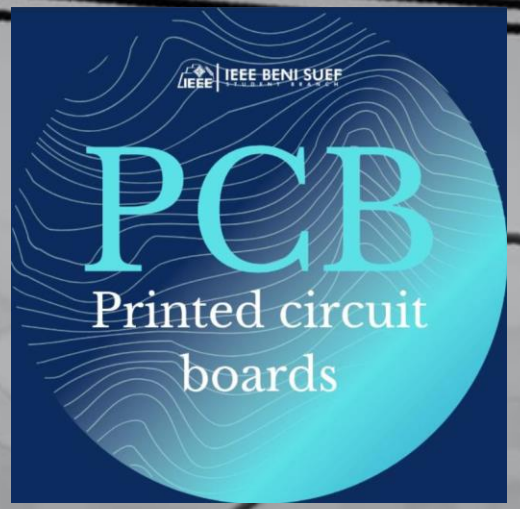


Pcb design

Session 2

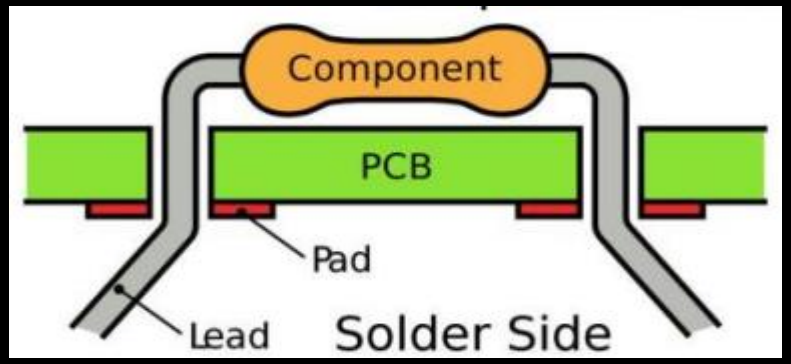
Yassa Mazhar
Lobna Hamdy

In this session

- Through hole technology
- Surface Mount Technology
- Electronic components packages

Through-hole technology (THT)

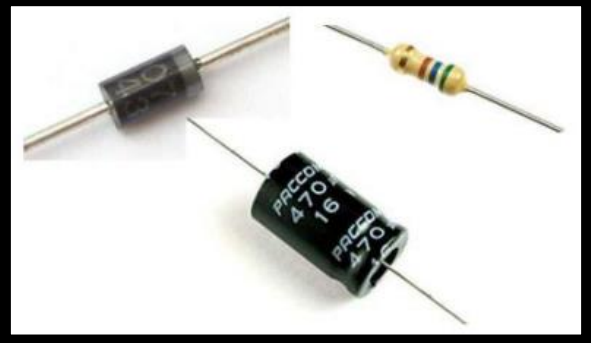
- It refers to the mounting scheme used for electronic components that involves the use of leads on the components that are inserted into holes drilled in printed circuit boards (PCB) and soldered to pads on the opposite side .Surface Mount Technology
- From the second generation of computers in the 1950s until surface-mount technology (SMT) became popular in the late 1980s, every component on a typical PCB was a through-hole component,



Types o through-hole components packages

Axial lead components

- Axial through-hole components have electrical leads that run along the axis of symmetry of the component.
- Think about a basic resistor; the electrical leads run along the cylindrical axis of the resistor. Many diodes, and capacitors are mounted in this way.

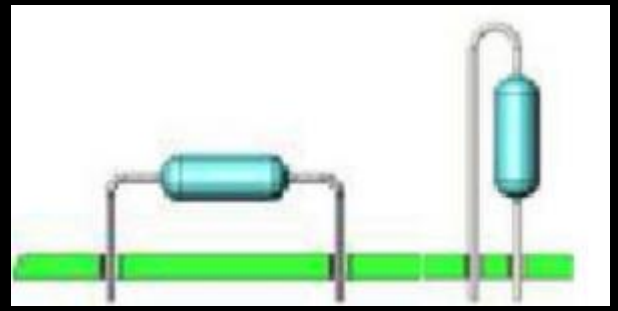


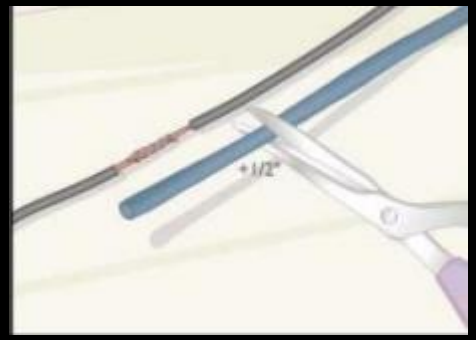
Radial lead components

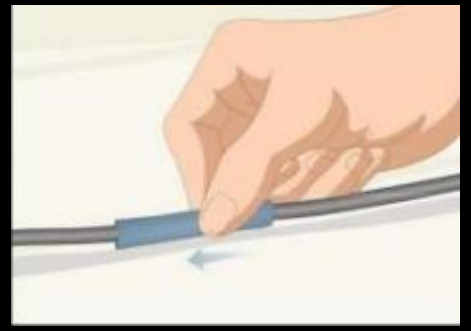
- Radial components have electrical leads that protrude in parallel from the same surface of the component.
- Radial leads occupy less surface area, making them better for high density boards.
- Radial lead components are available as ceramic disk capacitors and LED.

Types o through-hole components packages

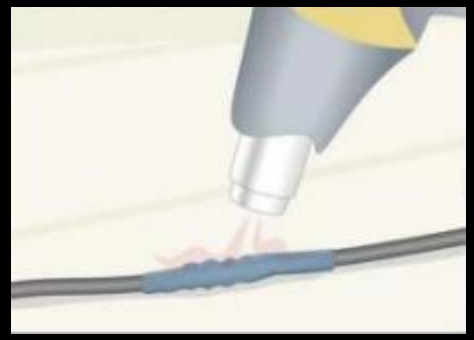
- When needed, an axial component can be effectively converted into a radial component, by bending one of its leads into a "U“ shape so that it ends up close to and parallel with the other lead. shorting out on nearby components.





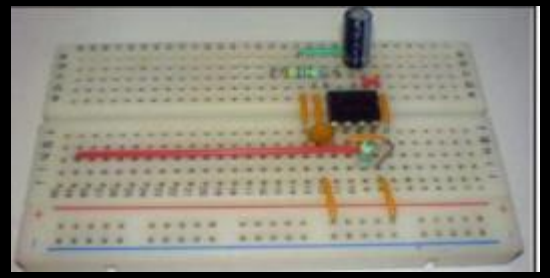


Extra insulation with heat-shrink tubing may be used to prevent shorting out on nearby components.



Advantages of Through-Hole Technology

- Through-hole soldering creates a stronger bond between components and the board, making it perfect for larger components that will undergo high power, high voltage.
- They can also withstand more environmental stress. That is why it is the preferred method for military and aerospace products that experience extreme accelerations or high temperatures.
- Also, if you 100k at industrial machines and equipment, you can find many boards that are built almost exclusively using through-hole components. Again, this is due to the harsh operating conditions, such as extremes Of temperature or situations involving high power consumption.
- It is great for prototyping and testing as you're able to easily swap out components on a printed circuit board.
- Throuah-hole technofoav mav be old and seem outdated. but it has c ouroose and can be used for its physical endurance and strenath in today's connected world.

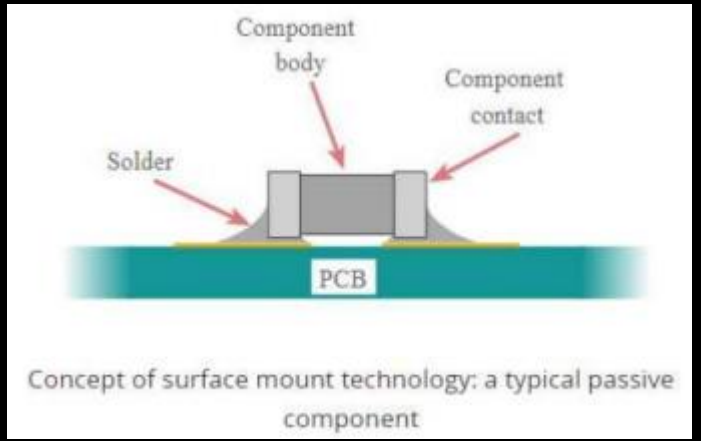


Disadvantages of Through-Hole Technology

- It requires the drilling holes, which is expensive and time consuming,
- It is not appropriate for high frequency or high-speed designs that require minimal stray capacitance and inductance in wire leads.
- It is not recommended for ultra-compact designs.
- It limits the available routing area on any multilayer boards, because the drilled holes must pass through all the PCB's layers.

Surface Mount Technology (SMT)ssion

- SMT the process by which components are mounted directly onto the surface of the PCB.
- The method was developed in the 1960s and has grown increasingly popular since the 1980s.
- These types of components do not use pins for electrical leads. Instead, the leads appear as small pads of metal on the same side of the component.
- The key differences between SMT and through-hole mounting are
- a) SMT does not require holes to be drilled through a PCB,
- b) SMT components are much smaller, and
- c) SMT components can be mounted on both side of the board.
- Today surface mount technology is the main technology used for PCB assembly within electronics manufacturing.



Concept of surface mount technology: a typical passive component

Surface Mount Technology: Advantages

- No drilling Cheaper board fabrication
- Faster & cheaper assembly
- Small size Denser boards
- Reduced parasitic - reliable at higher speeds

Surface Mount Technology: Disadvantages

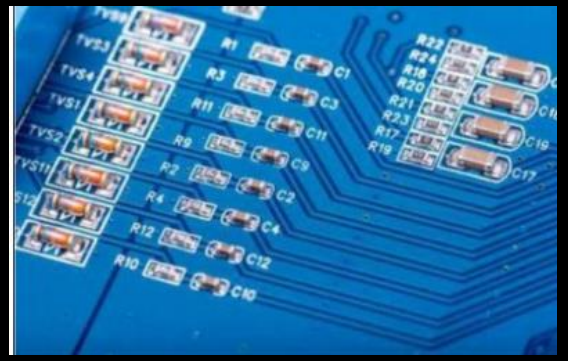
- Weaker physical connections to the PCB
- Lower power handling capability
- Lower heat tolerance
- Manual prototype assembly or component-level repair is more difficult and requires skilled operators and more expensive tools, due to the small sizes.

serface mount technology in design

- For the development engineer, the use of surface mount technology offers many advantages, although there are some points to watch:

Low spurious capacitance and inductance:

- In view Of the small size Of the components, the levels Of spurious inductance and capacitance are much smaller.
- SMT resistors function in a way that is closer to the perfect resistor than that of a leaded resistor.
- Similarly an SMT capacitor will exhibit much lower parasitic inductance.
- As a result faster speeds and higher frequencies are possible with standard SMT components than would be possible with leaded equivalents.

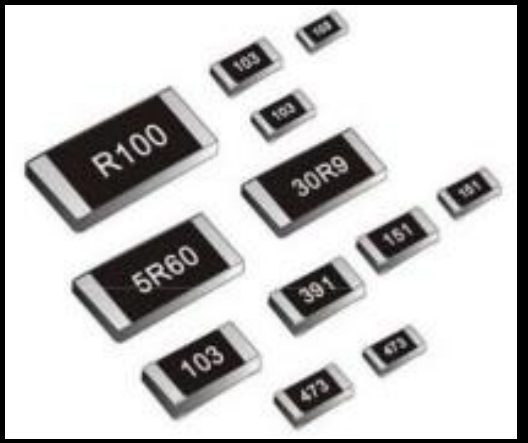


Surface mount technology in design

- For the development engineer, the use of surface mount technology offers many advantages, although there are some points to watch:

Low spurious capacitance and inductance:

- The power rating of surface mount components is of great importance.
- The surface mount resistor is the particular example.
- A standard leaded resistor can dissipate at least 0.25 watts.
- For surface mount resistors, big much smaller, the dissipation is also less.
- Be aware of this and check the manufacturers data.



Quize

https://forms.gle/iqDEV9382kb4fS3s5

electronic components packages

length measurement units

- International System (SI) of Units
- is the modern form of the metric system and is the most widely used system of measurement.

Submultiples			Multiples		
Value	SI symbol	Name	Value	SI symbol	Name
10^{-1} m	dm	decimetre	10^{1} m	dam	decametre
10^{-2} m	**cm**	**centimetre**	10^{2} m	hm	hectometre
10^{-3} m	**mm**	**millimetre**	10^{3} m	**km**	**kilometre**
10^{-6} m	**µm**	**micrometre**	10^{6} m	Mm	megametre
10^{-9} m	**nm**	**nanometre**	10^{9} m	Gm	gigametre
10^{-12} m	pm	picometre	10^{12} m	Tm	terametre
10^{-15} m	fm	femtometre	10^{15} m	Pm	petametre
10^{-18} m	am	attometre	10^{18} m	Em	exametre
10^{-21} m	zm	zeptometre	10^{21} m	Zm	zettametre
10^{-24} m	ym	yoctometre	10^{24} m	Ym	yottametre

Common prefixed units are in **bold** face.

British Irnperial System of units

- A thousandth of an inch is a
- derived unit of length in a system of units using inches.
- Equal to 1/ Of an inch, it is normally referred to as
- a thou, a thousandth. or (particularly in the United
- States) a mil
- The plural of mi/ is mi's (thus "10 mils").

units		conversions			
1 thou					= 0.001in
inch	[in]	= 0.0254 m (exactly)			
1 hand					= 4 in
1 foot	[ft]				= 12 in
1 cubit					= 18 in
1 yard	[yd]			= 3 ft	= 36 in
1 pace				= 5 ft	= 60 in
1 fathom			= 2 yd	= 6 ft	= 72 in
1 rod			= 5½ yd	= 16½ ft	= 198 in
1 chain		= 4 rods	= 22 yd	= 66 ft	= 792 in
1 furlong		= 10 chains	= 220 yd	= 660 ft	= 7920 in
1 statute mile	[mi]	= 8 furlongs	= 1760 yd	= 5280 ft	= 63,360 in
nautical mile		= 1,852 m (exactly) = 6076.12 ft (approximately)			
1 league		= 3 miles	= 5280 yd	= 15,840 ft	= 190,080 in

length measurement units

Quick conversion chart of mils to mm

1 mils to mm = 0.0254 mm

10 mils to mm = 0.254 mm

20 mils to mm = 0.508 mm

30 mils to mm = 0.762 mm

40 mils to mm = 1.016 mm

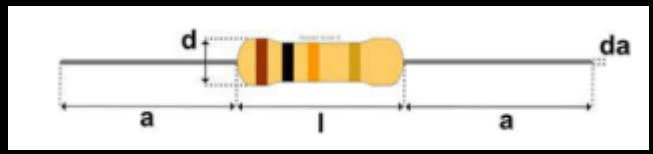
50 mils to mm = 1.27 mm

100 mils to mm = 2.54 mm

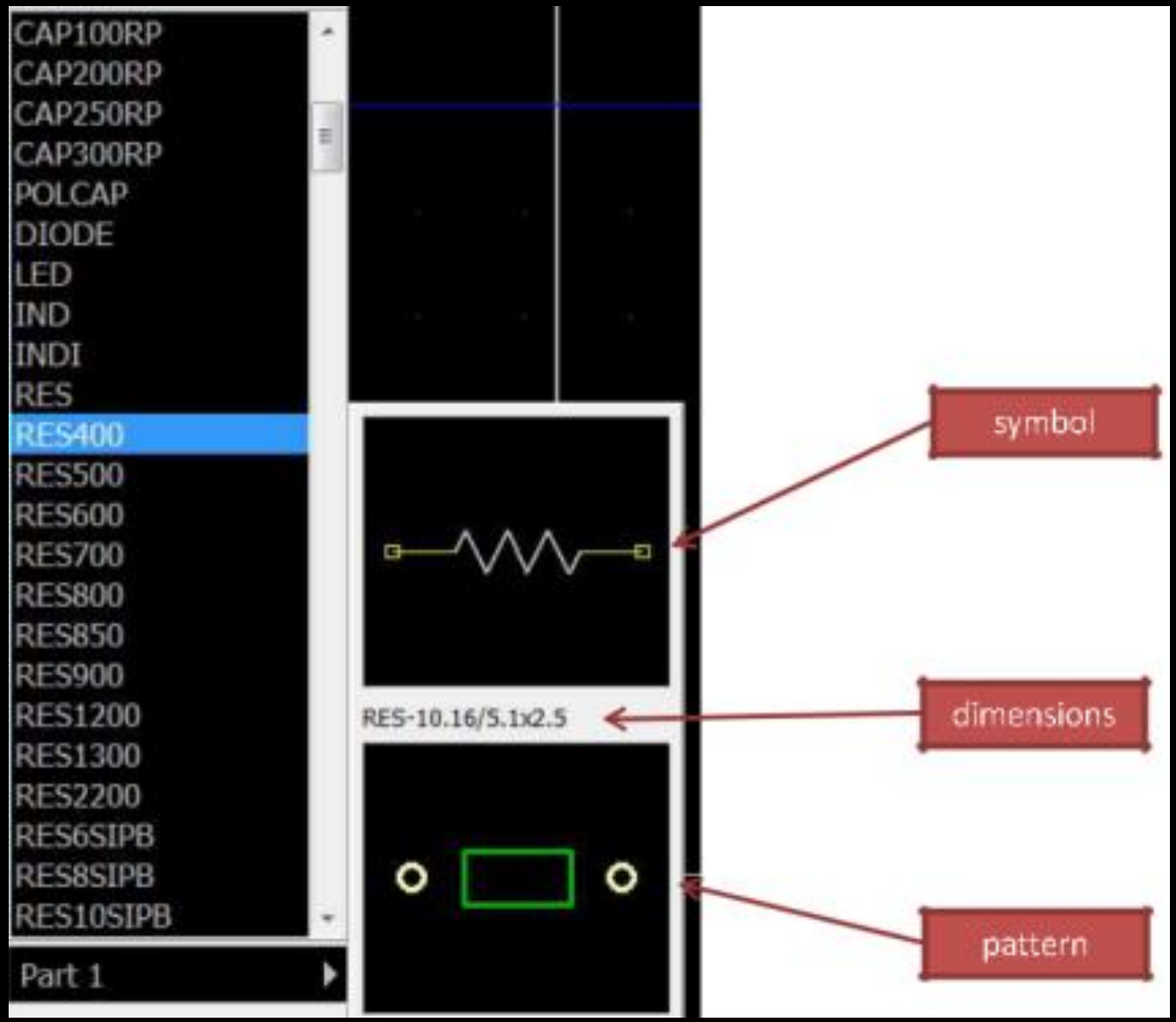
200 mils to mm = 5.08 mm

RESISTOR SIZES AND PACKAGES

- Axial resistor size
- The size of axial resistors is not as standardized as the SMD resistors and different manufacturers often use slightly different dimensions.
- Furthermore the size of an axial resistor depends or the power rating and the type of resistor.
- The following drawing and table give an indication of the dimensions of common carbon film and metal film axial resistors.
- Whenever the exact size needs to be known. Alwase check the manufacturer datasheet of the component.

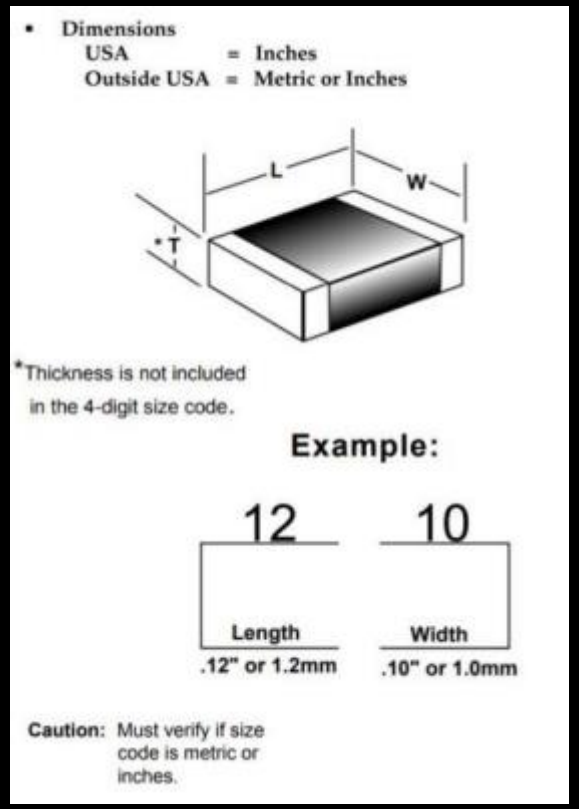


Power rating	Body length (l)	Body diameter (d)	Lead length (a)	Lead diameter (da)
Watt	mm	mm	mm	mm
1/8 (0.125)	3.0 ± 0.3	1.8 ± 0.3	28 ± 3	0.45 ± 0.05
1/4 (0.25)	6.5 ± 0.5	2.5 ± 0.3	28 ± 3	0.6 ± 0.05
1/2 (0.5)	8.5 ± 0.5	3.2 ± 0.3	28 ± 3	0.6 ± 0.05
1	11 ± 1	5 ± 0.5	28 ± 3	0.8 ± 0.05


CAP100RP
CAP200RP
CAP250RP
CAP300RP
POLCAP
DIODE
LED
IND
INDI
RES
RES400
RES500
RES600
RES700
RES800
RES850
RES900
RES1200
RES1300
RES2200
RES6SIPB
RES8SIPB
RES10SIPB
Part 1
RES-10.16/5.1x2.5
symbol
dimensions
pattern

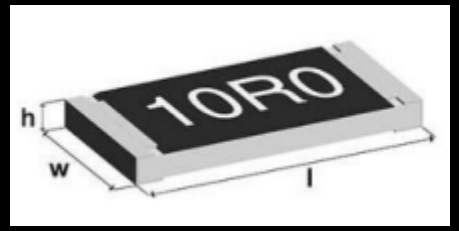
SMD resistor size

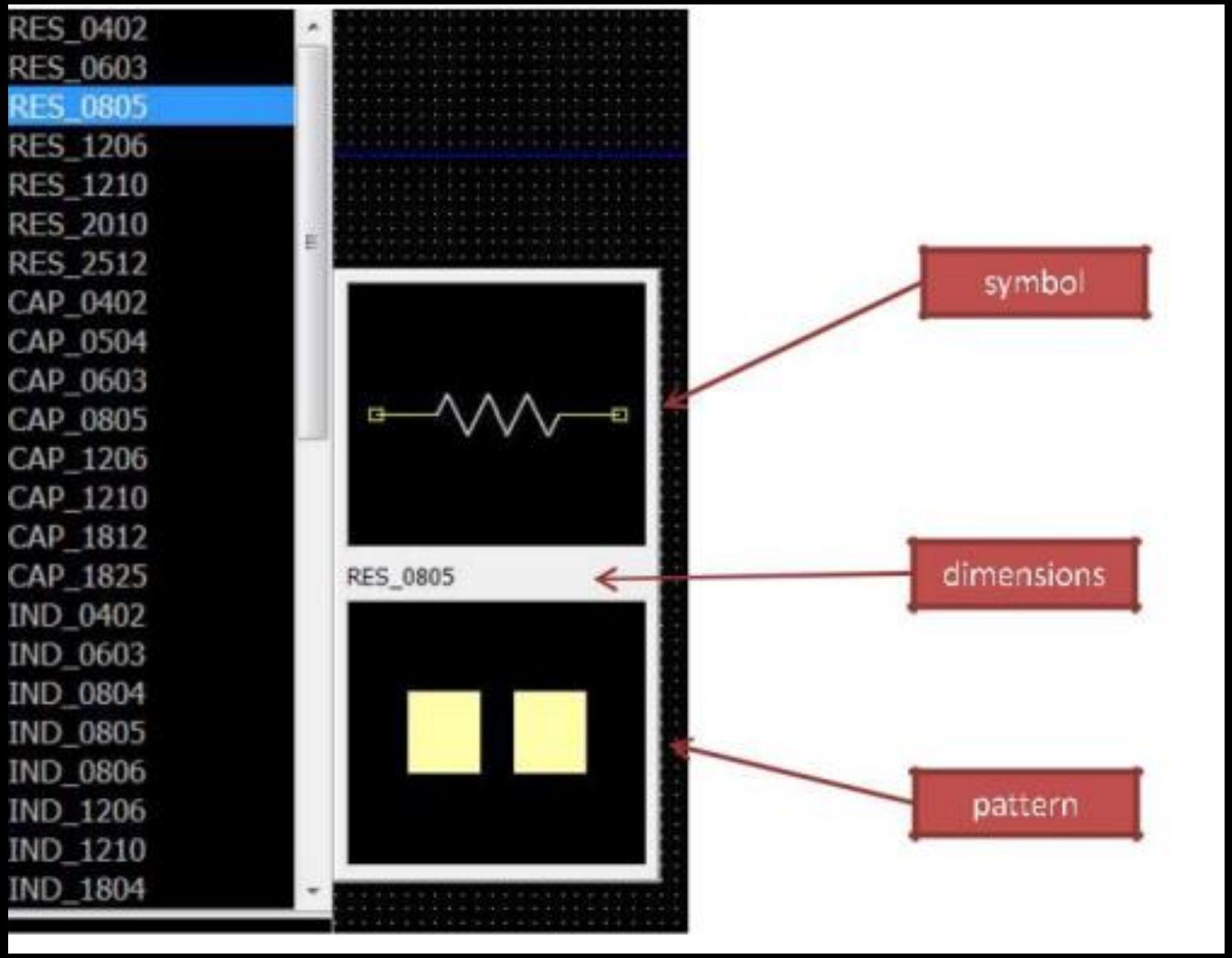
- The shape and size of surface mount resistors are standardized.➤ Most manufacturers use the JEDEC standards.
- The size of SMD resistors is indicated by a numerical code, such as 0603.
- This code contains the width and height of the package.
- So in the example of 0603 Imperial code, this indicates a length of 0.060" and a width of 0.030".
- This code can be given in Imperial or Metric units, in general the Imperial code is used more often to indicate the package size.
- On the contrary in modern PCB design metric units (mm) are more often used, this can be confusing. In general you can assume the code is in imperial units, but the dimensions used are in mm.
- The SMD resistor size depends mainly on the required power rating.



- The following table lists the dimensions and specifications of commonly used surface mount packages.This table is just an indication, you must refer to datasheet

Code		Length (l)		Width (w)		Height (h)		Power
Imperial	Metric	inch	mm	inch	mm	inch	mm	Watt
0201	0603	0.024	0.6	0.012	0.3	0.01	0.25	1/20 (0.05)
0402	1005	0.04	1.0	0.02	0.5	0.014	0.35	1/16 (0.062)
0603	1608	0.06	1.55	0.03	0.85	0.018	0.45	1/10 (0.10)
0805	2012	0.08	2.0	0.05	1.2	0.018	0.45	1/8 (0.125)
1206	3216	0.12	3.2	0.06	1.6	0.022	0.55	1/4 (0.25)
1210	3225	0.12	3.2	0.10	2.5	0.022	0.55	1/2 (0.50)
1812	3246	0.12	3.2	0.18	4.6	0.022	0.55	1
2010	5025	0.20	5.0	0.10	2.5	0.024	0.6	3/4 (0.75)
2512	6332	0.25	6.3	0.12	3.2	0.024	0.6	1



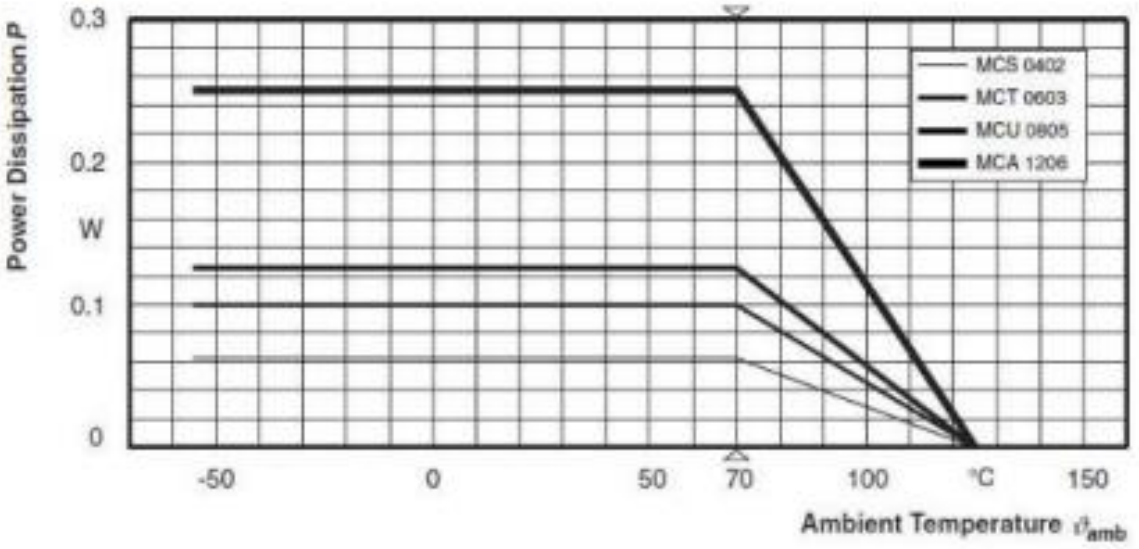

RES_0402
RES_0603
RES_0805
RES_1206
RES_1210
RES_2010
RES_2512
CAP_0402
CAP_0504
CAP_0603
CAP_0805
CAP_1206
CAP_1210
CAP_1812
CAP_1825
IND_0402
IND_0603
IND_0804
IND_0805
IND_0806
IND_1206
IND_1210
IND_1804
RES_0805
symbol
dimensions
pattern

TECHNICAL SPECIFICATIONS

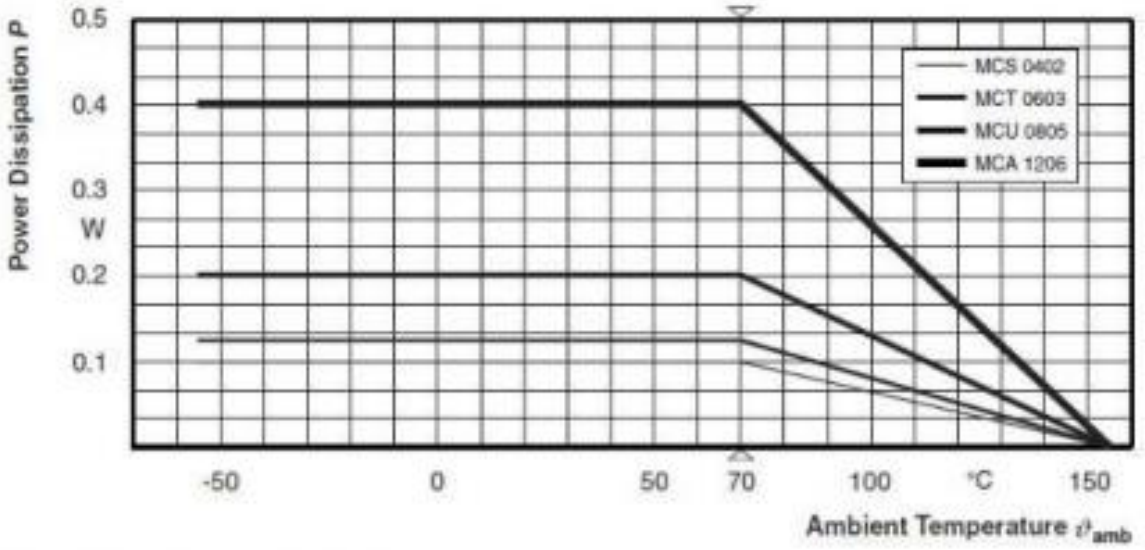
DESCRIPTION	MCS 0402	MCT 0603	MCU 0805	MCA 1206
Imperial size	0402	0603	0805	1206
Metric size code	RR1005M	RR1608M	RR2012M	RR3216M
Resistance range	10 Ω to 4.99 MΩ; 0 Ω	1 Ω to 10 MΩ; 0 Ω	1 Ω to 10 MΩ; 0 Ω	1 Ω to 2 MΩ; 0 Ω

MAXIMUM RESISTANCE CHANGE AT RATED DISSIPATION

OPERATION MODE		STANDARD	POWER
Rated dissipation, P_{70}	MCS 0402	0.063 W	0.100 W
	MCT 0603	0.100 W	0.125 W
	MCU 0805	0.125 W	0.200 W
	MCA 1206	0.250 W	0.400 W
Operating temperature range		-55 °C to 125 °C	-55 °C to 155 °C



Derating - Standard Operation



Derating - Power Operation

Resistors zero-ohm

- A zero-ohm link or zero-ohm resistor is a wire link used to connect traces on printed circuit board.
- This format allows it to be placed on the circuit board using the same automated equipment used to place other resistors, instead of requining a separate machine to install a jumper or other wire.
- Zero-ohm resistors may be packaged like cylindrical resistors, or like surface- mount resistors.
- The resistance is only approximately zero; only a maximum (typically 10- 50 m) is specified.

MELF resistor package sizes

- ➤Another form of surface mount resistor that can be used for some applications is known as a MELF (Metal Electrode Leadless Face) resistor.
- The main advantage of using MELF in stead of standard SMD packages is the lower thermal coefficient and better stability
- There are three common MELF package sizes:
- ✓ MicroMELF,
- ✓ MiniMELF
- ✓ MEI

Name	Abbr.	Code	Length	Diameter	Power
			mm	mm	Watt
MicroMELF	MMU	0102	2.2	1.1	0.2 – 0.3
MiniMELF	MMA	0204	3.6	1.4	0.25 – 0.4
MELF	MMB	0207	5.8	2.2	0.4 – 1.0