Computer Engineering Drafting and Design

Chapter 2

Electrical, Electronic and Logic Components

Lesson 2

Electrical, Electronic and Logic Components Diagram

Introduction

This standard contains definitions and general information applicable to most of the commonly used Electrical and Electronics Diagrams. It also includes detailed recommendations on preferred practices for use in the preparation of Electrical and Electronics Diagrams. The recommended practices covered by this standard are ground rules designed to eliminate divergent Electrical and Electronics Diagram drafting techniques. The illustrations shown represent good drafting practices. They are not intended as engineering design guides.

Specific Objectives

At the end of the lesson, the students should be able to:

- Familiarize in electronic and electrical symbols.
- Able to familiarize and identify the different types of electronic and electrical components
- Able to read resistor value using color code.

Duration

Lesson 2:	Electrical, Electronic and Logic Components Diagram	= 9 hours (7 hours discussion; 2 hours assessment)

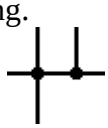
Circuit symbols

An electronic symbol is a pictogram used to represent various electrical and electronic devices or functions, such as wires, batteries, resistors, and transistors, in a schematic diagram of an electrical or electronic circuit. These symbols are largely standardized internationally today, but may vary from country to country, or engineering discipline, based on traditional conventions.

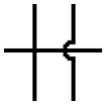
Wire Symbols

Electrical Wire – Conductor of electrical current.

Connected Wires – Connected crossing.

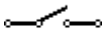


Not Connected Wires – Wires are not connected.

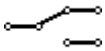


Switch Symbols and Relay Symbols

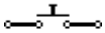
SPST Toggle Switch – Disconnects current when open.



SPDT Toggle Switch – Selects between two connections.



Pushbutton Switch (N.O) – Momentary switch - Normally Open.



Pushbutton Switch (N.C) – Momentary switch - Normally Closed.

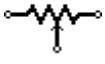
Ground Symbols

Earth Ground – Used for zero potential reference and electrical shock protection.

Resistor Symbols

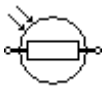
Resistor – Resistor reduces the current flow.

Potentiometer – Adjustable resistor - has 3 terminals.



Thermistor – Thermal resistor - change resistance when temperature changes.

Photoresistor / Light dependent resistor (LDR) – Photo-resistor - change resistance with light intensity change.

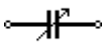


Capacitor Symbols

Capacitor – Capacitor is used to store electric charge. It acts as short circuit with AC and open circuit with DC.

Polarized Capacitor – Electrolytic capacitor.

Variable Capacitor Adjustable capacitance.



Inductor / Coil Symbols

Inductor – Coil / solenoid that generates magnetic field.

Power Supply Symbols

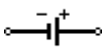
Voltage Source – Generates constant voltage.

Current Source – Generates constant current.

AC Voltage Source – AC voltage source.

Generator – Electrical voltage is generated by mechanical rotation of the generator.

Battery Cell – Generates constant voltage.



Battery – Generates constant voltage.

Controlled Voltage Source – Generates voltage as a function of voltage or current of other circuit element.

Controlled Current Source – Generates current as a function of voltage or current of other circuit element.

Meter Symbols

Voltmeter – Measures voltage. Has very high resistance. Connected in parallel.

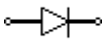
Ammeter – Measures electric current. Has near zero resistance. Connected serially.

Ohmmeter – Measures resistance.

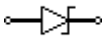
Wattmeter – Measures electric power.

Diode / LED Symbols

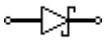
Diode – Diode allows current flow in one direction only - left (anode) to right (cathode).



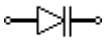
Zener Diode – Allows current flow in one direction, but also can flow in the reverse direction when above breakdown voltage.



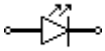
Schottky Diode – Schottky diode is a diode with low voltage drop.



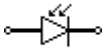
Varactor / Varicap Diode – Variable capacitance diode.



Light Emitting Diode (LED) – LED emits light when current flows through.



Photodiode – Photodiode allows current flow when exposed to light.



Transistor Symbols

NPN Bipolar Transistor – Allows current flow when high potential at base (middle).

PNP Bipolar Transistor – Allows current flow when low potential at base (middle).

JFET-N Transistor – N-channel field effect transistor.

JFET-P Transistor – P-channel field effect transistor.

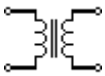
NMOS Transistor – N-channel MOSFET transistor.

PMOS Transistor – P-channel MOSFET transistor.

Misc. Symbols

Motor – Electric motor.

Transformer – Change AC voltage from high to low or low to high.



Electric bell – Rings when activated.

Buzzer – Produce buzzing sound.

Fuse – The fuse disconnects when current above threshold. Used to protect circuit from high currents.

Loudspeaker – Converts electrical signal to sound waves.

Microphone – Converts sound waves to electrical signal.

