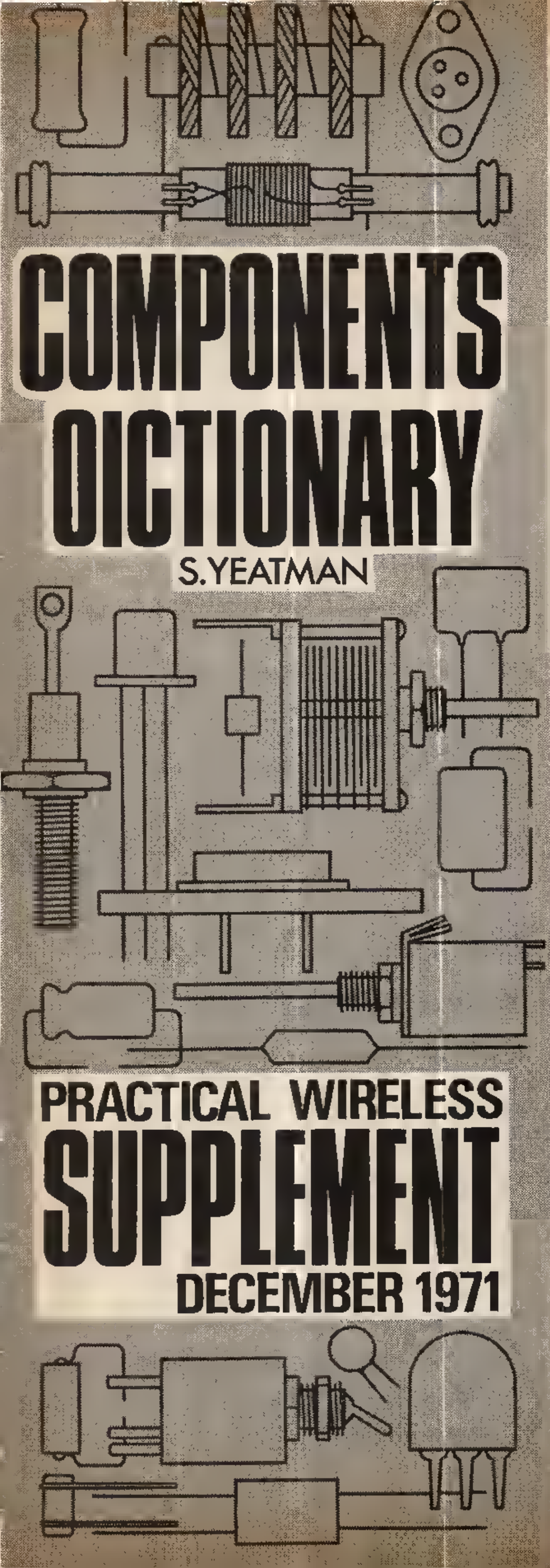


This dictionary has been compiled to assist the reader in identifying the more common components that he will come across when constructing electronic equipment. It will also enable him to choose the correct component for a particular purpose.

AERIALS, ferrite

Ferrite rod aerials are universal in transistor radios and many other receivers, obviating the need for an external aerial. Inductors suitable for the medium and/or long wave ranges are wound on formers on a flat slab or round rod of ferrite material, the formers being movable on the rod for alignment purposes. These inductors take the place of the conventional inductors in the input circuit of the first stage of the receiver.

Ferrite rod aerials have very pronounced directional characteristics having minimum pick-up off the ends of the rod and maximum pick-up at right angles to the line of the rod. This feature can be used to increase the strength of a signal or to null out an interfering signal if its direction is substantially different to that of the wanted signal.

Ferrite aerials are obtainable for use in either valve or transistor circuits.

CAPACITORS, fixed

Any two metal objects (plates) separated by an insulator (dielectric) possess capacitance, or the ability to hold an electrical charge. Introduction of a solid dielectric in place of air increases the value of a capacitor by several times.

Practical Units: The microfarad (μF) and the picofarad (pF=1/1,000,000μF).

Electrolytic capacitors basically consist of two lengths of metal foil separated by a length of insulating material, the whole rolled up and sealed in a tubular container. During the process an electrolyte is introduced often in the form of a jelly. The foil may be aluminium or tantalum which may be etched in order to increase the effective area and thus the capacitance. The insulating material will be as thin as possible consistent with the working voltage of the capacitor. All these measures are aimed at getting the maximum capacitance into the minimum of space.

Electrolytic capacitors are generally polarised, one side (or electrode) always being connected to the positive side of the supply and the other electrode to negative. Generally, the outer case, usually of aluminium, is connected to the negative side although occasionally it is isolated. If the voltage is applied in reverse polarity the capacitor will almost certainly be badly damaged. Plus and minus signs or red and black markings are usually boldly marked on polarised electrolytic capacitors.

