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Participant Handbook

Sector
Electronics

Sub-Sector
PCB Assembly

Occupation
Assembly and Soldering

Reference ID - **ELE/Q5102, Version 1.0**
NSQF Level 4

Pick and Place Assembly Operator

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"Skilling is building a better India. If we have to move India towards development then Skill Development should be our mission."

Shri Narendra Modi
Prime Minister of India

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Certificate

COMPLIANCE TO

QUALIFICATION PACK - NATIONAL OCCUPATIONAL STANDARDS

is hereby issued by the

ELECTRONICS SECTOR SKILL COUNCIL OF INDIA

for

SKILLING CONTENT : PARTICIPANT HANDBOOK

Complying to National Occupational Standards of

Job Role/ Qualification Pack: **"Pick and Place Assembly Operator "** QP No. **"ELE/Q5102, NSQF Level 4"**

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Authorised Signatory
(Electronics Sector Skill Council)

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The need for having a standard curriculum for the Job Role based Qualification Packs under the National Skills Qualification Framework was felt necessary for achi eving a uniform skill based training manual in the form of a Participant Handbook.

I would like to take the opportunity to thank everyone who contributed in developing this Handbook for the QP Pick and Place Assembly Operator.

The Handbook is the result of tireless pursuit to develop an effective tool for imparting the Skill Based training in the most effective manner.

I would like to thank the team of KontentEdge for their support to develop the content, the SME and the team at the ESSCI along with the industry partners for the tireless effort in bringing the Handbook in the current format.

CEO

Electronics Sector Skills Council of India

About this Book

This Participant Handbook is designed to enable training for the specific Qualification Pack (Q P). Each National Occupational (NOS) is covered across Unit/s.

Key Learning Objectives for the specific NOS mark the beginning of the Unit/s for that NOS.

- Describe a pick and place machine operator
- Explain the basics of active and passive components
- Explain the basics of a PCB
- Describe the process of mounting components on a PCB
- Explain Surface Mounting Technology (SMT)
- Explain the basics of PCB assembly (PCBA)
- Describe the parts of a pick and place machine
- Explain the setting up the pick and place machine software
- List the elements to be inspected
- Identify problems with a pick and place machine
- Execute preventive maintenance tasks
- Explain the need of documentation in PCB manufacturing
- Define reporting structure for smooth flow of tasks
- Identify target setting and achievement process
- Identify the correct way of interacting with supervisors and colleagues
- Identify soft skills required for doing the job of an assembly operator

The symbols used in this book are described below.

Symbols Used


Key Learning Outcomes


Steps


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Tips


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Unit Objectives


Practical


e-Resources


Activity

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1. Introduction to Pick and Place Machine Operator

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Unit 1.1 – Role of Pick and Place Machine Operator

Unit 1.2 – Basics of PCB

Unit 1.3 – PCB Assembly Process'

ELE/N5102

Key Learning Outcomes

At the end of this module, you will be able to:

1. Describe a pick and place machine operator
2. Explain the basics of active and passive components
3. Explain the basics of electromechanical components
4. Describe the characteristics of electronic components
5. Explain the basics of a PCB
6. Describe the process of mounting components on a PCB
7. Explain Surface Mounting Technology (SMT)
8. Explain the basics of PCB assembly (PCBA)
9. Describe the (PCB) assembly process
10. Explain the types of PCB assembly process

UNIT 1.1: Role of Pick and Place Machine Operator

Unit Objectives

At the end of this unit, you will be able to:

1. Describe a pick and place machine operator
2. Explain the basics of active components
3. Explain the basics of passive components
4. Explain the basics of electromechanical components
5. Describe the characteristics of electronic components

1.1.1 Who is a Pick and Place Operator?

A pick and place machine operator is a person responsible for operating the automated pick and place machine. The following figure lists the responsibilities of a pick and place assembly operator:

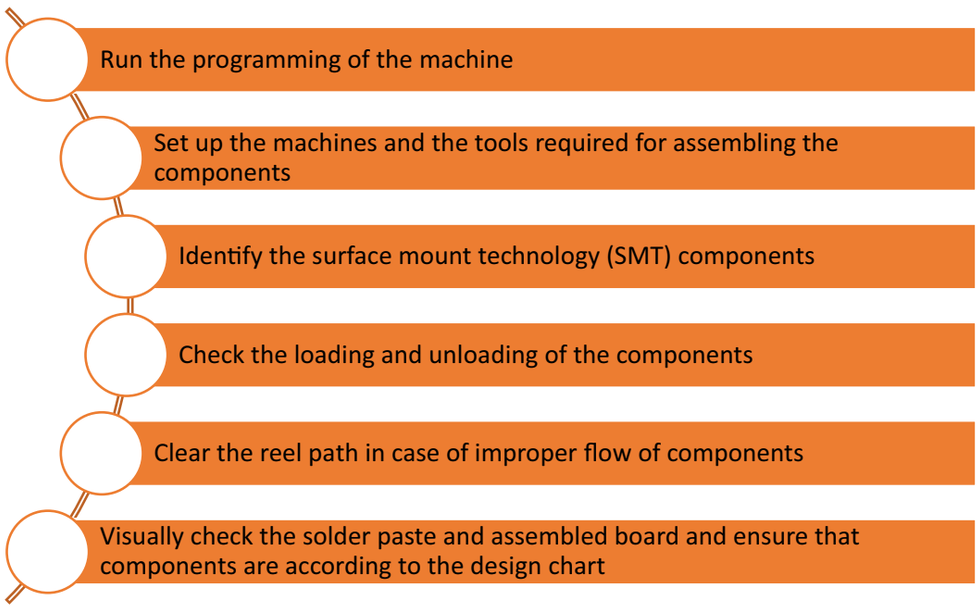


Fig. 1.1.1: Responsibilities of a pick and place assembly operator

To perform his/her job role properly, it is important that the pick and place operator has a thorough knowledge of the various electronic components used in the process. These components are mainly of three types. The following figure represents the types of electronic components:

Fig. 1.1.2: Electronic components

1.1.2 Active Components

Active components depend on a source of energy to perform their functions. These components can amplify current and can produce a power gain.

The following figure lists the different types of active components in a circuit:

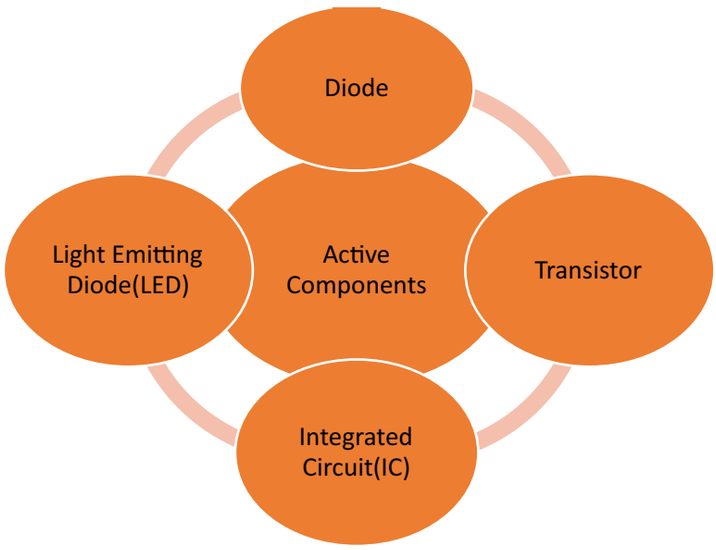


Fig. 1.1.3: Active components

Diode

A diode is a specialized electronic component with two terminals known as the anode and the cathode. It has asymmetric conductance, which means that it conducts mainly in one direction. It has very less resistance, ideally zero, to the flow of current in one direction whereas it has high resistance, ideally infinite, in the other direction. Diodes are usually made up of semiconductor materials such as germanium, silicon or selenium. The following image shows diodes:

Fig. 1.1.4: Diodes

Transistor

A transistor is an electronic device, made up of a semiconductor material. Usually, it consists of three or more terminals for connecting to an external circuit. It is utilized to amplify or switch electrical power and electronic signals. The following image shows a transistor:

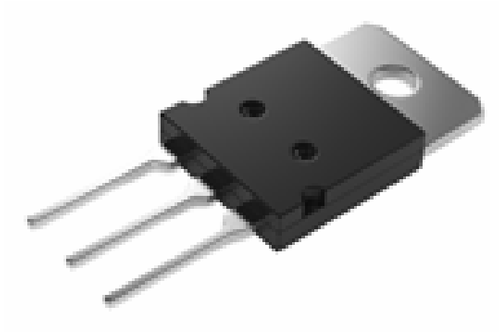


Fig. 1.1.5: A transistor

IC

An IC, also known as a microchip, is a semiconductor wafer on which a number of small resistors, capacitors and transistors are fabri cated. It can work as an oscillator, an amplifier, a timer, a counter, a microprocessor or as computer memory. The following image shows an IC:

Fig. 1.1.6: An IC

LED

An LED is made of a p-n junction diode which releases light when it is activated. It is a two-lead semiconductor source of light. Energy is released as photons when a suitable voltage is applied to the leads. The following image shows an LED:

Fig. 1.1.7: An LED

1.1.3 Passive Components

Passive components are those components which can perform their specific functions without any power source. These components are incapable of controlling current.
The following figure lists the different types of passive components in a circuit:

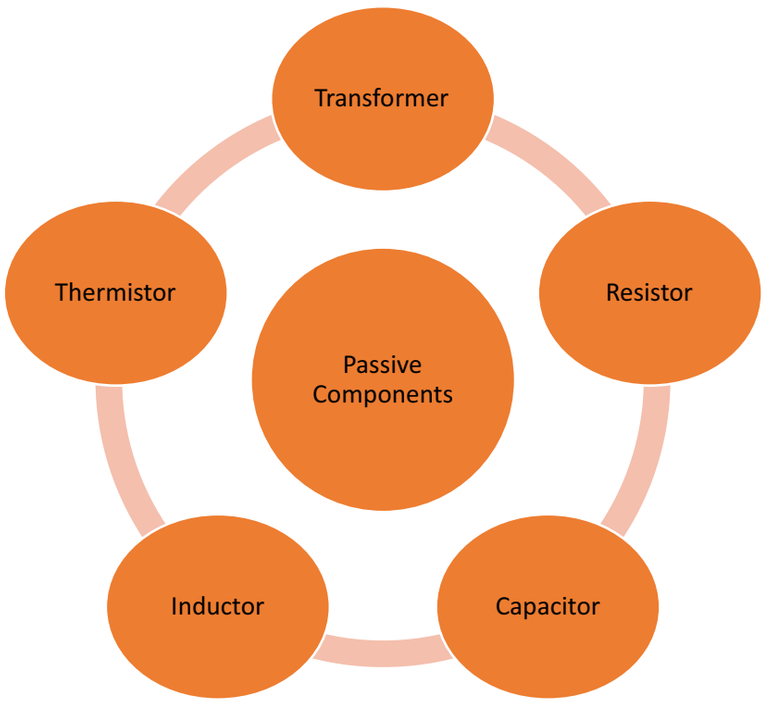


Fig. 1.1.8: Passive components

Generally, resistors, capacitors, inductors are used as SMT components.

Resistor

A resistor is a component in an electronic circuit which is built to resist or limit the flow of current in that circuit. It may be a small carbon device or a big wire-wound power resistor. Its size varies in length from 5mm up to 300mm.
The following image shows resistors:

Fig. 1.1.9: Resistors

Capacitor

A capacitor is a device which is made up of one or more pairs of conductors and an insulator separating them. It is used to store electric charge. The following image shows capacitors:

Fig. 1.1.10: Capacitors

Inductor

An inductor consists of a coil or a wire loop. This component is used to store energy in the form of a magnetic field. The more the turns in the coil, the more will be the inductance. The following image shows inductors:

Fig. 1.1.11: Inductors

1.1.4 Electromechanical Components

Electromechanical components convert electric energy into mechanical energy (mechanical movement) or vice versa for carrying out electric operations. The following figure lists various electromechanical components:

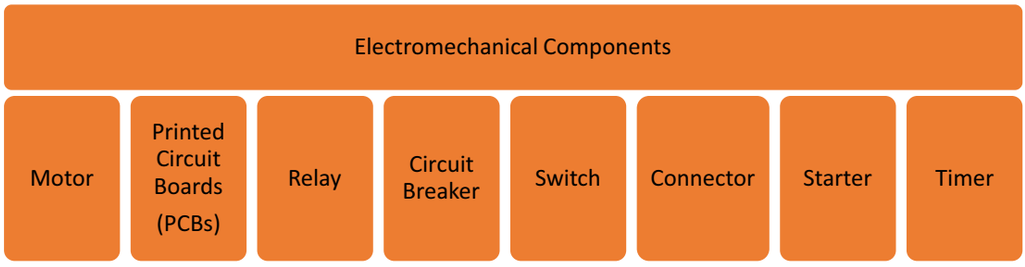


Fig. 1.1.12: Electromechanical components

Of all these electromechanical components, a pick and place operator needs to know only about PCBs.

PCB

A PCB acts as a base for the components that are mounted on its surface and are interconnected with wires, conductive tracks and so on. The components are generally soldered on the circuit board according to the specified design. Some common PCB components include battery, resistor, LED s, diodes, switches, inductors and so on. The following images show arrangement of different components on PCB:

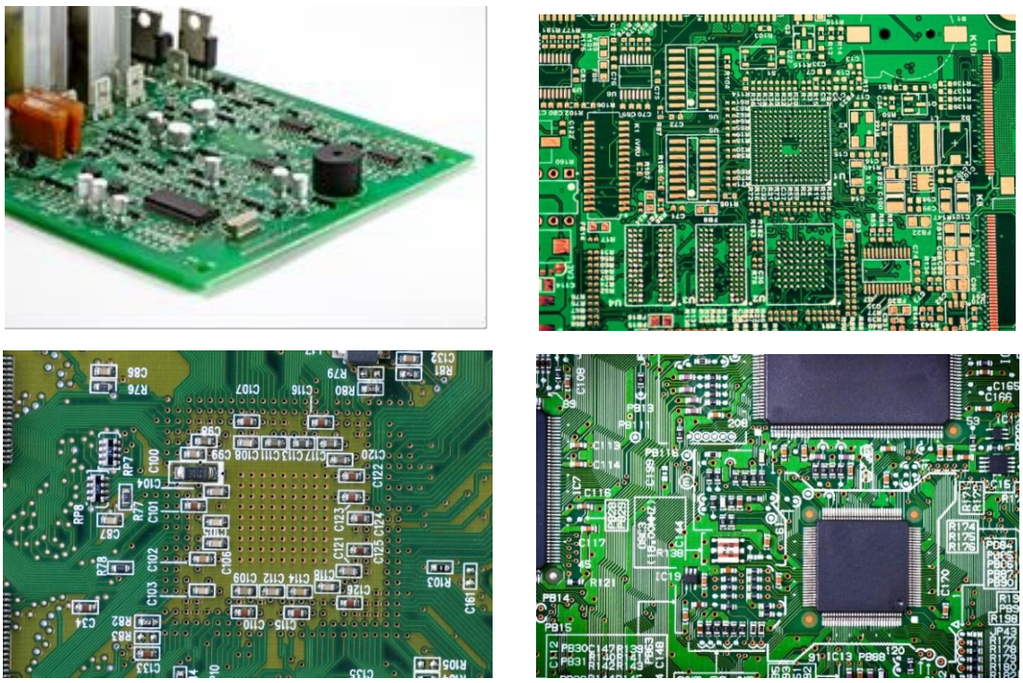


Fig. 1.1.13: Arrangement of different components on PCB

1.1.5 Characteristics of Electronic Components

When the electronic components are added to a circuit, their colour coding, polarity, orientation and tolerance need to be taken under consideration.

Colour Coding

Colour coding was formulated to indicate the value of electronic components such as resistors, capacitors, diodes and ICs.

Resistors

In a resistor, colour coding is read as follows:

- Colour bands should be read from that end which has the bands nearest to it.
- The 1st and 2nd bands stand for the first two digits.
- The 3rd band represents the power-of-ten multiplier (the number of zeroes after the second digit).
- The 4th band represents the manufacturer's tolerance (accuracy of the resistor).

The following image shows colour coding in a resistor:

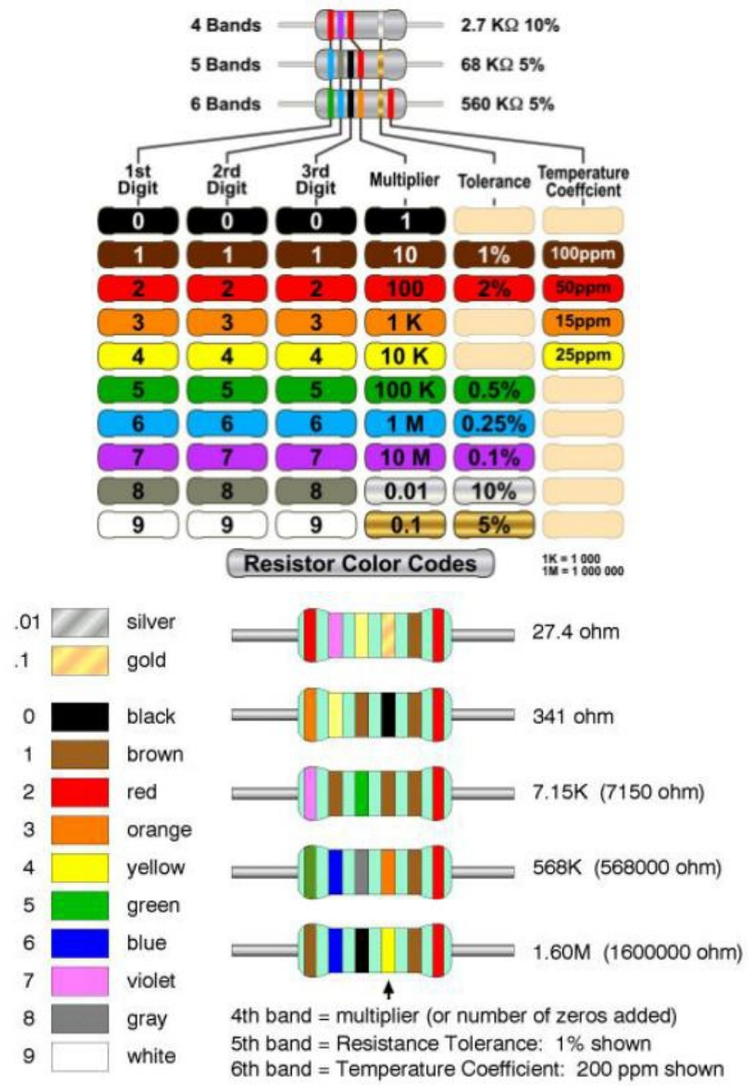


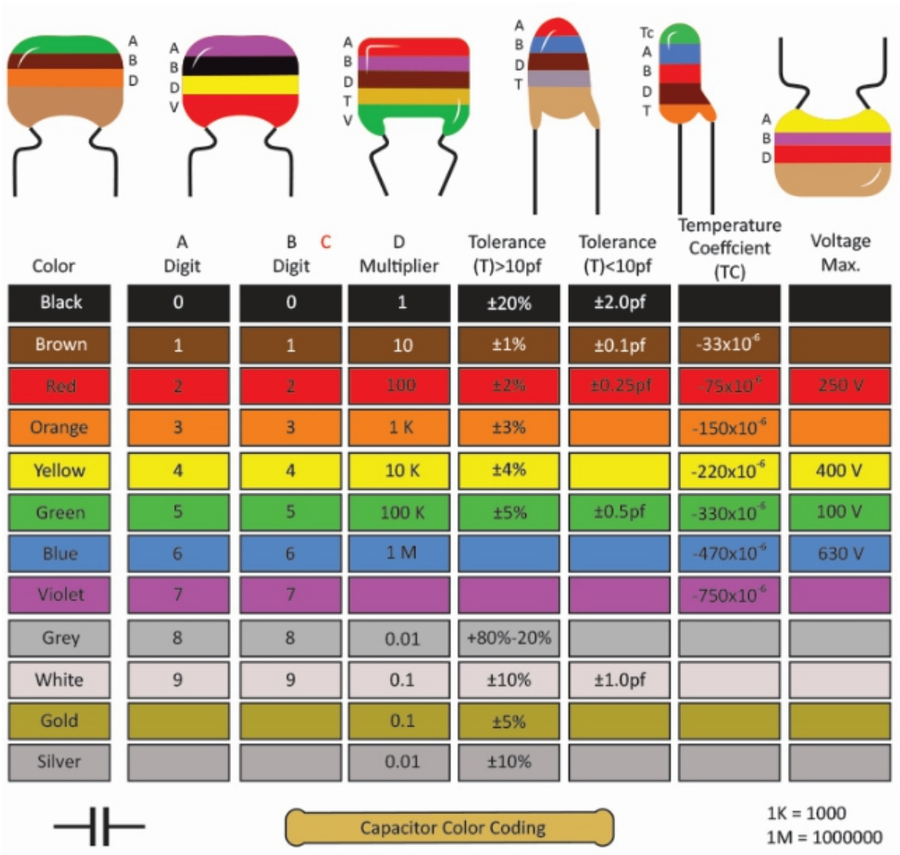
Fig. 1.1.14: Colour coding in a resistor

Capacitors

Capacitor colour coding is mostly similar to resistor colour coding. In a capacitor, colour code is read as follows:

- Colour bands should be read from left to right.
- The 1st and 2nd bands stand for the first two digits and represent significant digits.
- The 3rd band represents the power-of-ten multiplier (the number of zeroes after the second digit).
- The 4th band represents the manufacturer's tolerance (accuracy of the r esistor).
- In case of a five band capacitor, the first band represents the temperature coefficient and then the remaining four bands are the same as discussed above, starting from the significant digits to tolerance.

The following image shows colour coding in capacitors:



Color	A Digit	B Digit	C D Multiplier	Tolerance (T)>10pf	Tolerance (T)<10pf	Temperature Coeffcient (TC)	Voltage Max.
Black	0	0	1	±20%	±2.0pf		
Brown	1	1	10	±1%	±0.1pf	$-33x10^{-6}$	
Red	2	2	100	±2%	±0.25pf	$-75x10^{-6}$	250 V
Orange	3	3	1 K	±3%		$-150x10^{-6}$	
Yellow	4	4	10 K	±4%		$-220x10^{-6}$	400 V
Green	5	5	100 K	±5%	±0.5pf	$-330x10^{-6}$	100 V
Blue	6	6	1 M			$-470x10^{-6}$	630 V
Violet	7	7				$-750x10^{-6}$	
Grey	8	8	0.01	+80%-20%			
White	9	9	0.1	±10%	±1.0pf		
Gold			0.1	±5%			
Silver			0.01	±10%			

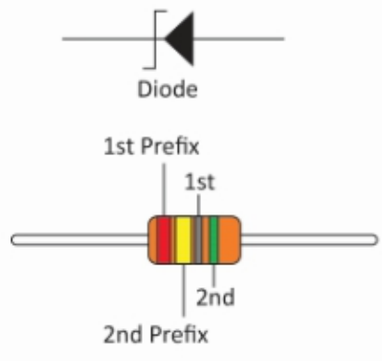
Fig. 1.1.15: Colour coding in a capacitor

Diodes

In diodes, colour coding is read as follows:

- Colour bands should be read from that end which has the bands nearest to it.
- The 1st and 2nd bands are for prefixes.
- The 3rd and 4th bands represent significant digits.

The following image shows colour coding in diodes:



Color	Prefix 1	Prefix 2	1st	2nd
Black	AA	X	O	O
Brown			1	1
Red	BA	S	2	2
Orange			3	3
Yellow		T	4	4
Green		V	5	5
Blue		W	6	6
Violet			7	7
Grey		Y	8	8
White		Z	9	9

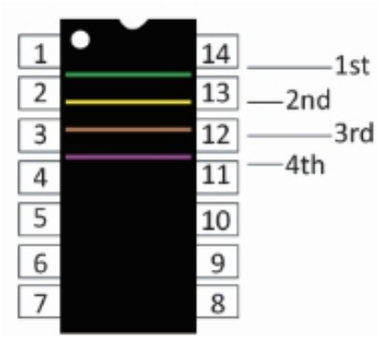
Fig. 1.1.16: Colour coding in diodes

ICs

In ICs, colour coding is read as follows:

- Colour bands should be read from left to right
- The 1st band represents prefixes.
- The 2nd band represents the first set of significant digits.
- The 3rd and 4th bands represent the second set of significant digits.

The following image shows colour coding in ICs:



Color	1st	2nd	3rd	4th
Black		O	O	O
Brown	CA	1	1	1
Red	CD	2	2	2
Orange	DM	3	3	3
Yellow	GD	4	4	4
Green	HA	14	5	5
Blue	HD	34	6	6
Violet	MC	40	7	7
Grey	TA	74	8	8
White	TC	140	9	9

Fig. 1.1.17: Colour coding in ICs

Polarity

In electronic components, the polarity of a component means whether the component is symmetric to the circuit or not. A non-polarized component can be connected in the circuit in any direction. A polarized component can only be connected in the circuit in a specified direction as a polarized component can have two to more pins and each pin has its own unique function. Therefore, it needs to be attached to a specified position in the circuit. In case a polarized component is connected incorrectly, then the component will not work or may get damaged. The following figure shows polarity in electronic components:

Fig. 1.1.18: Polarity in electronic components

Orientation

Every electronic component has a symbol present on it. This symbol is referred to as orientation and it enables every pin to be matched to the circuit board according to the pin numbers.

The symbols which are present on the components are:

- Stripe
- Notch
- Dimple
- Number
- Wedge

The following images represent some orientation symbols present in electronic components:

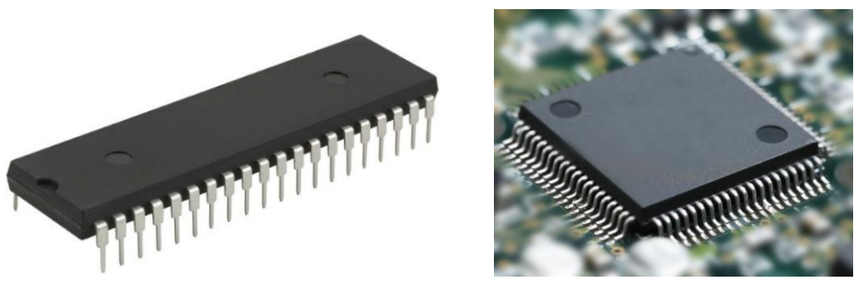


Fig. 1.1.19: Some orientation symbols in electronic components

Tolerance

Every electronic component has a range of specified value or percentage of error within which it can vary its value. This is known as the tolerance of an electronic component.

The following table lists the tolerance values of some of the electronic components:

Component	Tolerance
Resistor	Printed on the body of a resistor
Capacitor	Between +20% to -20%
Diode	Between +5% to -5%
ICs	0

Fig. 1.1.20: Tolerance values of some electronic components