Electronic Devices

Every electronic appliance we use in our day-to-day life, such as mobile phones, laptops, refrigerators, computers, televisions and all other electrical and electronic devices are manufactured with some simple or complex circuits. Electronic circuits are realized using multiple electrical and electronic components connected with each other by connecting wires or conducting wires for the flow of electric current through the multiple components of the circuit, such as resistors, capacitors, inductors, diodes, transistors, and so on.

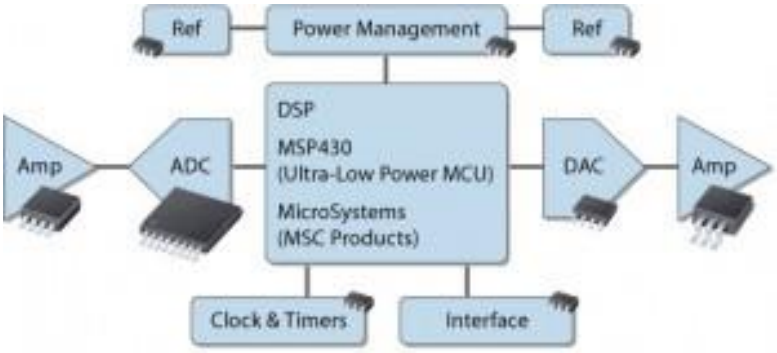
Circuits can be classified into different types based on different criteria, such as, based on connections: series circuits and parallel circuits; based on the size and manufacturing process of circuit: integrated circuits and discrete circuits; and, based on signal used in circuit: analog circuits and digital circuits.

Integrated Circuit

Integrated circuit or IC or microchip or chip is a microscopic electronic circuit array formed by the fabrication of various electrical and electronic components (resistors, capacitors, transistors, and so on) on a semiconductor material (silicon) wafer, which can perform operations similar to the large discrete electronic circuits made of discrete electronic components.

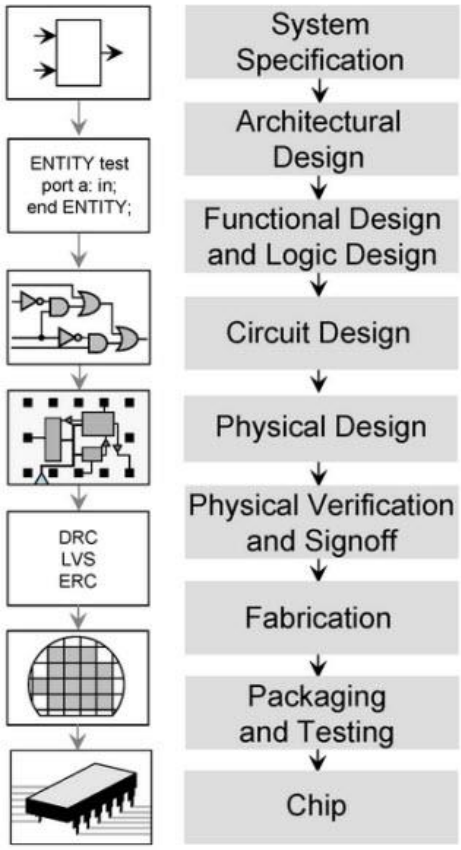
Different Types of Integrated Circuits

There are different types of ICs; classification of Integrated Circuits is done based on various criteria. A few types of ICs in a system are shown in the below figure with their names in a tree format.



Based on the intended application, the IC is classified as analog integrated circuits, digital integrated circuits, and mixed integrated circuits.

- **Digital Integrated Circuits**
  The integrated circuits that operate only at a few defined levels instead of operating overall levels of signal amplitude are called Digital ICs and these are designed by using multiple numbers of digital logic gates, multiplexers, flip flops, and other electronic components of circuits. These logic gates work with binary input data or digital input data, such as 0 (low or false or logic 0) and 1 (high or true or logic 1).



The above figure shows the steps involved in designing typical digital integrated circuits. These digital ICs are frequently used in computers, microprocessors, digital signal processors, computer networks, and frequency counters. There are different types of digital ICs or types of digital integrated circuits, such as programmable ICs, memory chips, logic ICs, power management ICs and interface ICs.

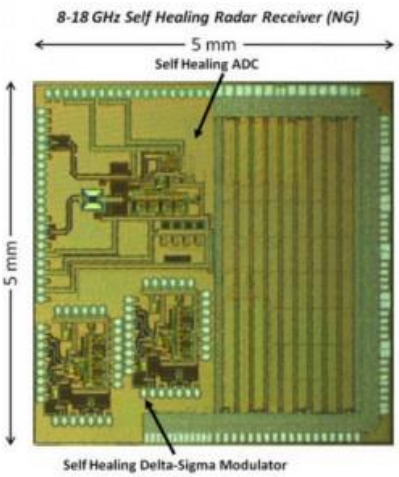
- **Analog Integrated Circuits**
  The integrated circuits that operate over a continuous range of signals are called Analog ICs. These are subdivided into linear Integrated Circuits (Linear ICs) and **Radio Frequency** Integrated Circuits (RF ICs). In fact, the relationship between the voltage and current may be nonlinear in some cases over a long range of the continuous analog signal.