It should be noted that non-polarised electrolytics are

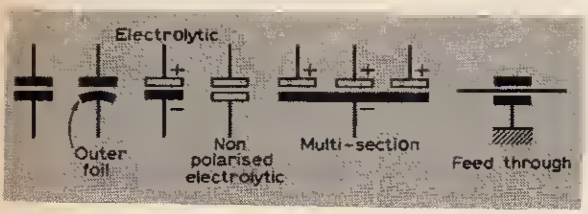
COMPONENTS DICTIONARY

also obtainable but they are the exception rather than the rule. Electrolytic capacitors with es many es four sections are avelleble such es 8+8+16+16μF usually with a common negative connection, with the one unit being used for smoothing and decoupling purposes. Values of electrolytic capacitors range from 0·25μF to 10000μF at working voltages from 2·5V to 600V. Tolerances on nominel capacity ara not "symmetrical" as with resistors (±5%) buf may be given as "−10% +50%" or "−10% +100%".

Electrolytic capecitors are used in electronic equipment for smoothing purposes in meins rectifier circuits and as decoupling cepacitors on h.t. and cathode circuits in valve redios, amplifiers etc. and as decoupling and coupling components in transistorised equipment.

Fixed Capacitors (non-electrolytic) have several different forms of construction, each with its own special characteristics, which must be taken into account when selecting a capacitor for a particular application, so each typa will be dascribed separately.

Silver Mica capacitors ere considered very stable with a low temperatura co-efficient and thus eminently suitable for use in tuned circuits. The working voltage is generally 350V and capacity tolerance 1 or 2% with velues available from 2·2 to 12000pF (0·012μF).



Polystyrene capecitors are cylindrical in form with the plastic film forming the dielectric. Possessing high insulation resistance, stability is feir and a negative tempereture co-efficient makes these capacitors suitebla for temperature compensation purposes in oscillator circuits. Also suitable for coupling end decoupling at radio frequencies. Capecitances aveilable from 2·2pF to 0·1μF with tolerances of 2½ to 5% and working voltages of 125V or 250V.

Polyester capacitors ara also tubular, the dielectric this time being polyester plastic foil, again providing high insulation resistence and thus much superior to paper insulation in every respect. Stability is good end performance at r.f. fair. These capecitors can be used to replace peper ones in all non-critical applications. The range of capacitance is 0·01μF to 0·5μF with a tolerance of 10% end working voltages of 125V or 250V.

Polycarbonata capacitors are somewhet similar to paper cepacitors in performance, having poor stability and only fair capabilities from tha point of view of r.f. performence.

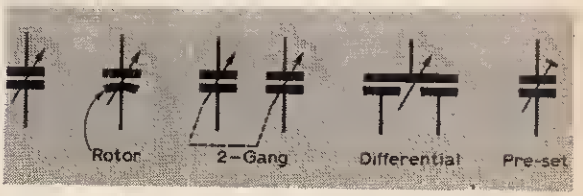
Caramic, tubuler capacitors hava good stebility characteristics together with known temperature co-efficients which mey be positive or negetive end sometimes included in the colour code merking. Hence these capacitors may be used to effect temperature compensation of tuned circuits with a fair amount of precision. Cara must be taken not to confuse these capacitors with the ceramic "High K" types which have a very high temperature co-efficient and are not particularly stable, being more suited for use es r.f. coupling and bypass capacitors. See table for colour coding.

CAPACITORS, variable

Veriable capacitors, like their fixed counterparts, come in a wide variety of sizas and values from the simplest two plate (vane) trimmer to tha multi-section tuning capacitor with a total of perhaps 120 vanes.

The moving plafes or rotor are usually electrically pert of the capecitor framework, the fixed vanes or stator being mounted in the framework on ceramic stand-off insulators to ensure minimum losses. Capacitors intended for use in oscillator circuits, where stability is most important, will heve a rotor bearing at each end of the framework while a single front beering is adequate for other uses.

The spacing between the vanes may only be a few thousendths of an inch in the case of miniature variable capacitors such es are used in transistor radios while those used in small trensmitters may have an air gap of a ¼in. depending upon the d.c. end r.f. voltages existing across the capacitor. In the process of miniaturisation the air dielectric is replaced by a plastic film considerably reducing the physical size of the unit for a given capactance.



Gangad capecitors may have ssveral sections mounted on a common spindle often with an end section of lower capacitanca then the others, for usa in tha oscillator circuit of a superhet receiver. Each section will have a built-in compression type trimmer for alignment purposes. Thesa trimmers ars not generally shown on circuit diagrams. Typical valuss for a two-gang unit are 176pF+208pF and, for a four-gang unit, 15pF+15pF+500pF+500pF, the latter being intended for use in an a.m./f.m. receiver.

Differential capacitors hava two stators arranged ebout a common rotor so that the capecitance of one is increesing while decreasing on the other, being, in effect, a cepacitative potentiometer.

The "law" of a capecitor relates the change in capecity with anguler movement of the rotor, common onas being SLF (streight line frequency) and SLW (straight line wavelength). In each case the dial celibration will be approximately linear. The law is determined by the shape of the rotor venes.

It is possible to obtein capacitors with integral slow-motion gearing obvieting the need for a seperate dial mechanism.

Trimmer capacitors are generally similar in construction to variable cepacitors except that the spindle is short and slotted to take a screwdriver. Air spaced trimmers are not generally available in values greater than 150pF. Ceramic trimmers ere fwo plate capacitors with the pletes in tha form of silver deposited on the ceramic base and ceremic disc rotor. The meximum velue of this type of trimmer is mostly under 50pF.

