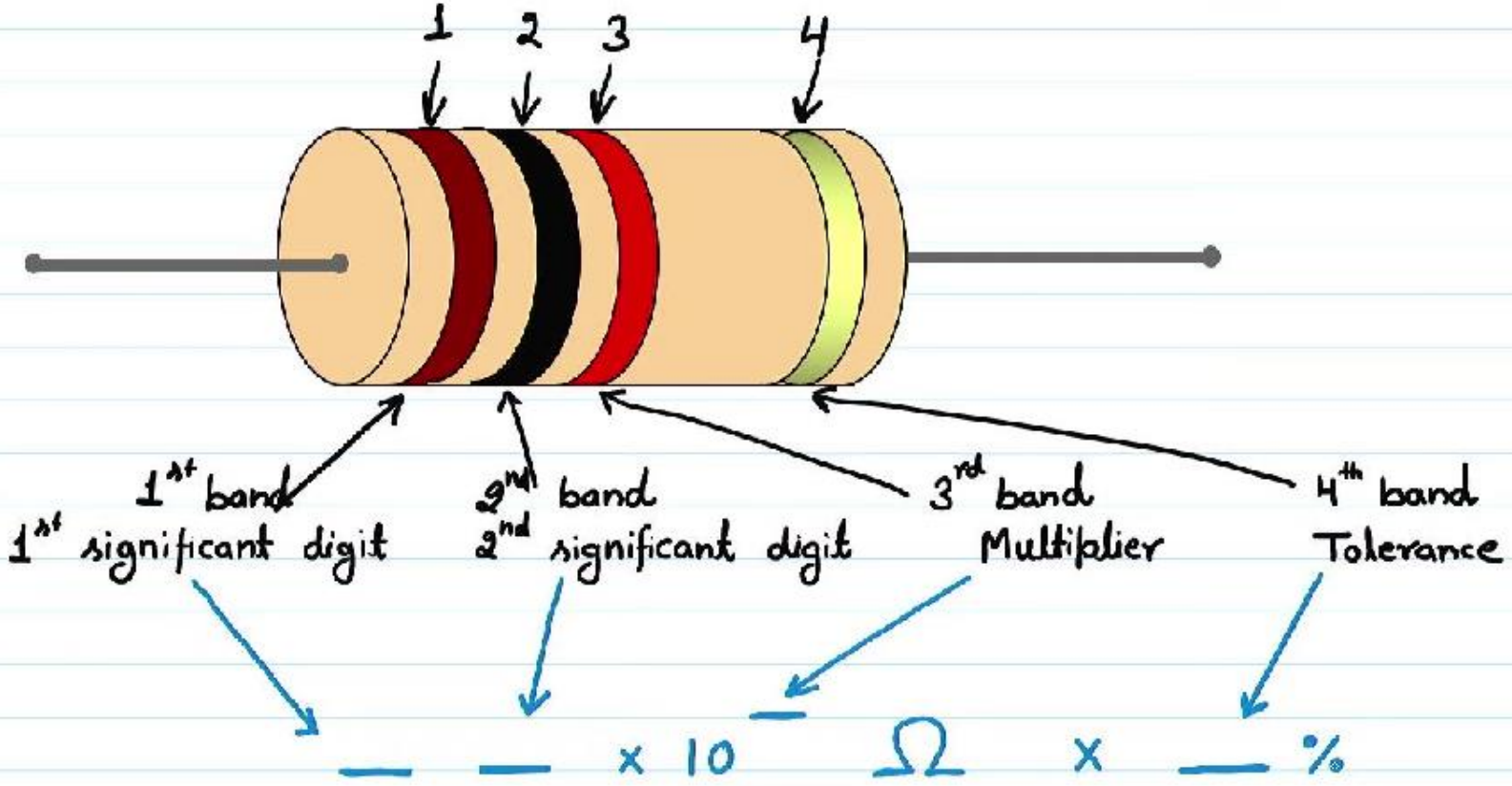
- The resistor nominal value is encoded in the color code in Powers of Ten notation.