  The frequently used analog IC is an operational amplifier or simply called an op-amp, similar to the differential amplifier, but possesses a very high voltage gain. It consists of a very less number of transistors compared to the digital ICs, and, for developing analog application-specific integrated circuits (analog ASICs), computerized simulation tools are used.

  - **Linear Integrated Circuits**
    In an analog integrated circuit, if a linear relation among its voltage as well as current exists then it is known as linear IC. The best example of this linear IC is.741 IC, is an 8-pin DIP (Dual In-line Package) op-amp,

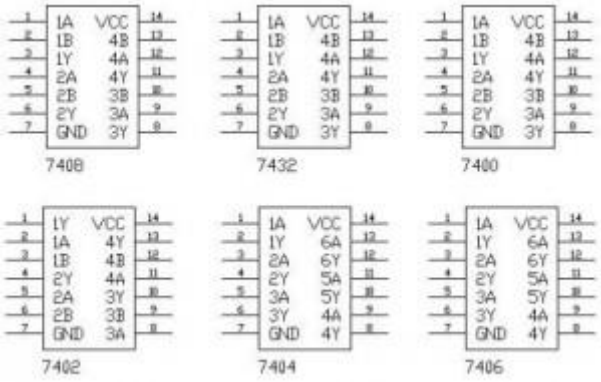
  - **Radio Frequency Integrated Circuits**
    In analog IC, if a non-linear relation among its voltage and current exists then it is called radiofrequency ICs. This kind of IC is also known as a radio frequency integrated circuit.

- **Mixed Integrated Circuits**
  The integrated circuits that are obtained by the combination of analog and digital ICs on a single chip are called Mixed ICs. These ICs functions as Digital to Analog converters, Analog to Digital converters (D/A and A/D converters), and clock/timing ICs. The circuit depicted in the above figure is an example of the mixed integrated circuit which is a photograph of the 8 to 18 GHz self-healing radar receiver.

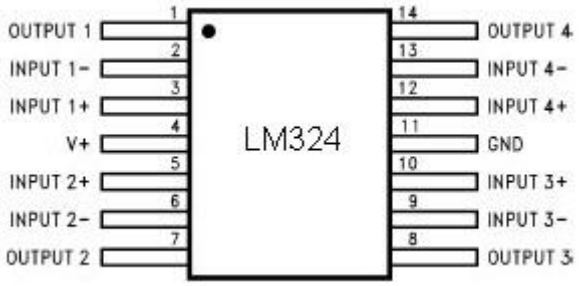


This mixed-signal Systems-on-a-chip is a result of advances in the integration technology, which enabled to the integration of digital, multiple analogs, and RF functions on a single chip.

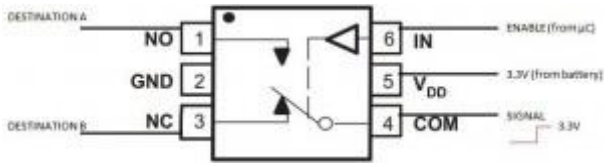
- **Logic Circuits**
  These ICs are designed using logic gates-that work with binary input and output (0 or 1). These are mostly used as decision-makers. Based on the logic or truth table of the logic gates, all the logic gates connected in the IC give an output based on the circuit connected inside the IC- such that this output is used for performing a specific intended task. A few logic ICs are shown below.



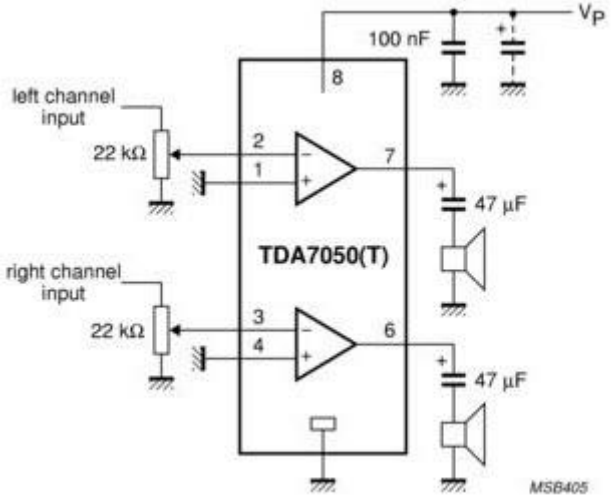
- **Comparators IC**
  The comparator ICs are used as comparators for comparing the inputs and then to produce an output based on the ICs' comparison.



- **Switching ICs**
  Switches or Switching ICs are designed by using the transistors and are used for performing the **switching operations**. The above figure is an example showing an SPDT IC switch.