Compression type trimmers utilise mica or plastic film for the dielectric between a stack of plates the capacity being adjusted by means of a central screw altering the pressure on the plates. The minimum capacitance of this type of trimmer tends to be high but the maximum capacitance can be as much as 2000pF. Typical ranges are 10–80pF and 500–2000pF. These trimmers are commonly known as "padders" and are mainly used in the oscillator circuit of receivers.

CIRCUIT BOARDS

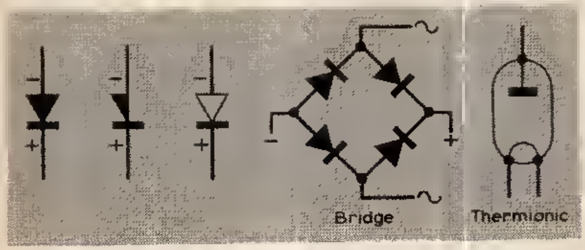
These are flat boards of insulating material on which components may be mounted and wired together to form electronic circuits. The insulation may be s.r.b.p. (synthetic resin bonded paper) or fibreglass. Boards may have the circuit printed on one side by depositing copper by chemical means, the components being interconnected with the circuit through small holes in the board. Copper clad boards having one side covered in copper can be used to form printed circuit boards by etching away the unwanted copper.

Other boards (Veroboard) have a series of copper strips on one side with a matrix of holes, usually of 0·10" or 0·15" spacing, along the strips thus enabling componants to be wired between the strips to form a circuit. Plain Veroboard is also available having the matrix of holes but no copper strips. Special pins are used with this board to which components and wiring may be connected.

Edge connector sockets can be fitted to electronic equipment enabling circuit boards to be rapidly inserted or removed for servicing.

DIODES

A diode is a simple rectifier capable of passing current essentially in one direction only and hence may be used to rectify a.c.



Thermionic diodes consist of a filament or heater, constituting the cathode, surrounded by a metal cylinder or anode, all enclosed in an evacuatad glass envelope. The diode may be a single unit or one or more may be incorporated with a triode or other valve. Power rectifiers consisting of two diodes, often with a common heater, are used in radio receivers and similar equipment to provide d.c. from an a.c. supply. Thermionic diodes or rectifiers are rapidly being replaced by silicon diodes which do not require a heater and are more efficient.

Semiconductor diodes are generally of silicon or germanium with a point contact or a junction of semiconductor materials. The smallest, a fraction of an inch long, are used for signal rectification and similar small signal purposes while the largest used in power supplies can pass several hundred amperes. Vast quantities of s.c. diodes are used in computers as high speed switches usually as part of integrated circuits. In a silicon diode the resistance in the forward direction is very low and high in the reverse direction. In a germanium diode the resistance in the reverse direction is appreciably lower than that of a silicon diode.

Semiconductor diodes are marked with a spot or a band or a plus sign indicating the end of the diode that will show a positive voltage when an a.c. voltage is applied to the diode. This end corresponds to the cathode in a thermionic rectifier.

A characteristic of diodes, quoted in maker's data, is the "peak inverse voltage" (PIV). This is the maximum peak voltage allowable across the diode during the non-conducting part of its operating cycle. In practice the p.i.v. will vary between 1·4 and 2·8 times the applied r.m.s. voltage depending upon the type of rectifier circuit employed.

INDUCTORS

While a straight wire possesses "inductance" the value of this inductance will be considerably increased if the wire is formed into a coil or inductor. An iron dust core inserted into the inductor will further increase this inductence.

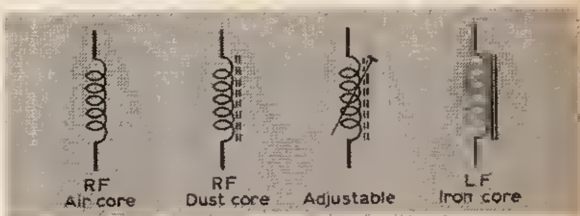
Practical Units: The henry (H), the millihenry (mH=1/1000H) and the microhenry (μH=1/1,000,000H).

LF Inductors, or chokes, are a single winding on an insulating former having a laminated core (see Transformers). The inductance will range from one or two henrys to around 50 henrys or so. These chokes offer high impedance to low frequencies and are used in audio amplifiers and filters, loudspeaker networks and as smoothing chokes in mains rectifier circuits.

RF Inductors, or coils, have a single winding, either layer or pile wound, on a low-loss former and may include an adjustable iron dust core for varying the inductence. If the coil is wound with heavy gauge wire the turns may be self-supporting. Windings of comparatively few turns may be added to the inductor to couple it to other circuits or to provide a feedback winding for use in oscillators.

Such inductors, with associated tuning capacitors, are found in r.f. amplifier, mixer and oscillator stages of receivers as well as in transmitters and signal generators and other test equipment. Although they are usually permanently wired into circuit they can be obtained mounted on a plug-in base for rapid coil changing.

The "goodness" or "Q" of an inductor may be enhanced by enclosing it in a ferrite "pot" with or without an adjustable iron dust core.



RF Chokes are inductors having a single winding, sometimes on a ferrite core, and of sufficiently large inductance to present a high impedance to specified radio frequencies. The winding may also be in the form of several separated pile wound sections in order to reduce the self-capacitence of the choke.