How to determine the nominal value and tolerance from color codes :



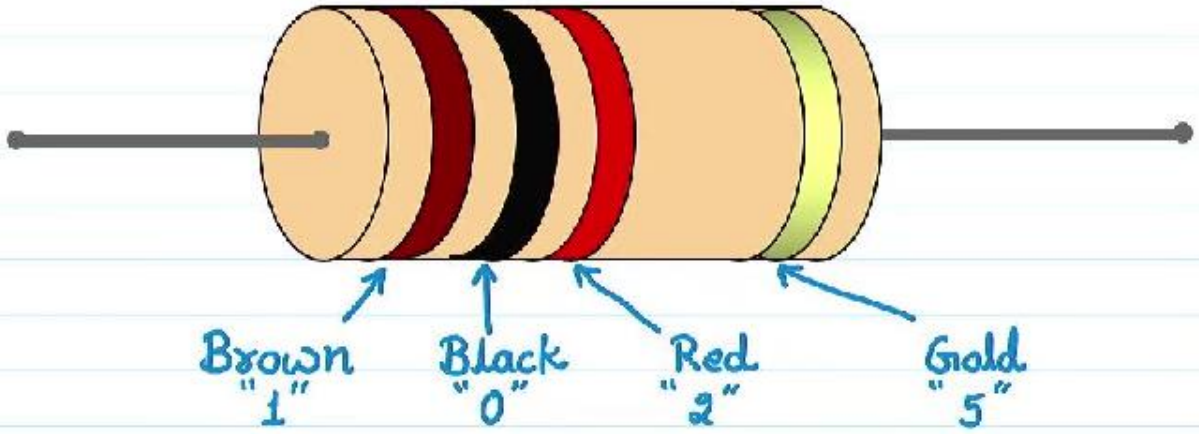

NPTEL

- How do we know which color corresponds to which number ?

  - Resistor color code table :

| | Color | Digit | Multiplier | Tolerance |
|---|---|---|---|---|
| | Black | 0 | $10^0 = 1$ | |
| | Brown | 1 | $10^1 = 10$ | ±1% |
| | Red | 2 | $10^2 = 100$ | ±2% |
| | Orange | 3 | $10^3 = 1{,}000$ | |
| | Yellow | 4 | $10^4 = 10{,}000$ | |
| | Green | 5 | $10^5 = 100{,}000$ | |
| | Blue | 6 | $10^6 = 1{,}000{,}000$ | |
| | Violet | 7 | $10^7 = 10{,}000{,}000$ | |
| | Gray | 8 | $10^8 = 100{,}000{,}000$ | |
| | White | 9 | $10^9 = 1{,}000{,}000{,}000$ | |
| | Silver | | $10^{-2} = 0.01$ | ±10% |
| | Gold | | $10^{-1} = 0.1$ | ±5% |
| | No band | --- | --------- | ±20% |

Example : Determine the normal resistance value and the tolerance for the resistance shown below :




$$\underline{1}\ \underline{0} \times 10^{\underline{2}}\ \Omega\ \pm\ \underline{5}\ \%$$

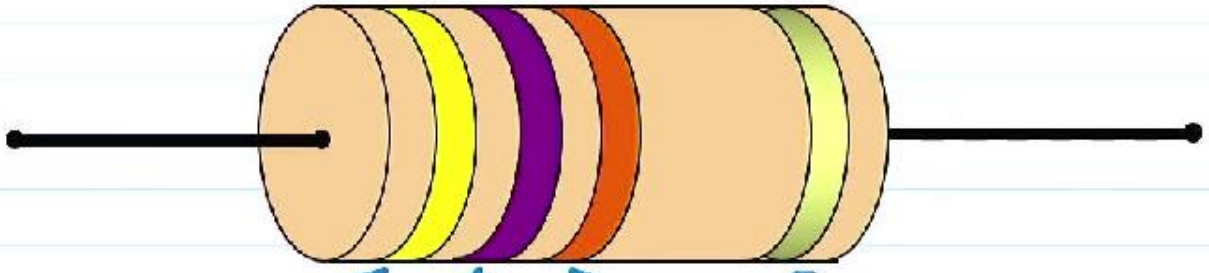
Nominal value = $10 \times 10^2\ \Omega$

= $1000\ \Omega$

Tolerance = 5 %

Example : Determine nominal value and tolerance

- What is minimum value of resistor ?
- What is maximum value of resistor ?