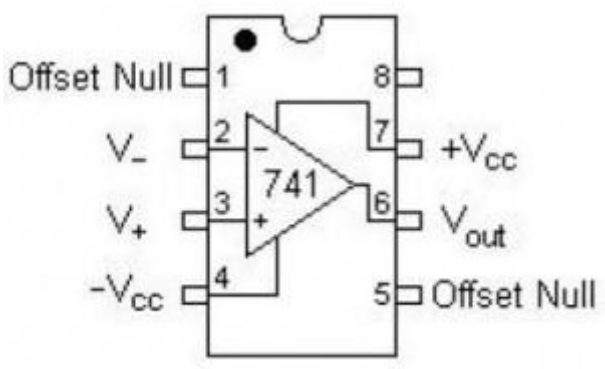
- **Audio Amplifiers**
  The audio amplifiers are one of the many types of ICs, which are used for the amplification of the audio. These are generally used in audio speakers, television circuits, and so on. The above circuit shows the low- voltage audio amplifier IC.



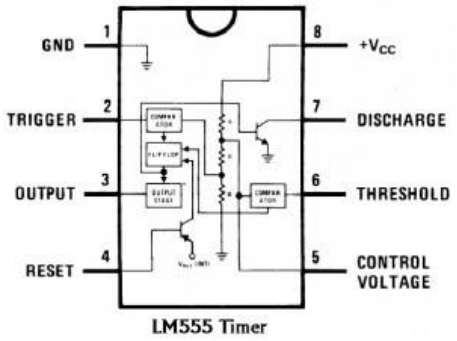
- **CMOS Integrated Circuit**
  CMOS integrated circuits are extremely used in different applications as compared with FETs because of their capabilities like lower threshold voltage, low-power consumption. A CMOS IC includes P-MOS & N-MOS devices which are fabricated jointly on a similar chip. The structure of this IC is a Polysilicon gate that aids to decrease the device's threshold voltage, therefore allowing process at low-voltage levels.

- **Voltage Regulator ICs**
  This kind of integrated circuit provides a stable DC output despite the changes within DC input. The commonly used type regulators are LM309, uA723, LM105 & 78XX ICs.

- **Operational Amplifiers**
  The operational amplifiers are frequently used ICs, similar to the audio amplifiers which are used for the audio amplification. These op-amps are used for amplification purposes, and these ICs work similarly to the **transistor** amplifier circuits. The pin configuration of the 741 op-amp IC is shown in the figure.



- **Timer ICs**
  Timers are special-purpose integrated circuits used for the purpose of counting and to keep a track of time in intended applications. The block diagram of the internal circuit of the **LM555 timer IC** is shown in the above circuit. Based on the number of components used (typically based on the number of transistors used), they are as follows



LM555 Timer

  - **Small-scale Integration** consists of only a few transistors (tens of transistors on a chip), these ICs played a critical role in early aerospace projects.

  - **Medium-scale Integration** consists of some hundreds of transistors on the IC chip developed in the 1960s and achieved better economy and advantages compared to the SSI ICs.

  - **Large-scale Integration** consists of thousands of transistors on the chip with almost the same economy as medium-scale integration ICs. The first microprocessor, calculator chips, and RAMs of 1Kbit developed in the 1970s had below four thousand transistors.

  - **Very Large-scale Integration** consists of transistors from hundreds to several billion in number.(Development period: from the 1980s to 2009)

  - **Ultra large-scale Integration** consists of transistors in excess of more than one million, and later wafer-scale integration (WSI), system on a chip (SoC), and three-dimensional integrated circuit (3D-IC) were developed.

All these can be treated as generations of integrated technology. ICs are also classified based on the fabrication process and packing technology. There are numerous types of ICs among which, an IC will function as a timer, counter, register, amplifier, oscillator, logic gate, adder, microprocessor, and so on.

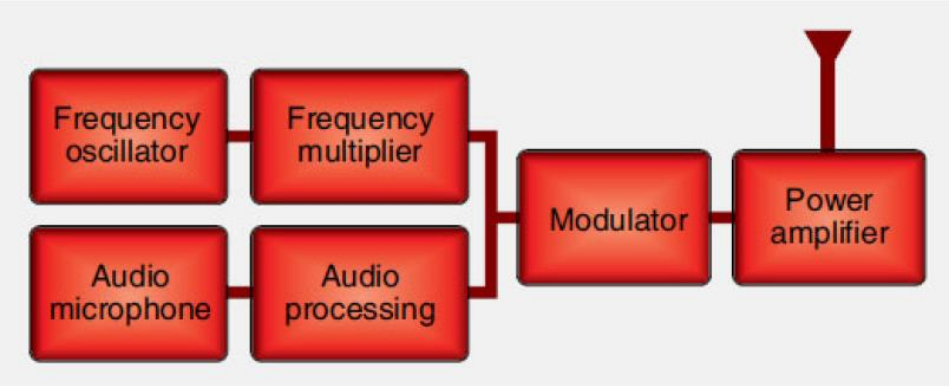
Transmitters

A transmitter consists of a precise oscillating circuit or oscillator that creates an AC carrier wave frequency. This is combined with amplification circuits or amplifiers. The distance a carrier wave travels is directly related to the amplification of the signal sent to the antenna.