Values of inductance range from a few microhenrys for v.h.f. work to 30 millihenrys for the lower radio frequencies.

INTEGRATED CIRCUITS

The integrated circuit is produced by methods similar to those used in transistor manufacture and combines a number of discrete components on the one silicon chip. Apart from the transistors or diodes, resistors, capacitors

COMPONENTS DICTIONARY

and inductors can be formed as well as the necessary interconnections.

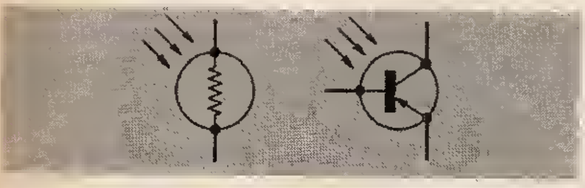
Linear i.c.'s include wideband, audio and operational amplifiers while digital i.c.'s are used in frequency counters, digital clocks, computers etc.

Integrated circuits may be encapsulated or mounted in metal cases. Lead-out wires or tags enable the device to be directly wired into a circuit board or plugged into a suitable holder.

PHOTOCONDUCTIVE CELLS

These devices are sensitive to light, either producing a voltage when subjected to sunlight as in the case of selenium and silicon photocells, or varying their internal resistance as with cadmium sulphide photocells. The latter are also known as light-dependent resistors (LDR).

The silicon and selenium cells will deliver enough power to operate a transistorised radio or even a small electric motor, a single silicon cell providing nearly half a volt at a current of 15mA.



With LDR's the effect of the varying resistance with changes of incident light can be amplified and used to actuate an alarm or counter or similar device. A typical LDR is the ORP12 which has a "dark resistance" of several megohms falling to a few hundred ohms with full illumination.

RESISTORS, fixed

Every electrical circuit possesses "resistance" which limits the current flowing in the circuit. Resistors of known value are used to introduce resistance into circuits, usually to a pre-arranged design.

Practical Units: The ohm (Ω), kilohm (kΩ=1000Ω) and the megohm (MΩ=1,000,000Ω).

Fixed resistors (carbon) are moulded from a special carbon composition, the connections to the resistor being in the form of wire ends. Resistors are given a wattage rating by the makers which represents the maximum power that the resistor may safely dissipate. Wattages generally available range from ⅛ watt to 2 watts in values from 1 ohm to 22 megohms.

The tolerances available on the nominal value are usually plus or minus (±) 5 and 10% although 20% was common in the recent past.

The stability of composition resistors is poor but their performance at radio frequencies can be considered fair while their change of value with change in temperature (temp. co-efficient) is poor being about ten times worse than a wire-wound resistor. Such resistors should only be used in non-critical applications.

High wattage carbon resistors, 25W or more, are often used as non-inductive loads for transmitters and amplifiers although they are somewhat difficult to obtain. Constructors can improvise by series/paralleling lower wattage resistors until the required value is obtained.

Fixed resistors (metal oxide/carbon film) are formed by deposition on to a ceramic tube or rod, their main advantage being that of high stability. Tolerances are generally 1 or 2%.

Their performance at r.f. is good although care should be taken in using them at v.h.f. or u.h.f. since the metal film is often in the form of a spiral which can introduce appreciable inductance at these frequencies. These resistors are particularly suitable for audio amplifiers and circuits where a low noise level is essential.

Fixed resistors (wire-wound) are composed of a layer of resistance wire on a ceramic tube or rod, with clips or wire ends, and generally having a coating of vitreous enamel or something similar. Some versions have one or more movable clips so that intermediate values of resistance can be had.

Wire-wound resistors must not be used in r.f. circuits since by the very nature of their construction they are highly inductive. Those with special windings and termed "non-inductive" should also be treated with some suspicion at r.f. On the credit side these resistors have a very low noise characteristic and low temperature co-efficient compared to carbon resistors.

Wire-wound resistors are available to the constructor in ratings from 1W to around 50W and in values from 0·22Ω to 100kΩ usually with a tolerance of 5%. Mains "dropper" resistors are a special breed of wire-wound resistor used in transformerless radios and TV sets and fitted in series with the valve heater chain. They may have adjustable clips or tapped sections.

Resistor values, for carbon resistors, are indicated by a colour coding, details of which are given in the accompanying table. If a tip or spot colour appears to be missing it can be assumed to have the same colour as the body of the resistor. For example, a resistor which is red all over has a value of 2·2kΩ and one with an orange body and a yellow spot only is 330kΩ.

The actual values of resistors in common use conform to the "E12 Series" of twelve values and their decades (see table) but there is also the "E24 Series" with a further twelve values intermediate with the E12 series. These are: 1·1, 1·3, 1·6, 2·0, 2·4, 3·0, 3·6, 4·3, 5·1, 6·2, 7·5 and 9·1 and their decades.

Wirewound resistors usually have their value marked in plain numbers.