$4 \quad 7 \times 10^{3} \ \Omega \pm 5\ \%$

Nominal value $= 47 \times 10^{3} \ \Omega$

$= 47 \ k\Omega$

Tolerance $= \pm 5\ \%$

- Minimum resistance value :

Multiply the nominal value by the tolerance and then subtract this from the nominal value :

Min value = Nom value − ( Nom value × tolerance)

= 47 kΩ − ( 47 kΩ × 0·05 )
= 47 kΩ − 2·35 kΩ
= 44·65 kΩ

- Maximum resistance value :

Multiply the nominal value by the tolerance and then add this to the nominal value :

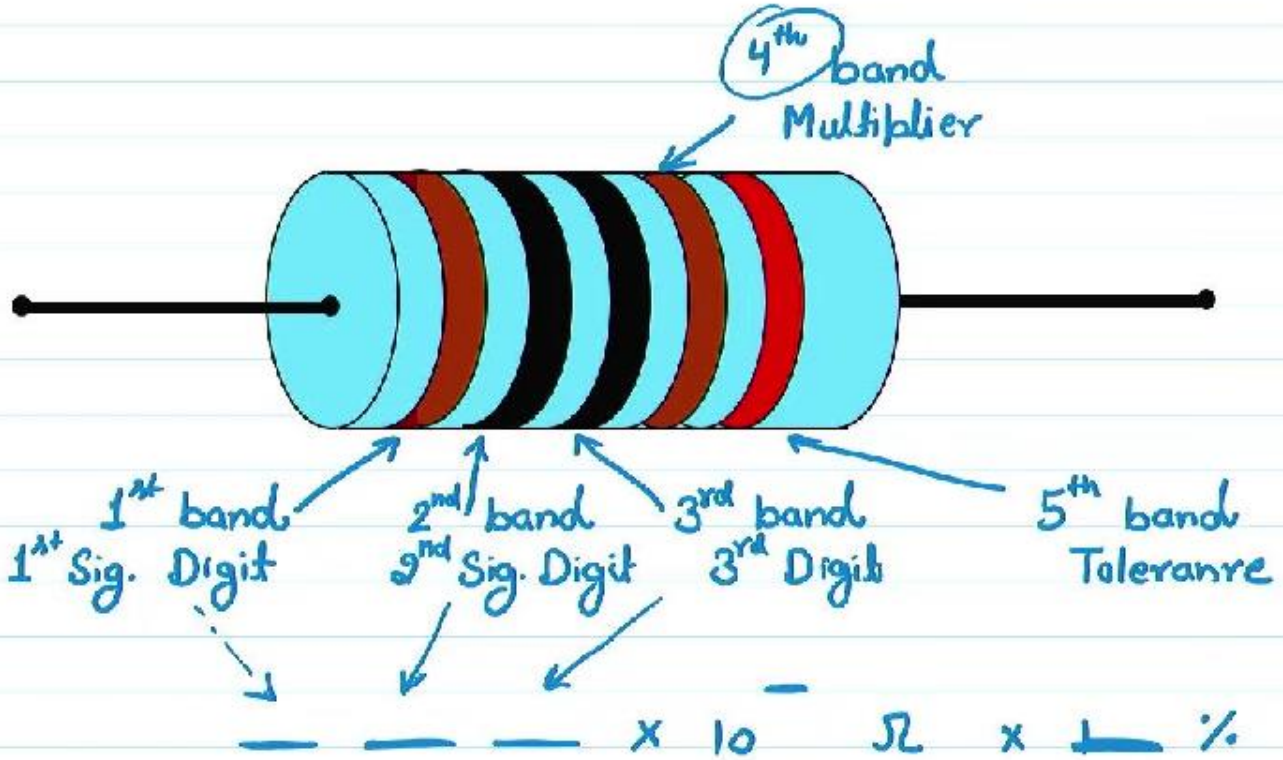
Max value = Nom value + ( Nom value × tolerance)

