC, 1 February 2011.

Technical Manual, Organizational Maintenance, System Schematics, Environmental Control Systems, Navy Model F/A-18E/F and EA-18G, 165533 and Up, A1-F18EA-410-500, Commander, Naval Air Systems Command, Washington, DC, 1 October 2010.

Chapter 5

Technical Manual, Organizational Maintenance, Principles of Operation, Fuel Systems, Navy Model F/A-18A and F/A-18B, 161353 and Up, A1-F18AC-460-100, Commander, Naval Air Systems Command, Washington DC, CH-4, 1 July 2009.

Technical Manual, Organizational Maintenance, Principles of Operation, Power Plants and Related Systems, A1-F18AC-270-100, Commander, Naval Air Systems Command, Washington, DC, CH-4, 1 February 2004.

Technical Manual, Organizational Maintenance, Principles of Operation, Rotor Systems, Blade Fold System, A1-H60CA-150-100, Commander, Naval Air Systems Command, Washington, DC, 30 July 2004.

Technical Manual, Maintenance Instructions, Organizational, Utility Systems, Navy Models P-3A, P-3B, and P-3C Aircraft, NAVAIR 01-75PAA-2-2.4, Commander, Naval Air Systems Command, Washington, DC, 15 July 2011.

Technical Manual, Organizational Maintenance, Principles of Operation, Secondary Power System, Navy Model F/A-18A/B/C/D, A1-F18AC-240-100, Commander, Naval Air Systems Command, Washington, DC, 1 August 2002.

Chapter 6

Interactive Electronic Technical Manual (IETM), A1-F18E/F/G, Buno 166817, Lot 30, OFP H5E, *Air Data System.*

Interactive Electronic Technical Manual (IETM), A1-F18E/F/G, Buno 166817, Lot 30, OFP H5E, *Backup Attitude and Navigation System.*

Interactive Electronic Technical Manual (IETM), A1-F18E/F/G, Buno 166817, Lot 30, OFP H5E, Cabin Pressurization System.

Interactive Electronic Technical Manual (IETM), A1-F18E/F/G, Buno 166817, Lot 30, OFP H5E, *Hydraulic System.*

Interactive Electronic Technical Manual (IETM), A1-F18E/F/G, Buno 166817, Lot 30, OFP H5E, *Instrument System.*

NEETS, Module 4, *Introduction to Electrical Conductors, Wiring Techniques and Schematic Reading,* NAVEDTRA 14176, NETPDTC, Pensacola, FL, September 1998.

NEETS, Module 15, *Principles of Synchros, Servos, and Gyros,* NAVEDTRA 14187, NETPDTC, Pensacola, FL, July 2003.

Technical Manual, Maintenance Instructions, Organizational, Electrical Wiring Data, Navy Models P-3A and P-3B Aircraft, NAVAIR 01-75PAA-2-13.2, Commander, Naval Air Systems Command, Washington, DC, CH-10, 1 August 2005.

Technical Manual, Organizational Maintenance, Aircraft Electromechanical System Theory, Navy Model E2-C Aircraft, NAVAIR 01-E2AAA-2-1.1, Commander, Naval Air Systems Command, Washington, DC, CH-9, 15 July 2008.

Technical Manual, Organizational Maintenance, Principles of Operation, Air Data Computer System, Navy Model F/A-18A/B/C/D 161353 and Up, A1-F18AC-560-100, Commander, Naval Air Systems Command, Washington, DC, CH-3, 1 July 2001.

Technical Manual, Organizational Maintenance, Principles of Operation, Inertial Navigation and Backup Attitude and Navigation System, Navy Model F/A-18A/B/C/D 161353 and Up, A1-F18AC-730-100, Commander, Naval Air Systems Command, Washington, DC, 15 June 2007.

Technical Manual, Organizational Maintenance, Principles of Operation, Instrument Systems, Navy Model F/A-18A/B/C/D 161353 and Up, A1-F18AC-510-100, Commander, Naval Air Systems Command, Washington, DC, CH-4, 1 December 1999.

Chapter 7

Interactive Electronic Technical Manual (IETM), A1-F18E/F/G, Buno 166817, Lot 30, OFP H5E, *Inertial Navigation System and Accurate Navigation System (ANAV), Global Positioning System (GPS).*

Interactive Electronic Technical Manual (IETM), A1-F18E/F/G, Buno 166817, Lot 30, OFP H5E, *Mission Computer (MC)/Fiber Channel Network (FCN).*

Interactive Electronic Technical Manual (IETM), A1-F18E/F/G, Buno 166817, Lot 30, OFP H5E*, Multipurpose Display Group (MDG), Flight Incident Recorder and Monitoring System (FIRAMS).*

Interactive Electronic Technical Manual (IETM), A1-F18E/F/G, Buno 166817, Lot 30, OFP H5E, *Tactical Moving Map Capability (TAMMAC) System, Display Symbology.*

NEETS, Module 15, *Principles of Synchros, Servos, and Gyros,* NAVEDTRA 14187, NETPDTC, Pensacola, FL, July 2003.

Technical Manual, Organizational Maintenance, Principles of Operation, Navigation Systems, Navy Model CH-53E, MH-53E, A1-H53CE-700-100, Commander, Naval Air Systems Command, Washington, DC, 1 November 2010.

Technical Manual, Organizational Maintenance, Testing and Troubleshooting Procedures Flight Reference and Automatic Flight Control System, Effectivity: SH-60B Helicopter Serial No. 161553 and Subsequent, A1-H60BB-560-200, Naval Air Systems Command, Washington, DC, 1 November 2007.

Chapter 8

NATOPS Flight Manual, Navy Model SH-60B, NAVAIR A1-H60BB-NFM-000, Naval Air Systems Command, Washington, DC, 15 February 2010.

NEETS, Module 15, *Principles of Synchros, Servos, and Gyros,* NAVEDTRA 14187, NETPDTC, Pensacola, FL, July 2003.

Technical Manual, Organizational Maintenance, Principles of Operation, Stability Augmentation System (SAS 1), Effectivity: HH-60H Helicopter Serial No. 163783 and Subsequent HH-60J Helicopter Serial No. 163801 and Subsequent, A1-H60HA-560-100, Naval Air Systems Command, Washington, DC, 27 February 2009.

Technical Manual, Organizational Maintenance, Principles of Operation, Stability Augmentation System (SAS 1), Effectivity: MH-60S Helicopter Serial No. 165742 and Subsequent, A1-H60SA-560-100, Naval Air Systems Command, Washington, DC, 1 October 2009.

Technical Manual, Organizational Maintenance, Principles of Operation, Integrated Flight Controls, Navy Model F/A-18A/B/C/D 161353 and Up, A1-F18AC-570-100, Naval Air Systems Command, Washington, DC, 1 October 2003.

APPENDIX IV

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7-24.	C

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8-4.	B
8-5.	A
8-6.	D
8-7.	B
8-8.	C

8-9.	A
8-10.	B
8-11.	D
8-12.	D
8-13.	B
8-14.	C
8-15.	B
8-16.	A

8-17.	C
8-18.	B
8-19.	B
8-20.	B
8-21.	A
8-22.	B