RESISTORS, variable

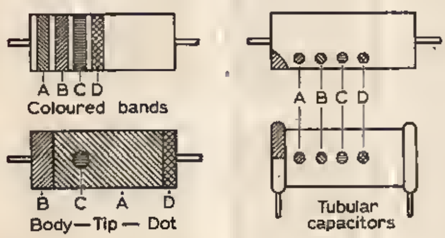
Like fixed resistors, these use either carbon composition or resistance wire for the resistance element. The moving arm or rotor moves over the element thus enabling any value between virtually zero and the value of the variable resistor to be selected. The rotor spindle is extended to take a control knob where frequent adjustment is required, such as with a volume control, or may be short and slotted for adjustment with a screwdriver as a preset control. Potentiometer or "pot" is the general name given to such variable resistors.

Carbon potentiometers have a moulded composition track or a carbon deposit on an insulating ring. The rotor contact, generally with two or more "fingers" to ensure continuous pressure on the track, is usually isolated from the spindla.

The amount of resistance in circuit ralative to the angular movament of the rotor constitutes the "law" of the potentiometer. If equal resistance change results from equal angular movement of the rotor tha potentiometer is said to be "linear". If the change is logarithmic the potentiometer is "log" law. If checked on a test meter such a potentiometer would show little change in resistance at the beginning of the movement (clockwise) and a very rapid change towards the end of the movement. An "anti-log" potentiometer will show the reverse effect.

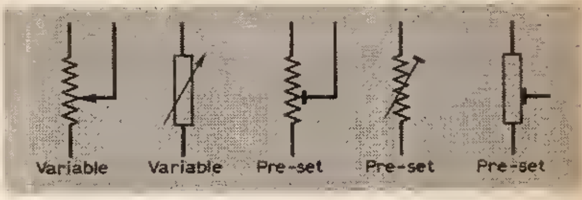
Log potentiometers are ganerally used as volumes controls on radios and audio amplifiers sinca the human aar responds to sound levels on a logarithmic basis. Such a volume control will appear to give equal changes in sound level for equal movement of the control.

Potentiometers can be obtained ganged together with a common spindle or with concentric spindles for independent operation. On stereo amplifiers ganged potentiometers are used for volume controls, filter adjustments, balancing and similar circuits where both amplifiers must be adjusted simultaneously. It is common practice to fit a volume control with a single or double pole mains on/off switch oparated by the rotor of the potentiometer at the beginning of its travel.



Values of carbon potentiometers go from around 100Ω to about 2MΩ. Wattage ratings are not always quoted since thasa controls are not usually called upon to pass any appreciable current.

Pre-set carbon potentiometers may be of completely enclosed construction or open skeleton type. The latter generally hava wire lead-outs or tags suitable for direct mounting on circuit boards.



Wirewound potentiometers are similar in most respects to the carbon ones except that the resistance element consists of resistance wire wound on to a flat insulating strip which is then formed into a ring, the rotor generally moving round one edge of the ring.

Values of these potentiometers of interest to the constructor run from 10Ω to 100kΩ in ratings from 1 to 3W. Again, mains on/off switches can be fitted if required.

Precision wirewound potentiometers have the winding in helical form needing perhaps ten or more turns of the control spindle to cover the whole winding. A turns counter is fitted to the spindle. Preset wirewound potentiometers for use on circuit boards have a straight winding with a sliding contact operated by a screw thread, the whole enclosed in a plastic moulding. For use in adverse conditions of dirt or moisture both carbon and wirewound potentiometers can be had as hermetically sealed units.

SWITCHES

The simplest device for making or breaking a circuit is the on/off switch and from this devolves a multiplicity of types.

COLOUR CODE FOR CAPACITORS AND RESISTORS

	First Figure 'A'	Sec'd Figure 'B'	Multiplier 'C'		Tolerance 'O'		
			Resistors	Caps pF	Res	Ceramic Capacitors to 10pF	Ceramic Capacitors over 10pF
Black	—	0	1	1	—	2pF	±20%
Brown	1	1	10	10	±1%	0·1pF	±1%
Red	2	2	100	100	±2%	—	±2%
Orange	3	3	1,000	1,000	—	—	±2½%
Yellow	4	4	10,000	10,000	—	—	—
Green	5	5	100,000	—	—	0·5pF	±5%
Blue	6	6	1,000,000	—	—	—	—
Violet	7	7	10,000,000	—	—	—	—
Grey	8	8	100,000,000	0·01μF	—	0·25pF	—
White	9	9	1,000,000,000	0·1μF	—	1pF	±10%
No colour	—	—	—	—	±20%	—	—
Silver	—	—	—	—	±10%	—	—
Gold	—	—	—	—	±5%	—	—

A salmon-pink fifth ring or body colour danotes a Grade 1 high-stability composition resistor. There are variations in the code for capacitors other than ceramic tubular typas.

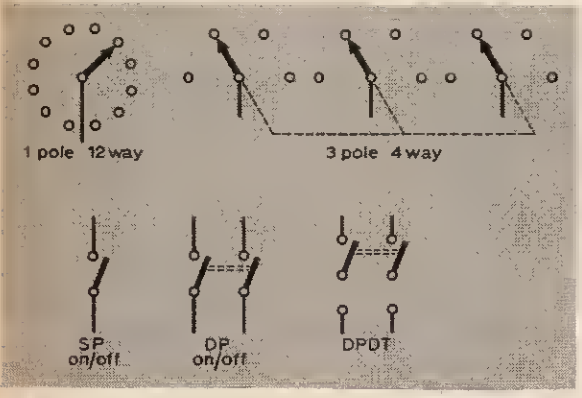
The "preferred" series of values is as follows:—1·0 1·2 1·5 1·8 2·2 2·7 3·3 3·9 4·7 5·6 6·8 8·2 and thair decades.