= 47 kΩ + (47 kΩ * 0·05 )
= 47 kΩ + 2·35 kΩ

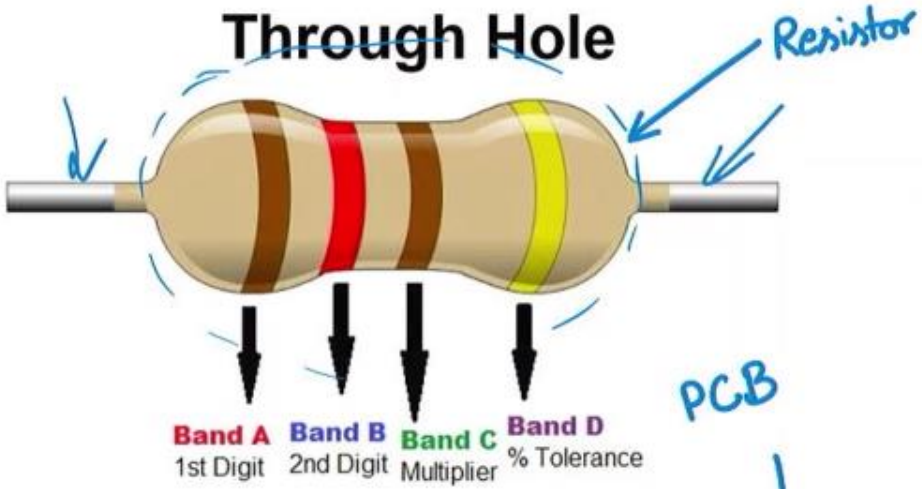
= 49·35 kΩ.

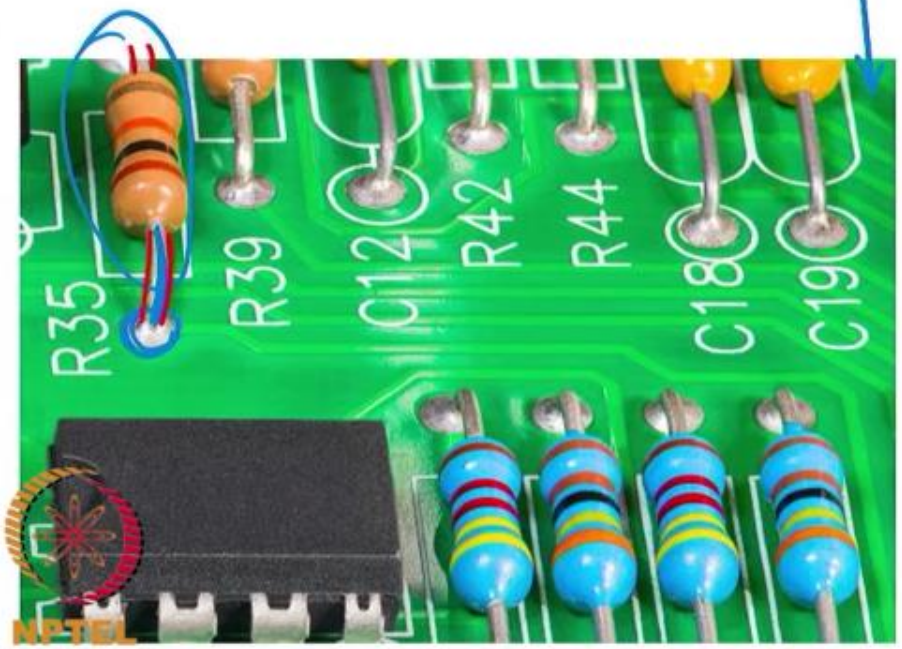
- 5 Band resistors :