Other circuits are used in a transmitter to accept the input information signal and process it for loading onto the carrier wave. Modulator circuits modify the carrier wave with the processed information signal. Essentially, this is all there is to a radio transmitter.

NOTE: Modern transmitters are highly refined devices with extremely precise frequency oscillation and moulation. The circuitry for controlling, filtering, amplifying, modulating, and oscillating electronic signals can be complex.

A transmitter prepares and sends signals to an antenna that, in the process described above, radiates the waves out into the atmosphere. A transmitter with multiple channel (frequency) capability contains tuning circuitry that enables the user to select the frequency upon which to broadcast. This adjusts the oscillator output to the precise frequency desired. It is the oscillator frequency that is being tuned. most radio transmitters generate a stable oscillating frequency and then use a frequency multiplier to raise the AC to the transmitting frequency. This allows oscillation to occur at frequencies that are controllable and within the physical working limits of the crystal in crystal-controlled oscillators.



Receivers

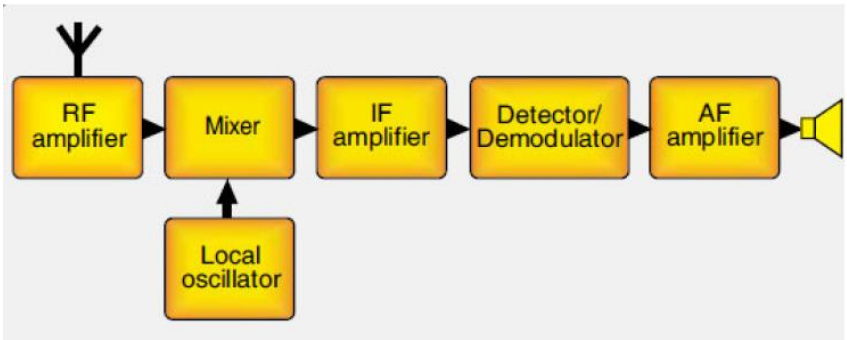
Antennas are simply conductors of lengths proportional to the wavelength of the oscillated frequency put out by the transmitter. An antenna captures the desired carrier wave as well as many other radio waves that are present in the atmosphere. A receiver is needed to isolate the desired carrier wave with its information. The receiver also has circuitry to separate the information signal from the carrier wave. It prepares it for output to a device, such asspeakers or a display screen. The output is the information signal originally introduced into the transmitter.

A common receiver is the super heterodyne receiver. As with any receiver, it must amplify the desired radio frequency captured by the antenna since it is weak from

traveling through the atmosphere. An oscillator in the receiver is used to compare and select the desired frequency out of all of the frequencies picked up by the antenna. The undesired frequencies are sent to ground.

A local oscillator in the receiver produces a frequency that is different than the radio frequency of the carrier wave. These two frequencies are mixed in the mixer. Four frequencies result from this mixing. They are the radio frequency, the local oscillator frequency, and the sum and difference of these two frequencies. The sum and difference frequencies contain the information signal.

The frequency that is the difference between the local oscillator frequency and the radio frequency carrier wave frequency is used during the remaining processing. In VHF aircraft communication radios, this frequency is 10.8 MHz called the intermediate frequency, it is amplified before it is sent to the detector. The detector, or demodulator, is where the information signal is separated from the carrier wave portion of the signal. In AM, since both sidebands contain the useful information, the signal is rectified leaving just one sideband with a weak version of the original transmitter input signal. In FM receivers, the varying frequency is changed to a varying amplitude signal at this point. Finally, amplification occurs for the output device.



Over the years, with the development of transistors, micro transistors, and integrated circuits, radio transmitters and receivers have become smaller. Electronic bays were established on older aircraft as remote locations to mount radio devices simply because they would not fit in the flight deck. Today, many avionics devices are small enough to be mounted in the instrument panel, which is customary on lightest aircraft. Because of the number of communication and navigation aids, as well as the need to present an uncluttered interface to the pilot, most complicated aircraft retain an area away from the flight deck for the mounting of avionics. The control heads of these units remain on the flight deck.

Transceivers

A **transceiver** is a communication radio that transmits and receives. The same frequency is used for both. When transmitting, the receiver does not function. The push to talk (PTT) switch blocks the receiving circuitry and allows the transmitter circuitry to be active. In a transceiver, some of the circuitry is shared by the transmitting and receiving functions of the device. So is the antenna. This saves space and the number of components used. Transceivers are half duplex systems where communication can occur

in both directions but only one party can speak while the other must listen. VHF aircraft communication radios are usually transceivers.

Basic Components Used in Electronics & Electrical

In any electronic circuit, we come across two types of electronic component: One which response to the flow of **electrical energy** and either store or dissipate energy. These are the Passive Components. They can be linear components with a linear response to the electrical energy or nonlinear components with a nonlinear response to the electrical energy.