COMPONENTS DICTIONARY

Toggle switches have a laminated or moulded body with a metal or insulated dolly or operating lever. Switch contact combinations include single pole, single throw, (s.p.s.t.), double pole, single or double throw (d.p.s.t. and d.p.d.t.) and double pole change-over. Some types are obtainable with a centre off position. The dolly may be slotted for operation from a cam on an associated control. Other variations include biasing in one position, terminal or tag connections and instrument type toggles which are designed to have very low contact resistance for instrument use.

The ordinary toggle is designed to carry 3A at 250V a.c. with other ratings up to 10A.

Other switches performing the same function as toggle switches include rotary toggle switches, miniature slide switches and press button switches although these are generally s.p.s.t. only.



Microswitches are button operated switches capable of operation with pressures as low as 1 ounce usually by means of a lever or similar attachment. Contact arrangements are fairly simple, on/off or s.p.d.t. the contacts themselves handling 6A at 12V a.c. or 3A at 250V a.c. although models are obtainable for up to 10A.

Wafer rotary switches consist of a flat ring of paxolin insulating material with fixed contacts riveted around the periphery. A disc in the centre of the ring carries the rotor contacts, the disc being rotated by a spindle attached to an index plate. The maximum number of fixed contacts is generally 12 with a maximum of four on the rotor giving various combinations such as 1 pole, 12 way to 4 pole, 3 way.

Since the wafers are very thin several may be mounted on one spindle, sometimes with metal screens between sections to reduce unwanted coupling. These switches are widely used as wavechange switches on radios, audio filters and tone control circuits as well as in meters and test equipment.

Mains switches are available for use with wafer switch assemblies since the wafers themselves should not be used for this purpose. The contects are not designed to carry any appreciable current. Wafers in ceramic or other low-loss materials are available for switching r.f. circuits. The switches can be bought as complete units or the individual wafers and parts obtained end assembled to suit particular requirements.

THERMISTORS

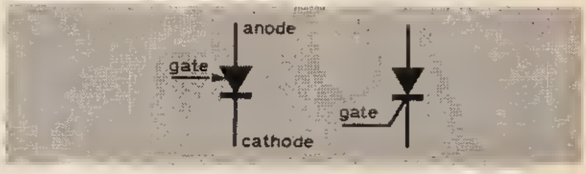
Thermistors are a special kind of resistor having a pronounced negative temperature co-efficient. They are used in circuits, such as valve heater chains, to restrict initial current surges when first switching on. The initial high resistance of the thermistor drops logarithmically as the protected device warms up.

The thermistor is also used to protect photo flood lamps from current surges and in temperature sensitive fire alarm systems. Audio signal generetors and oscillators utilise the thermistor in feedback circuits to provide a constant output. Bead type thermistors are used in these circuits since their reaction time to current changes is comparatively short. Bead types can also be employed in measuring r.f. power especially at very high frequencies.

Thermistors in generel use have current ratings renging from 2mA to 2A.

THYRISTORS

Also known as silicon controlled rectifiers (SCR) the thyristor is basically a silicon diode rectifier with an additional electrode or "gate" which is used to control the current flowing through the thyristor. A pulse applied to the gate can switch the thyristor on or off. Once the thyristor is conducting a minimum current is required to maintain conduction.



Thyristors used by the constructor will have current ratings between 1 and 10A and peak voltage ratings up to 600V. The p.i.v. figure required for a particular application will be approximately 1½ times the applied r.m.s. voltage.

The gate trigger circuit will need to provide a voltage of the order of 3V at a current of up to 20mA. Small current thyristors are generally contained in a TO5 type metal case with wire lead-outs while the larger thyristors have a stud mounting and tag connectors.

TRANSFILTERS

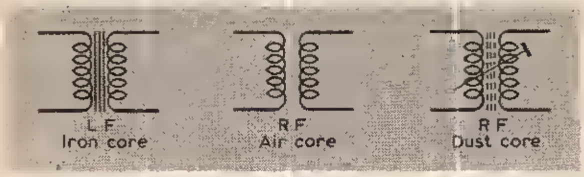
Transfilters are ceramic filters having somewhat similar characteristics to those of the conventional i.f. transformer. Several transfilters may be combined with capacitors to provide specified bandpass filter features. Several types of transfilter are available around 455kHz as well as for 10·7MHz for use in the i.f. stages of f.m. receivers. Since transfilters do not require any alignment in a receiver they are gradually replacing the tuned i.f. transformers in commercial receivers.

TRANSFORMERS

Basically two coils coupled together so that an alternating current in one coil, the primary, will induce an alternating current in the second coil, the secondary. The ratio of the input voltage, producing the current in the primary, to the voltage et the secondary is directly proportional to the turns ratio of the two coils.

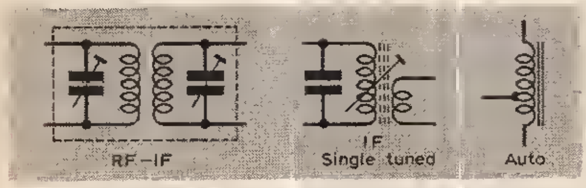
In this way the transformer can be used to match one impedance to another.

LF Transformers are wound on a laminated core of ferromegnetic material, the laminations being electrically insuleted from each other. Mains transformers may heve extra windings for valve heaters, pilot lamps etc. as well as taps on the primary winding to accommodate variations in mains supply voltages.

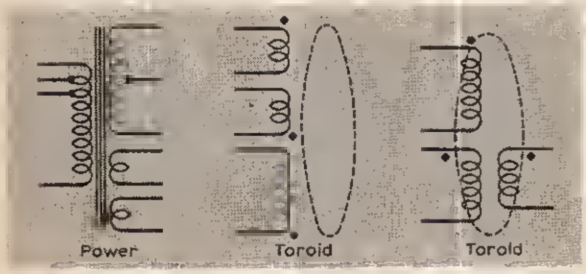


RF Transformers have coils wound in layer or pile-wound form, or air-spaced, on insulating formers often with iron dust cores or slugs to enable each winding to be separately tuned.

IF Transformers are similar to r.f. trensformers, being designed to work at the fixed intermediate frequency in superhet receivers, usuelly between 450 to 475kHz or around 1·6MHz. As well as dust cores each winding generally has a fixed capacitor across it in order to obtain the optimum inductance to capacitance ratio.



Autotransformers have a single tapped winding the ratio of the turns each side of the tap providing the required transformation ratio. One winding may be common to both circuits providing an alternative ratio. Note thet an autotransformer does not provide the isolation obtainable with a double wound transformer. A common form of autotransformer is the *Variac* used for compensating changes in mains supply voltages.



Toroid transformers have the windings wound on an annular ferrite core. The separate wires comprising the windings are laid or twisted together and then wound round the ferrite ring. On the circuit symbol the start of each winding is marked with a dot to assist in identification.

TRANSISTORS

The transistor is a three electrode semiconductor device capable ot amplifying an electrical signal. The semiconductor materials used in making transistors are either silicon or germanium although there are others such as selenium.

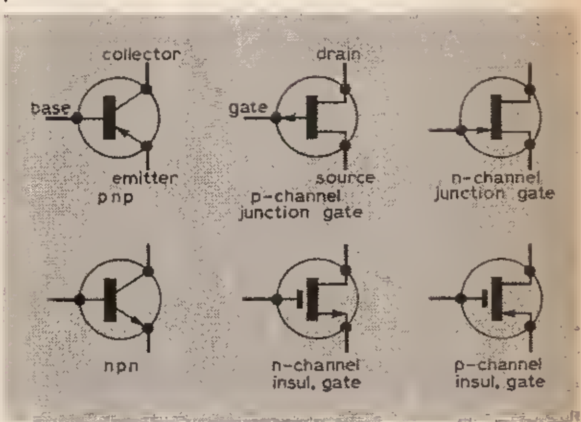
The pure silicon or germanium is treated with either of two impurities in minute quantities to produce 'p' end 'n' type silicon end germanium. A junction of silicon p and n material will show a high resistance in one direction and a low resistance in the other thus forming a diode. A germanium diode similarly formed will not show such a wide change in resistance.

A p-n-p transistor is formed from a thin slice of n material sandwiched between two pieces of p material, the slice being known es the base and the p material es the emitter and collector respectively. An n-p-n transistor has a slice of p material between two pieces of n material.

With an n-p-n transistor the emitter voltage must always be negative with respect to the collector and the emitter of a p-n-p transistor positive with respect to the collector. N-P-N and p-n-p transistors can have very similar characteristics in which case they are said to be "complementary".

Many different processes are used in the manufecture of transistors producing devices of widely varying characteristics and types:

Alloy trensistors were among the earliest types produced. The germanium alloy transistors are cheap to produce but do not have a very good pertormance et high frequencies. They ere widely used as power transistors since their low resistance permits the maximum current to be passed at low voltages. Silicon alloy trensistors are used mainly because of their ability to operate at high temperatures.



Alloy-diffused transistors have improved performence with a cut-off frequency of the order of 100MHz and being cheap to produce are widely used in radio receivers.

Mesa transistors with a cut-off frequency of over 1000MHz are among the best at high frequencies.