- For resistors with ± 1% or ± 2% tolerance, color codes consists of 5 bands:




- Mounting Technology :

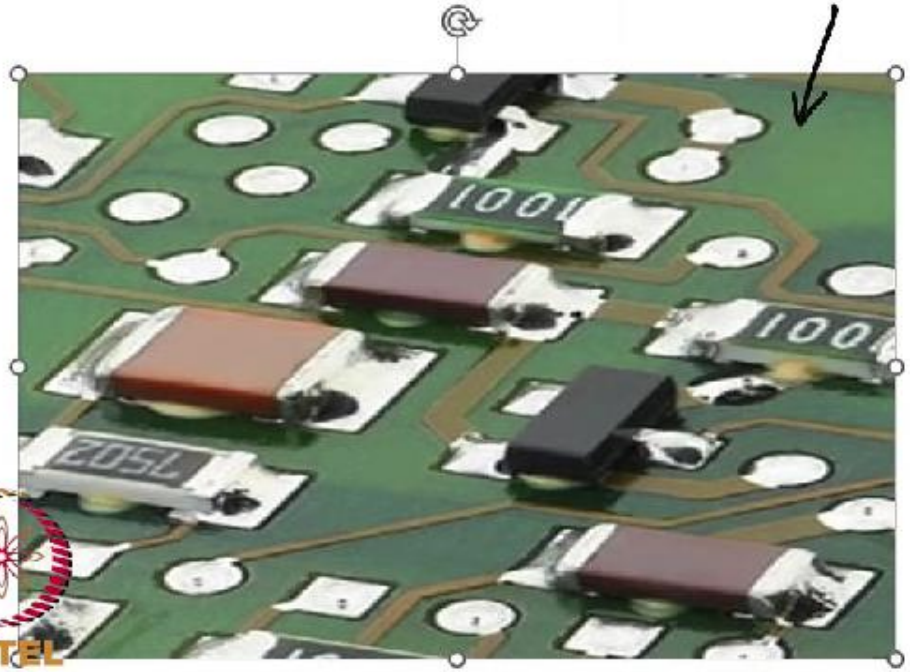



Pin - Through holed (PTH) components

- Bond wires contribute parasitic inductance
- For multiple components, PCB may have mechanical problems.
- Good Thermal reliability

- Surface Mount Technology :