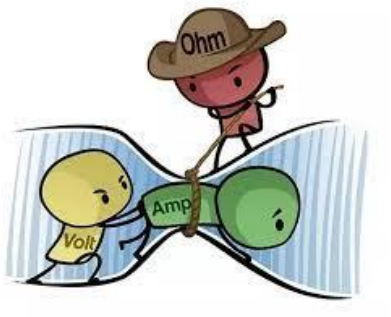
One which supplies energy or controls the flow of energy. These are the Active components. They require an external power source to be triggered and are generally used to amplify an electrical signal. Let us see every component in detail.

Passive Linear Components:

Passive components cannot control electric current utilizing a second electrical signal. Some important passive components are capacitors, resistors, inductors, and transformers. Passive components do not require energy to operate barring the AC circuit. Unlike the Active component, they are unable to augment the signal power and also cannot amplify it.

- **Resistor**
  A resistor is an electronic component that is used to resist the flow of current and cause a reduction in potential. It consists of a low conductive component joined by conducting wires at both ends. When current flows through the resistor, the electrical energy is absorbed by the resistor and dissipated in the form of heat. The resistor thus offers a resistance or opposition to the flow of current.

  - **Resistance**
    The resistance provides the required reduction in current or the desired drop in voltage.

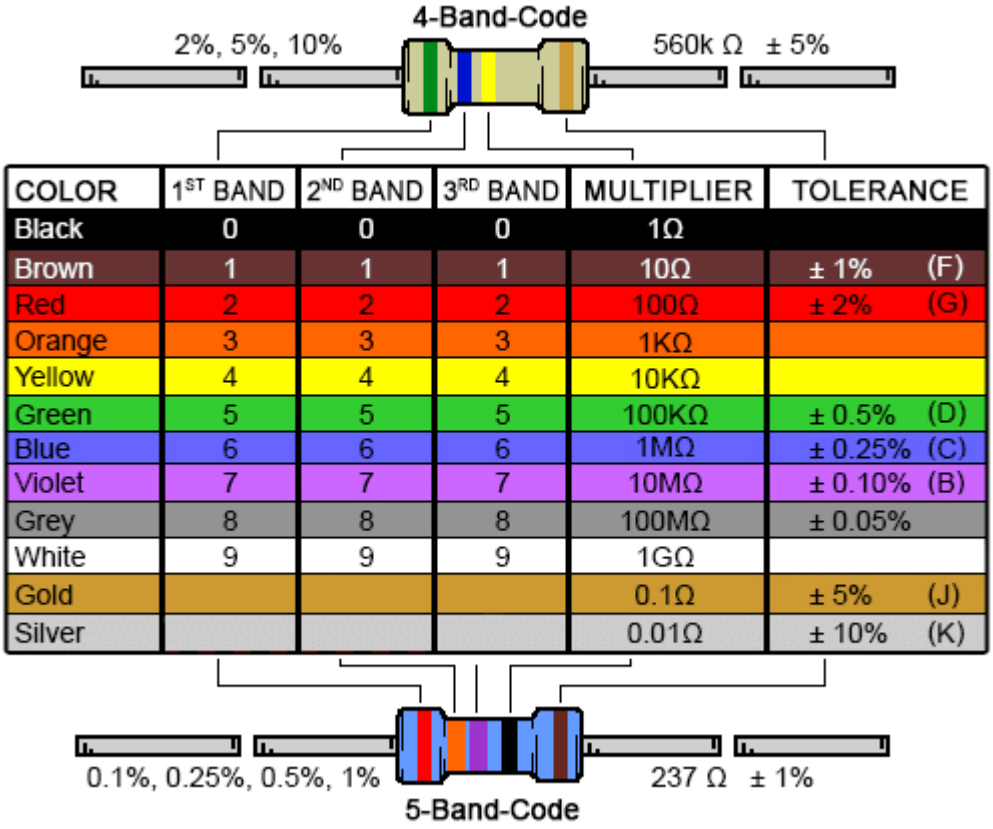


- **Two methods to measure resistance values:**

  1) **Using color code:** Each resistor consists of a 4 or 5 color band on its surface. The first three (two) colors represent the resistor value, whereas the 4th (third) color represents the multiplier value and the last one represents the tolerance.

  2) **Using Multi-meter:** A simple way to measure resistance is by using a multi-meter to measure the resistance value in ohms.

- **Resistor Color Coding**



COLOR	1ST BAND	2ND BAND	3RD BAND	MULTIPLIER	TOLERANCE
Black	0	0	0	1Ω	
Brown	1	1	1	10Ω	± 1% (F)
Red	2	2	2	100Ω	± 2% (G)
Orange	3	3	3	1KΩ	
Yellow	4	4	4	10KΩ	
Green	5	5	5	100KΩ	± 0.5% (D)
Blue	6	6	6	1MΩ	± 0.25% (C)
Violet	7	7	7	10MΩ	± 0.10% (B)
Grey	8	8	8	100MΩ	± 0.05%
White	9	9	9	1GΩ	
Gold				0.1Ω	± 5% (J)
Silver				0.01Ω	± 10% (K)

- **Resistor SMD Code**

  Because of the small size of SMD resistors, there is often not room for the traditional color band code to be printed on them. Therefore, new resistor SMD codes were developed. The most commonly seen codes are the three digit and four digit system and an Electronic Industries Alliance (EIA) system called EIA-96.

- **The Three-Digit and Four-Digit Systems**

  In these systems, the first two or three digits indicate the numerical resistance value of the resistor and the last digit gives a multiplier. The number of the last digit indicates the power of ten by which to multiply the given resistor value. Here are some examples of values under this system.

  - *Three-digit system*
    $450 = 45\ \Omega \times 10^0$ is 45 Ω
    $273 = 27\ \Omega \times 10^3$ is 27,000 Ω (27 kΩ)

  - *Four-digit system*
    $7992 = 799\ \Omega \times 10^2$ is 79,900 Ω (79.9 kΩ)
    $1733 = 173\ \Omega \times 10^3$ is 173,000 Ω (173 kΩ)

- **Types of Resistors**
  - **Carbon film** – Compared to carbon composition resistors, carbon-film resistors have tighter tolerances, are less sensitive to temperature changes and aging, and generate less noise.

  - **Metal film** – Metal film resistors have very tight tolerances, are less sensitive to temperature changes and aging, and generate less noise.

  - **Surface-mount resistors (chip resistors)**
  - Temperature-stable and rugged
  - Their end electrodes are soldered directly to a circuit board.
  - Much smaller than conventional resistors with axial leads.

  - **Fusible Resistors** – Fusible resistors are wire-wound resistors made to burn open easily when the power rating is exceeded. They serve a dual function as both a fuse and a resistor.

  - **Thermistors –** Thermistors are temperature sensitive resistors whose resistance value changes with changes in operating temperature. Used in electronic circuits where temperature measurement, control, and compensation are desired.

  - **Variable Resistors –** They provide a variation in their resistance value. They are generally used in voltage division. They can be potentiometers or presets. The resistance can be varied by controlling the wiper movement. The variable resistor or variable resistance, which consists three connections. Generally used as an adjustable voltage divider. It is a resistor with a movable element positioned by a manual knob or lever. The movable element is also called as wiper; it creates a contact with a resistive strip at any point which is selected by the manual control.

- **Capacitors**

A capacitor is a linear passive component that is used to store an electrical charge. A capacitor generally provides reactance to the flow of current. A capacitor consists of a pair of electrodes between which there is an insulating dielectric material.

When a capacitor is connected in a DC circuit, or when a constant current flows through it, which is constant with time (zero frequency), the capacitor simply stores the whole charge and opposes the flow of current. Thus a capacitor blocks DC.

When a capacitor is connected in an AC circuit, or a time-varying signal flows through it (with non-zero frequency), the capacitor initially stores the charge and later offers a resistance to the flow of charge. It can thus be used as a voltage limiter in the AC circuit. The resistance offered is proportional to the frequency of the signal.

- **Types of Capacitor**
  - **Ceramic Capacitors –** A ceramic capacitor is a fixed-value capacitor where the ceramic material acts as the dielectric. It is constructed of two or more alternating layers of ceramic and a metal layer acting as the electrodes. The composition of the ceramic material defines the electrical behavior and therefore applications.

  - **Polyester Capacitors –** The polyester capacitor is designed with two metal plates where the polyester film is arranged between them; otherwise, a metalized film can be placed over the insulator.

  - **Electrolytic Capacitors –** An electrolytic capacitor is a polarized capacitor whose anode or positive plate is made of a metal that forms an insulating oxide layer through anodization. This oxide layer acts as the dielectric of the capacitor. A solid, liquid, or gel electrolyte covers the surface of this oxide layer, serving as the cathode or negative plate of the capacitor.

- **Inductor Coils**

  It can be used as a choke to offer resistance to the applied voltage and store the energy or used in combination with a capacitor to form a tuned circuit, used for oscillations. In AC circuits, the voltage leads the current as imposed voltage takes some time to build up the current in the coil due to opposition.

Active Linear Components:

Active components are devices that can amplify an electric signal and produce power. Any characteristic active component will comprise an oscillator, transistor or an integrated circuit. An active component functions as an alternating current circuit in devices. This helps the device to augment power and voltage. This component can execute its operations because it is powered by a source of electricity. All active components necessitate some source of energy which commonly is extracted from a DC circuit.

- **Diode**
  A diode is a semiconductor device that essentially acts as a one-way switch for current. It allows current to flow easily in one direction, but severely restricts current from flowing in the opposite direction.

  Diodes are also known as rectifiers because they change alternating current (ac) into pulsating direct current (dc). Diodes are rated according to their type, voltage, and current capacity.

  Diodes have polarity, determined by an anode (positive lead) and cathode (negative lead). Most diodes allow current to flow only when positive voltage is applied to the anode.

  - **Types of Diodes:**
    - **PN Junction Diode** – A simple PN junction diode consists of a p-type semiconductor mounted on an n-type semiconductor such that a junction is formed between the p and n types. It can be used as a rectifier that allows current flow in one direction through proper connection.

    - **Zener Diode** – It is a diode made up of heavily doped p region compared to the n-region, such that it not only allows current flow in one direction but also allows current flow in the opposite direction, on the application of sufficient voltage. It is generally used as a voltage regulator.

    - **Tunnel Diode** – It is a heavily doped PN junction diode where the current decreases with increasing forward voltage. The junction width is reduced with increasing impurity concentration. It is made from germanium or Gallium Arsenide.

    - **Light Emitting Diode** – It is a special type of PN junction diode made from semiconductors like Gallium Arsenide, which emits light when a suitable voltage is applied. The light emitted by the LED is monochromatic, i.e. of a single color, corresponding to a particular frequency in the visible band of the electromagnetic spectrum.

    - **Photo Diode** – It is a special type of PN junction diode whose resistance decreases when light falls on it. It consists of a PN junction diode placed inside a plastic.

- **A Photodiode Switches** – Switches are devices that allow the flow of current to the active devices. They are binary devices, which when completely on, allows the flow of current and when completely off, block the flow of current. It can be a simple toggle switch which can be a 2-contact or a 3 contact switch or a push-button switch.

- **Transistor**

  A transistor is **a device that regulates current or voltage flow** and acts as a switch or gate for electronic signals. Transistors consist of three layers of a semiconductor material, each capable of carrying a current. ... A transistor consists of three layers of a semiconductor material, each capable of carrying a current.

  - **Types of Transistor:**
    BJT or Bipolar Junction Transistor: A BJT is a current controlled device that consists of a layer of n-type semiconductor material sandwiched between two layers of p-type semiconductor material. It consists of three terminals – The emitter, base, and collector. The collector-base junction is less doped compared to the emitter-base junction. The emitter-base junction is forward biased whereas the collector-base junction is reverse biased in normal transistor operation.

    - **Bipolar Junction Transistor**
      FET or Field Effect Transistor: A FET is a voltage-controlled device. The ohmic contacts are taken from the two sides of the n-type bar. It consists of three terminals – Gate, Drain, and Source. The voltage applied across the Gate-Source and the Drain-Source terminal controls the flow of current through the device. It is generally a high resistance device. It can be JFET (junction Field effect transistor) which consists of an n-type substrate, on the side of which a bar of the opposite type is deposited or a MOSFET (Metal Oxide Semiconductor FET) which consists of an insulating layer of silicon oxide between the metallic Gate contact and the substrate.

    - **MOSFET**
      TRIACS or SCR: An SCR or Silicon Controlled Rectifier is a three-terminal device which is generally used as a switch in power electronics. It is a combination of two back to back diodes having 3 junctions. The current through the SCR flows because of the voltage applied across anode and cathode and is controlled by the voltage applied across the Gate terminal. It is also used as a rectifier in AC circuits.

References/Additional Resources/Readings

- https://www.elprocus.com/different-types-of-integrated-circuits/
- https://learn.sparkfun.com/tutorials/capacitors/all
- https://en.wikipedia.org/wiki/Capacitor
- https://www.allaboutcircuits.com/textbook/direct-current/chpt-13/practical-considerations-capacitors/
- https://www.slideshare.net/sheebabhagiavahy/heating-effect-of-current

Activity Sheet

ACTIVITY 2

Name: _____Course/Year/Section: _____ Score: _____

Direction: Identify the following type of process flowchart

_____1. It is a pictogram used to represent various electrical and electronic devices or functions.
_____2. Integrated circuits that operate over a continuous range of signals.
_____3. A linear relation among its voltage as well as current.
_____4. A non-linear relation among its voltage and current.
_____5. Integrated circuits that are obtained by the combination of analog and digital ICs.
_____6. These ICs are designed using logic gates-that work with binary input and output.
_____7. ICs are used as comparators for comparing the inputs and then to produce an output based on the ICs' comparison.
_____8. ICs are designed by using the transistors and are used for performing the switching operations.
_____9. Types of ICs, which are used for the amplification of the audio.
_____10. This kind of IC provides a stable DC output despite the changes within DC input.

Learner's Feedback Form

Name of Student: _____
Program : _____
Year Level : _____ Section : _____
Faculty : _____
Schedule : _____

Learning Module : Number: _____ Title : _____

How do you feel about the topic or concept presented?

☐ I completely get it. ☐ I'm struggling.
☐ I've almost got it. ☐ I'm lost.

In what particular portion of this learning packet, you feel that you are struggling or lost?

_____
_____
_____

Did you raise your concern to you instructor? ☐ Yes ☐ No

If Yes, what did he/she do to help you?

_____
_____
_____

If No, state your reason?

_____
_____
_____

To further improve this learning packet, what part do you think should be enhanced?

_____
_____
_____

How do you want it to be enhanced?

_____
_____
_____

NOTE: This is an essential part of course module. This must be submitted to the subject teacher (within the 1st week of the class).