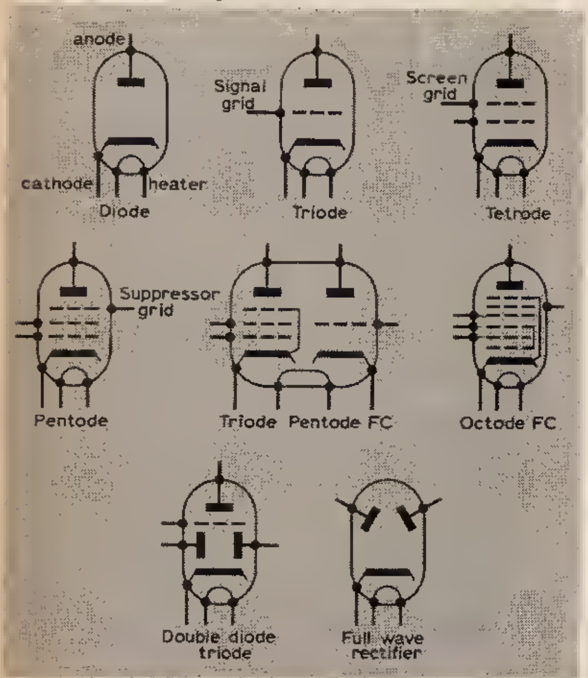
Planar and epitaxial planar transistors have been developed to reduce the collector leakage current and also to include a shield to reduce the cepacitance existing between the collector and base electrodes.

Field effect transistors are unipolar as distinct from those listed above which are bi-polar. F.E.T.'s are more akin to the thermionic valve than any previous transistors. While bi-polar transistors are essentially current operated devices and have a low input resistance f.e.t.'s are voltage controlled and consequently have a very high input resistance. The controlling "gate" may be either a junction type (j.u.g.f.e.t.) or insulated type gate (i.g.f.e.t.) either type being obtaineble as p-channel or n-channel f.e.t. The i.g.f.e.t. is also known es the metal oxide silicon f.e.t. (m.o.s.f.e.t.).

COMPONENTS DICTIONARY

VALVES

Thermionic valves contain a filament or heater/cathode which emits electrons, with one or more other electrodes, all contained in an evacuated glass envelope. The four basic types of valve are the diode, triode, tetrode/pentode and frequency changer or mixer.



The Diode comprises the cathode and a metal plate or cylinder called the anode. Small single or double diode units are used for signal rectification in detectors and a.g.c. circuits. Larger single or double units are employed in half and full wave power rectifier circuits. A special use for diodes is in the line scanning circuits of TV sets where they are known as "efficiency diodes".

One or more diodes are frequently found in a common structure with triodes and pentodes where they are associated with the signal circuits.

The Triode has a wire mesh, the signal grid, placed between the cathode and the anode. A negative voltage on the grid controls the anode current enabling the triode to be used as an a.f. amplifier or oscillator at a.f. or r.f. A triode is commonly incorporated with a pentode where it acts as a preamplifier.

The Tetrode has a second grid placed between the signal grid and the anode. This "screen grid" reduces inter-electrode capacitance and overcomes a deficiency of the triode known as the "space charge effect".

The Pentode has yet another grid, the suppressor grid, between the screen grid and the anode, which eliminates the kink in the characteristic curve of the tetrode caused by secondary emission. In "beam" tetrodes this third grid is omitted but its effect is simulated by the careful placement of the anode with respect to the other electrodes. Tetrodes and pentodes are used for both r.f. and a.f. work.

Frequency changers, or mixers, are used in superhets to produce the intermediate frequency (i.f.) from the input signal and the local oscillator signal. The mixer valve takes the form of a pentode or tetrode with additional grids to which these signals are applied. Some frequency changers incorporate a separate triode for the local oscillator feeding internally or externally into the mixer section.

Battery type valves have 1·4V filaments for operation from a single cell, taking a current of 25 or 50mA. The maximum anode voltage is generally 90V. Valves fed from a mains supply may have 6·3V heaters which are connected in parallel each heater taking anything from 200 to 600mA. Dual section valves sometimes have heaters with a centre tap allowing operation in series on 12·6V or in parallel on 6·3V.

Other mains operated valves have the heaters in series based on a common current of 100, 150 or 300mA with individual heater voltages of 4 up to 50V. In a.c./d.c. receivers and TV sets the heater chain may be connected across the mains, the difference between the sum of the heater voltages and the mains voltage being taken up by a "dropper" resistor (see Resistors, fixed).

VARICAP DIODES

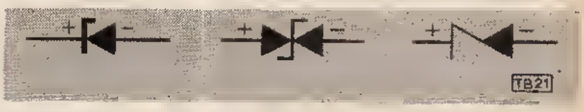
Varicap Diodes, sometimes known as varactors, are similar to semiconductor p-n junction diodes in that the capacity existing between the regions varies with the applied reverse voltage. Varicap diodes provide known changes of capacity over a given range of reverse voltage, typically 50 to 10pF for a range of 1 to 20 volts.

These diodes can thus be used to tune r.f. circuits by means of a potentiometer controlling the applied reverse voltage. They are useful up to frequencies of several hundred MHz and are currently being employed commercially in v.h.f. receivers and t.v. tuners.

ZENER DIODES

The zener diode is a semiconductor diode which breaks down and conducts when a voltage applied in the reverse direction reaches a predetermined value. The action is somewhat similar to that of a gas filled voltage stabiliser.

The external circuitry of a zener diode must be designed so that its rated power dissipation is not exceeded.



Zener diodes of interest to the constructor are available with nominal zener voltages ranging from 2·4V to 200V with tolerances from 5 to 20% and dissipations from 200mW to 20W. These diodes are used as voltage stabilisers, voltage reference sources, limiters etc.

The end of a zener diode intended to be connected to the positive side of a supply is usually marked with a spot or band or a plus sign.