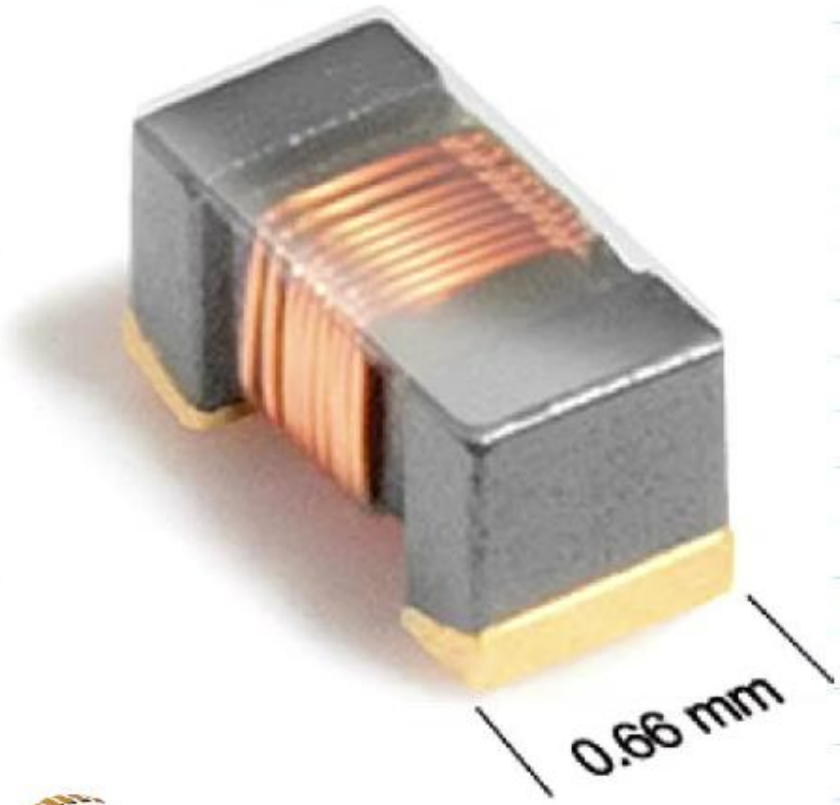



- Smaller in size
- Higher density
- No PTH needed, good mechanical strength.
- Can be mounted both sides
- Higher speed

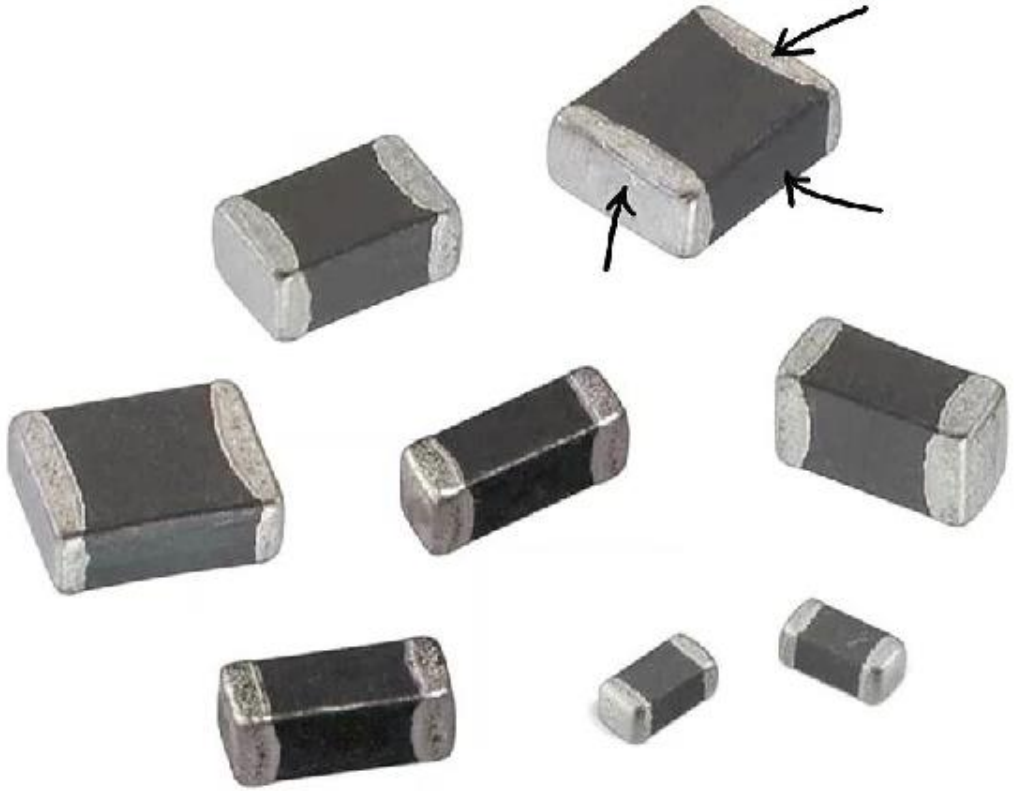
- Thermal problems
- Manual design is difficult
- High precision PCB needed.

# Surface Mount Inductors and Capacitors :

SMD Inductor




SMD Capacitors



# Through-hole vs Surface Mount IC Packages: