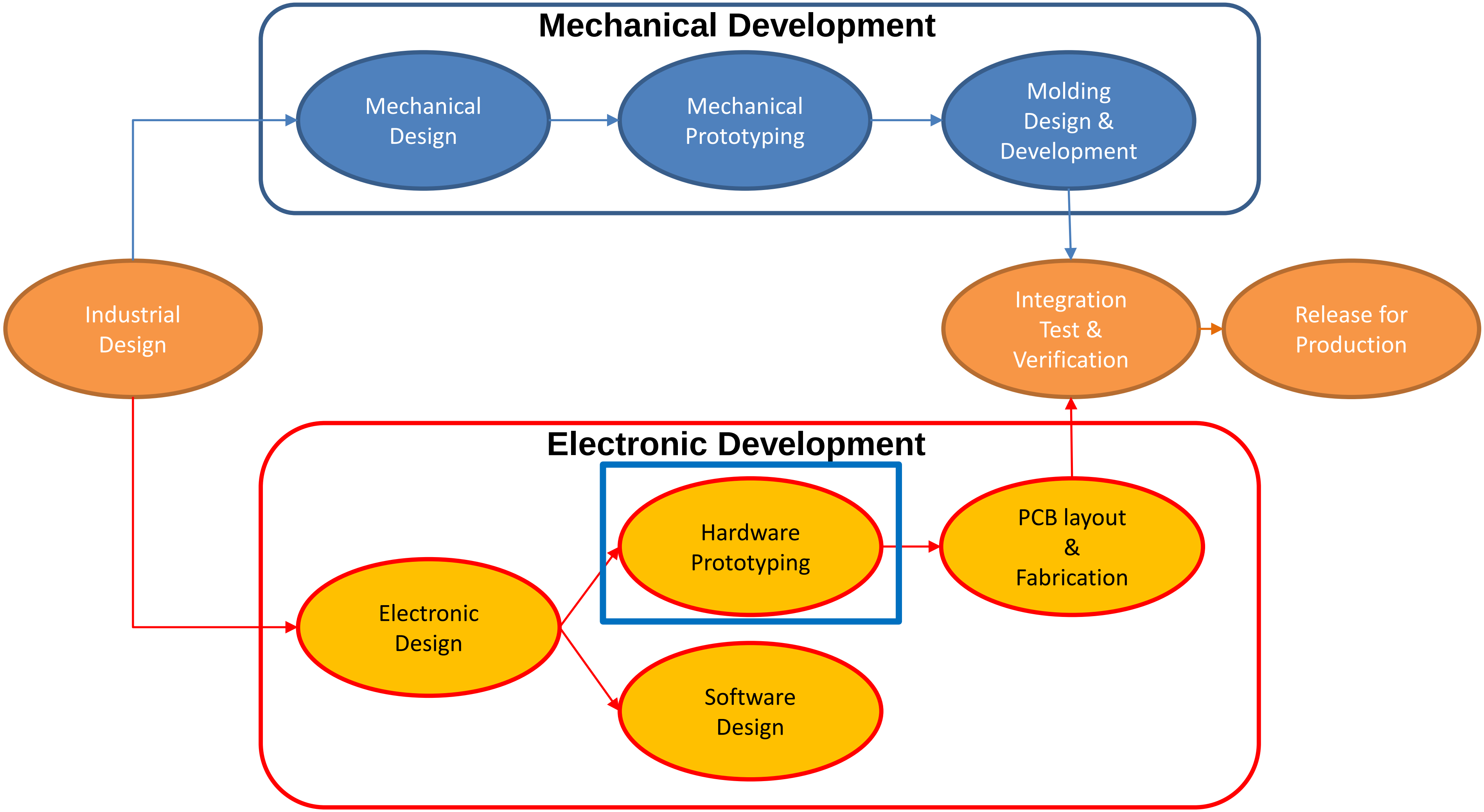
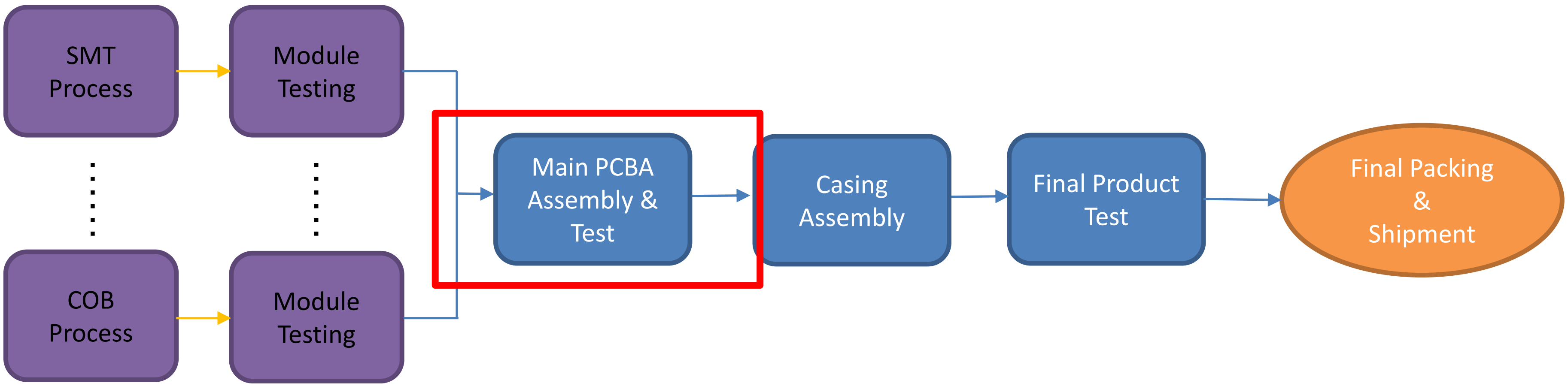
THE HONG KONG POLYTECHNIC UNIVERSITY
香港理工大學
Industrial Centre



Product Development Flow



Product Production Flow

Soldering and desoldering

Content Overview

- **Introduction of common electronics parts**
- **Soldering and desoldering techniques**
- **Packaging of electronic components**

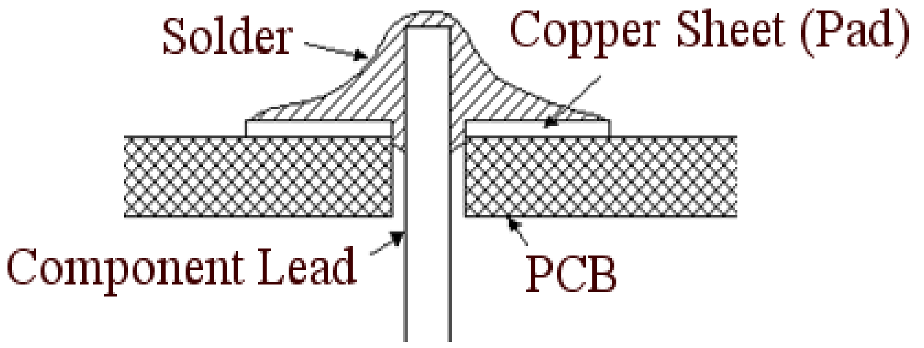
Soldering

- **Hold the soldering iron like a pen, and hold it near to the base of the plastic handle.**
Never touch the hot element or tip.

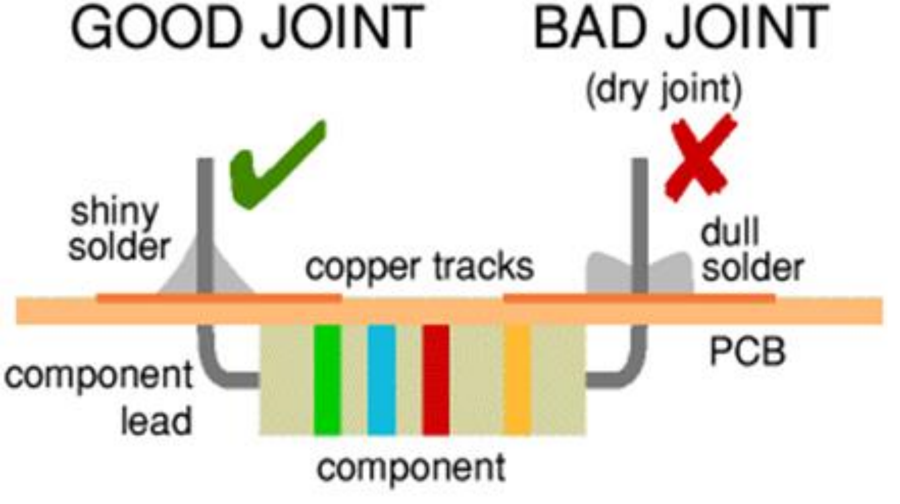
- **Place the soldering iron onto the joint to be made.**
Make sure it touches both the component lead and the track. Hold the tip there for 2-3 seconds and

- **Feed a little bit solder onto the joint.**
It should flow smoothly onto the lead and track to form a shape like Fuji Mountain.

Soldering



Solder Joint Quality



Soldering

<u>Preparing the soldering iron:</u>

- Place the soldering iron in its stand and turn it on.
- Dampen the sponge in the stand.
- Wait a few minutes for the soldering iron to warm up.
- Wipe the tip of the iron on the damp sponge.
- Place a little bit solder on the hot tip of the iron until it has melted.

Soldering

Types of Solder and Flux

- Solder is a metal or metallic alloy
- The commonly used alloys are mixture of tin and lead in different proportion.
- The flux is corrosive, like an acid and it cleans the metal surfaces as the solder melts.

The table below shows the melting points of some common solder alloys.

 Tin/Lead	Melting Point
40/60	230 °C
50/50	214 °C
60/40	190 °C
63/37	183 °C
95/5	224 °C

Soldering

Lead-Free Solder

- Lead-Free solders contain no lead and has a higher melting point.
- Most lead-free alloys are not eutectic, i.e., the alloy does not change from solid to liquid or back again all at once. However, it passes through a mushy stage.
- Soldering at higher temperature will greatly increase the amount of oxidation and quickly consume all the flux, so that it is more difficult in soldering when lead-free solder is used.

Soldering

Lead-Free Solder

•Some of the most commonly used Lead-Free solder alloys are :

Alloy composition	Melting Point $^{\circ}$C
Sn0.7Cu (tin & copper)	227
Sn3.5Ag (tin & silver)	221
SnAgCu (tin, silver & copper)	~210 - 215
Sn9Zn (tin & zinc)	198
Sn8Zn3Bi (tin, silver & bismuth)	~191
58Bi42Sn (bismuth & tin)	138

lead-free

Desoldering

In some circumstances, you would de-solder a joint in order to remove or re-position a wire or component. There are two ways to remove the solder:

1. Using desoldering pump (solder sucker)

•Set the pump by pushing the spring-loaded plunger down until it locks.

•Apply both the pump nozzle and the tip of your soldering iron to the joint.

•Wait a few seconds until the solder melts.

•Then press the button on the pump to release the plunger and suck the molten solder into the tool.

Using a desoldering pump

•Repeat if necessary to remove as much solder as possible.

•Empty the pump occasionally by unscrewing the nozzle.

Desoldering

2. Using solder remover wick (copper braid)

With solder wick
to remove the excess
solder

•Apply both the end of the wick and the tip of your soldering iron to the joint.

•As the solder melts, most of it will flow onto the wick, away from the joint.

•Remove the wick first, then the soldering iron.

•Cut off and discard the wick which is coated with solder.

Safety:

• Always place your soldering iron to its stand immediately after use.

• Don’t touch the joints and components until it has been cooled for a minute.

• Never touch the tip of a soldering iron unless you make sure it is cold.

• Always turn off when the soldering iron is no longer in use.

Component Identification

- **1. Resistor**

Circuit symbol

Resistors restrict the flow of electric current. Resistance is measured in ohms (symbol: Ω). The symbol Ω is usually omitted in circuit diagram. Resistor values are usually shown by the colored bands.

- Most resistors have 4 bands of color code.
  - The first band gives the value of first digit.
  - The second band gives the value of second digit.
  - The third band is the multiplier. It indicates the number of zeros following after 2nd digit.
  - The fourth band is used to shows the tolerance (precision) of the resistor, this may be ignored for almost all circuits.

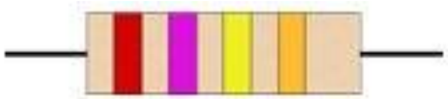
Component Identification

Resistor

For example: Carbon film (1/4W)

The Resistor Colour Code

This resistor has red (2), violet (7), yellow (4 zeros) and gold bands.
So its value is 270000 Ω = 270 kΩ.



Colour	Value
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Grey	8
White	9

Resistor value (in shorthand)

For example:
560R means 560
2K7 means 2.7 kΩ = 2700 Ω
39K means 39 kΩ
1M means 1MΩ = 1000 kΩ

The fourth band indicates tolerance. The special color code is used:
silver ±10%, **gold** ±5%, **red** ±2%, **brown** ±1%.
If there is no fourth band, the tolerance is ±20%.

Component Identification

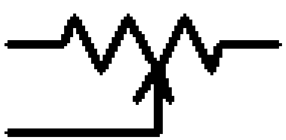
High power Resistor

Wirewound Aluminum Housed

Wirewound Ceramic Body

Variable resistors

Variable resistors are often called **potentiometers** in books**.** They are specified by their maximum resistance, linear or logarithmic track, and their physical size.



Component Identification

2. Capacitor

Capacitance is a measure of a capacitor's ability to store electric charge. A large capacitance means that more charge can be stored. Capacitance is measured in farads, symbol F. However, the majority of capacitor used in circuit board is much smaller than 1F. So, the prefixes are used to represent the smaller capacitor values.

Three prefixes (multipliers) are used, μ (micro), n (nano) and p (pico):

μ means 10^{-6} (millionth), so 1000000μF = 1F

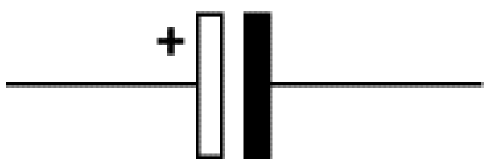
n means 10^{-9} (thousand-millionth), so 1000nF = 1μF

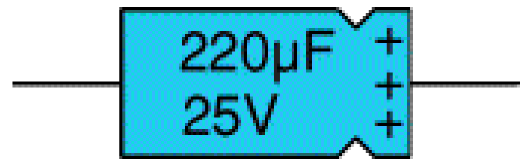
p means 10^{-12} (million-millionth), so 1000pF = 1nF

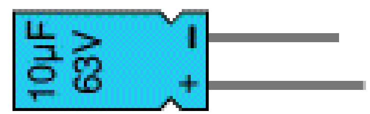
Component Identification

(1)Electrolytic capacitors (> 1µF)

Examples:







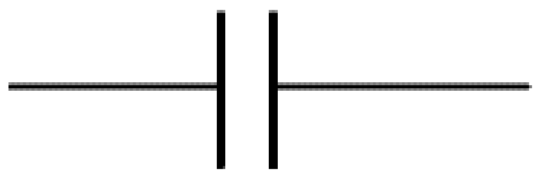
There are two designs for electrolytic capacitors:

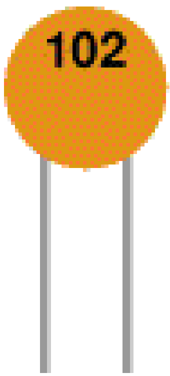
- **axial** where the leads are attached to each end (220µF)
- **radial** where both leads are at the same end (10µF).

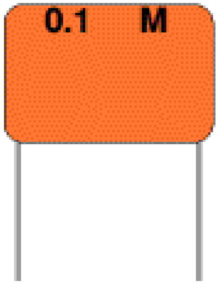
Component Identification

(2)Unpolarised capacitors (1pF - 1μF)

Examples:







Small capacitors are unpolarised . They have high voltage ratings of at least 50V, usually 250V or so. Usually, their capacitor values are printed on them.

For example, **0.1** means 0.1μF = 100nF.
Sometimes, the multiplier is used in place of the decimal point.
For example: **4n7** means 4.7nF.

Component Identification

Capacitor Number Code

The capacitor code is often used, when the actual value can hardly be printed on those tiny capacitor. The code contains 3 numbers at most.

•1st number is the 1st significant digit.
•2nd number is the 2nd significant digit.
•3rd number is a multiplier, it indicates the number of zeros following after the 2nd digit. (The first two digits gives the value in pF)
•Ignore any letters - they indicate tolerance and voltage rating.

For example: **102** means 1000pF = 1nF *(not 102pF!)*

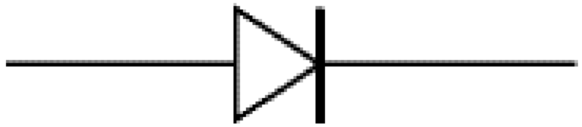
For example: **472J** means 4700pF = 4.7nF (J means 5% tolerance).

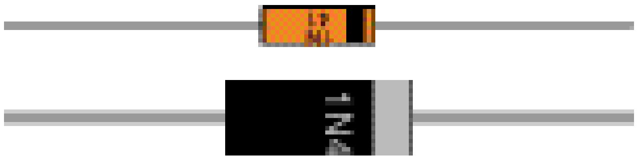
Component Identification

3. Diode

Diodes allow electricity to flow in only one direction. General purpose signal diodes such as the 1N4148 are made from silicon and have a forward voltage drop of 0.7V. The 1N4001 is suitable for most low voltage circuits with a current of less than 1A.

Germanium diodes such as the OA90 have a lower forward voltage drop of 0.2V and this makes them suitable to use in radio circuits as detectors which extract the audio signal from the weak radio signal.

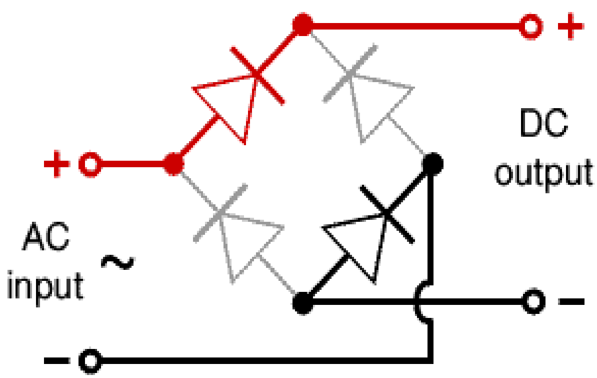




Component Identification

Various types of Bridge Rectifiers

The bridge rectifiers contain four diodes. Bridge rectifiers are rated by their maximum current and maximum reverse voltage. They have four leads or terminals: the two DC outputs are labeled + and -, the two AC inputs are labeled .

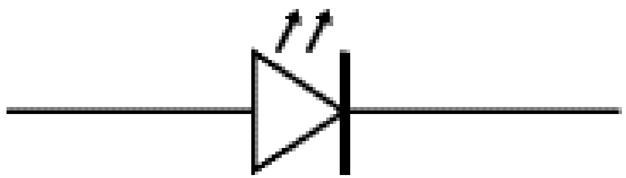


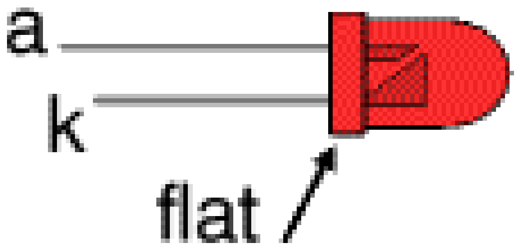
Component Identification

4. LED

LEDs emit light when the electric current passes through them. LEDs can be damaged by excessive heat. It should NOT be happened during soldering, unless the technician heats it too long.

Never connect an LED directly to a battery or power supply!





Component Identification

The table below shows the typical technical data for some 5mm diameter round LEDs with diffused packages (plastic bodies). The blue highlighted columns are most important.

Type	Colour	I_F max.	V_F typ.	V_F max.	V_R max.	Luminous intensity	Viewing angle	Wavelength
Standard	Red	30mA	1.7V	2.1V	5V	5mcd @ 10mA	60°	660nm
Standard	Bright red	30mA	2.0V	2.5V	5V	80mcd @ 10mA	60°	625nm
Standard	Yellow	30mA	2.1V	2.5V	5V	32mcd @ 10mA	60°	590nm
Standard	Green	25mA	2.2V	2.5V	5V	32mcd @ 10mA	60°	565nm
High intensity	Blue	30mA	4.5V	5.5V	5V	60mcd @ 20mA	50°	430nm
Super bright	Red	30mA	1.85V	2.5V	5V	500mcd @ 20mA	60°	660nm
Low current	Red	30mA	1.7V	2.0V	5V	5mcd @ 2mA	60°	625nm

Component Identification

The technical definitions are explained as below:

I_F max. Maximum forward current, forward just means with the LED connected correctly.

V_F typ. Typical forward voltage, V_L in the LED resistor calculation.
This is about 2V, except for blue and white LEDs for which it is about 4V.

V_F max. Maximum forward voltage.

V_R max. Maximum reverse voltage
You can ignore this for LEDs connected in the right direction

Luminous intensity

Brightness of the LED at the given current, mcd = millicandela.

Viewing angle

Standard LEDs have a viewing angle of 60°, others emit a narrower beam of about 30°.

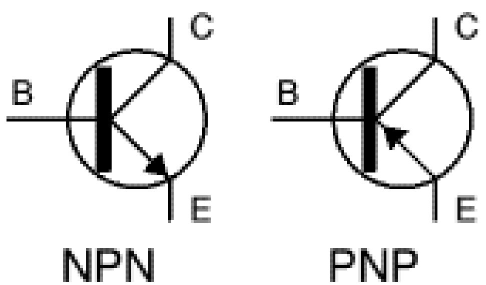
Wavelength

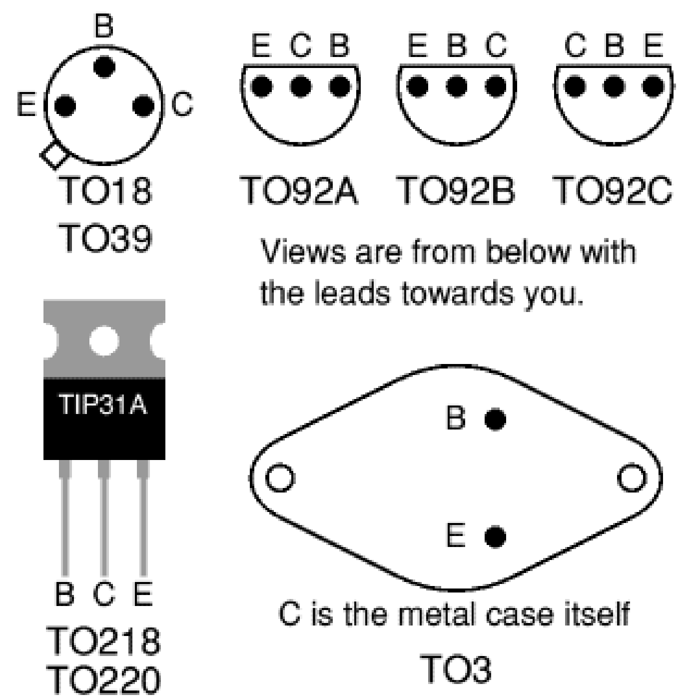
The peak wavelength of the light emitted, this determines the colour of the LED.
nm = nanometre.

Component Identification

5. Transistor

A transistor may be used as a **switch** or **amplifier.** There are two types of standard transistors, **NPN** and **PNP**, with different circuit symbols. The leads are labeled **base** (B), **collector** (C) and **emitter** (E).





Component Identification

The technical definitions are explained as below:

I_C max. Maximum collector current.

V_{CE} max. Maximum voltage across the collector-emitter junction. You can ignore this rating in low voltage circuits.

h_{FE} This is the **current gain** (strictly the DC current gain). The guaranteed minimum value is given because the actual value varies from transistor to transistor, even for those of the same type! Note that current gain is just a number, so it has no units.

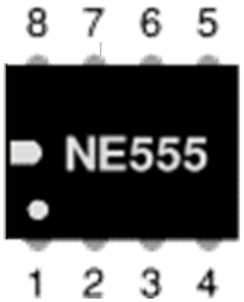
The gain is often quoted at a particular collector current I_C which is usually in the middle of the transistor's range. For example, '100@20mA' means the gain is at least 100 at 20mA. Sometimes minimum and maximum values are given. Although the gain is roughly constant for various currents, it varies from transistor to transistor. For general users, they can pay little attention to this. Only the expects may have interest in the detail.

P_{tot} max. Maximum total power which can be developed in the transistor, note that a heat sink will be required to achieve the maximum rating. This rating is important for transistors operating as amplifiers, the power is roughly $I_C \times V_{CE}$. For transistors operating as switches, the maximum collector current (I_C max.) is more important.

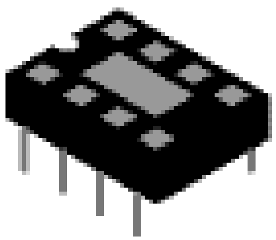
Component Identification

6. IC

Integrated Circuits are usually called ICs or chips. They are complex circuits which have been etched onto tiny chips of semiconductor. The pins are numbered in anti-clockwise, the pin1 is next to the dot mark on the IC. The diagram shows the numbering for 8-pin IC, but the principle is the same for all sizes. When we insert the chip into the socket, make sure all its pins are lined up with the socket, then push it down firmly with your thumb.



IC



IC Socket

Many ICs are static sensitive.

Put ICs in their antistatic packages until you need them. Before touching/holding the ICs, discharge the static electricity (grounding) by touching a metallic water pipe or window frame.

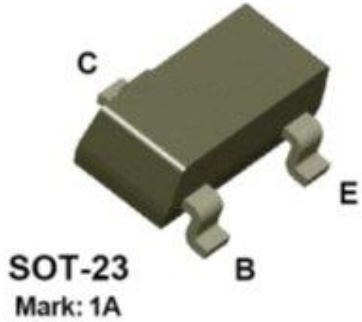
SMT Component

SMD Resistor

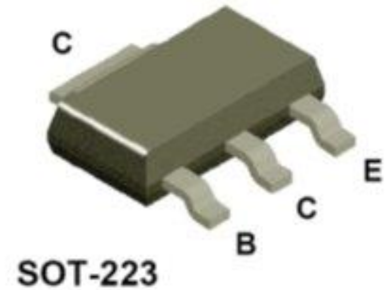
1kΩ

Commonly seen codes are the three and four digit

MMBT3904



PZT3904



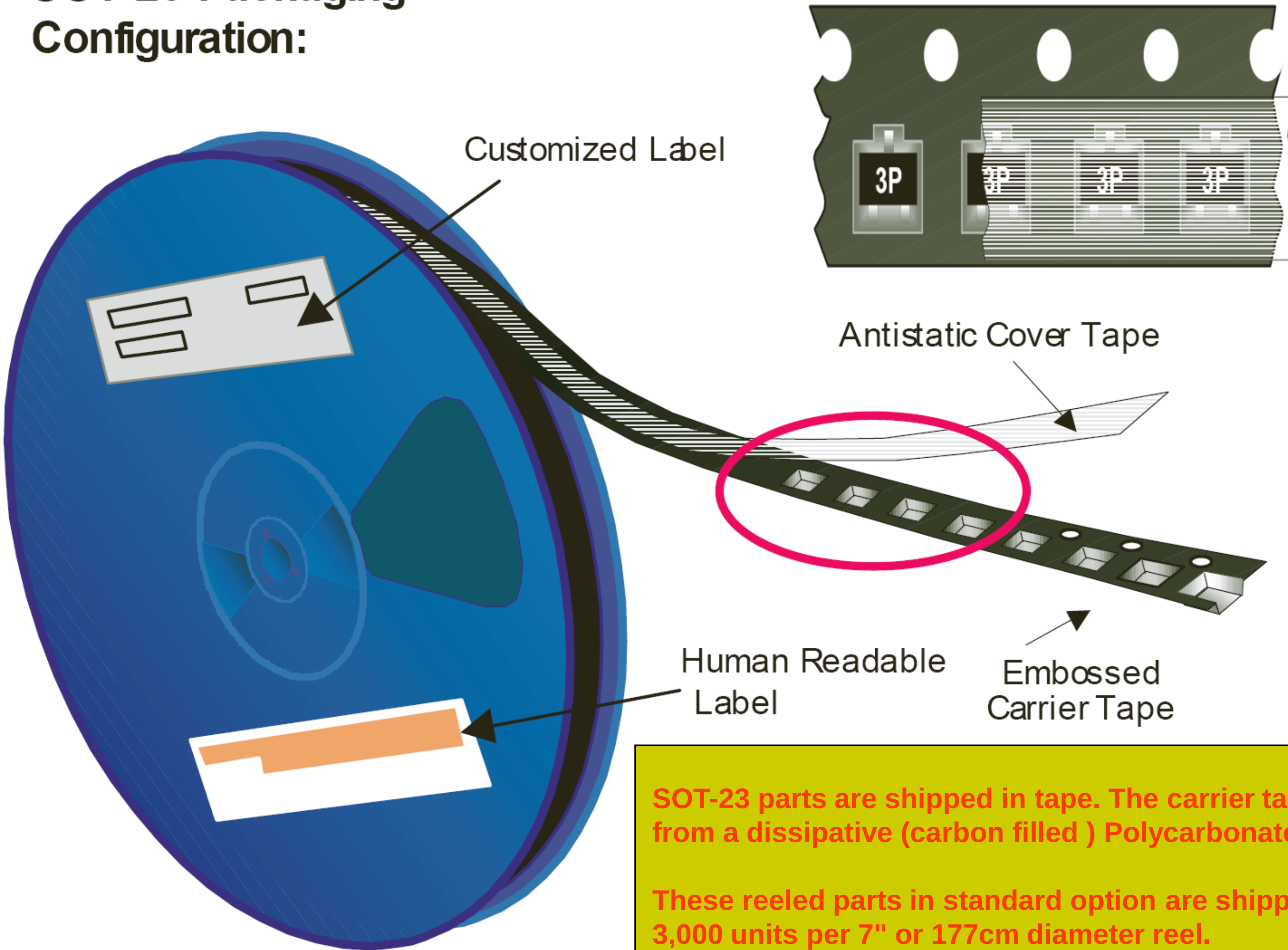
NPN General Purpose Amplifier

This device is designed as a general purpose amplifier and switch.

The useful dynamic range extends to 100 mA as a switch and to 100 MHz as an amplifier.

SOT-23 Tape and Reel Data

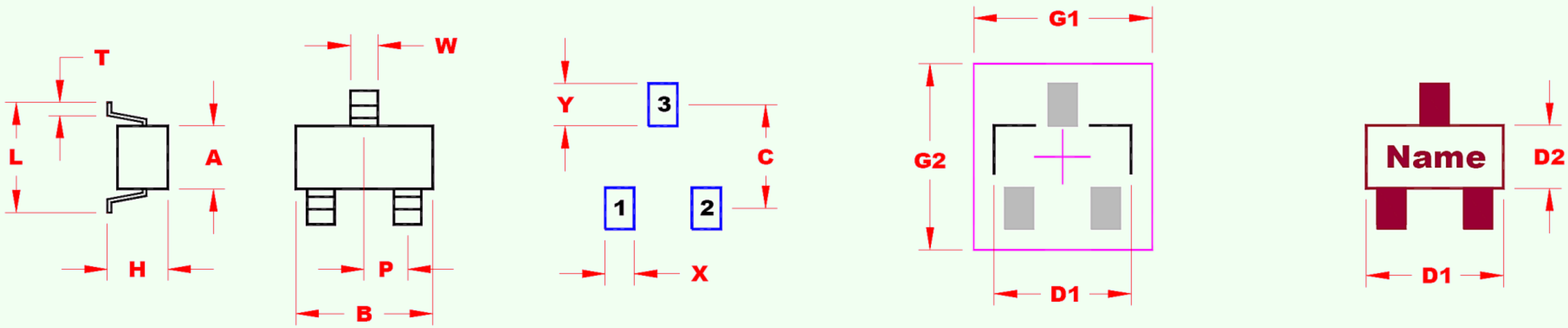
SOT-23 Packaging Configuration:



SOT-23 parts are shipped in tape. The carrier tape is made from a dissipative (carbon filled) Polycarbonate.

These reeled parts in standard option are shipped with 3,000 units per 7" or 177cm diameter reel.

SOT-23 Packaging :

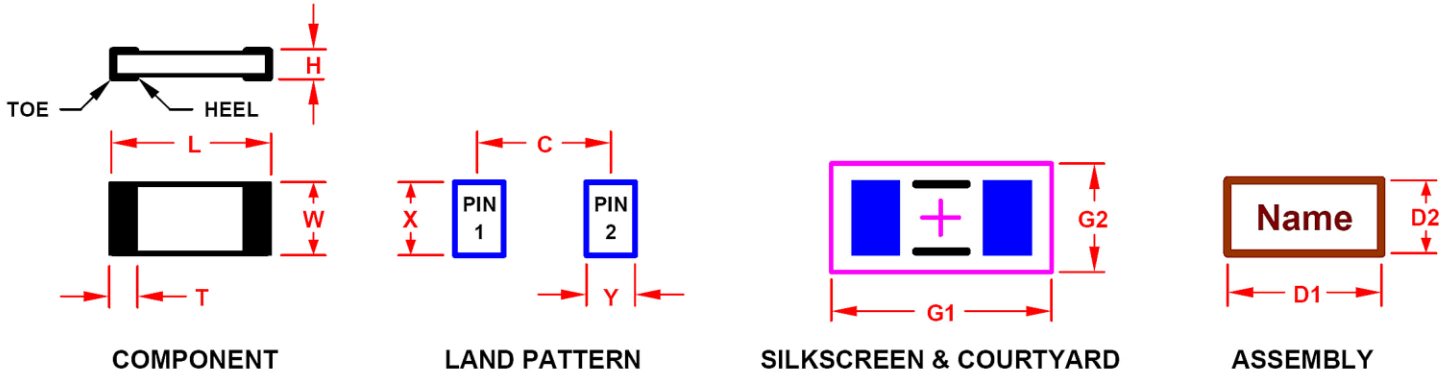


COMPONENT LAND PATTERN SILKSCREEN & COURTYARD ASSEMBLY

Units are **mm** [mils]

NUE SOT-23		COMPONENT							LAND PATTERN			COURTYARD		SILKSCREEN ASSEMBLY	
	Land Pattern Name	P	A nom	B nom	L nom	T max	W max	H max	C	X	Y	G1	G2	D1	D2
1	SOT-23	0.95 [37]	1.30 [51]	2.90 [114]	2.45 [96]	0.60 [24]	0.50 [20]	1.10 [43]	2.10 [83]	0.60 [24]	1.50 [59]	3.40 [134]	4.10 [161]	2.90 [114]	1.30 [51]

SMT Component - Chip Capacitors



Units are **mm** [mils]

NUE Chip Capacitors		COMPONENT					LAND PATTERN			COURTYARD		ASSEMBLY	
	Land Pattern Name	**L nom**	**W nom**	**W max**	**T max**	**H max**	**C**	**X**	**Y**	**G1**	**G2**	**D1**	**D2**
1	**CAP0603** (0201)	**0.60** [24]	**0.30** [12]	**0.35** [14]	**0.20** [8]	**0.30** [12]	**0.80** [31]	**0.30** [12]	**0.60** [24]	**1.90** [75]	**0.90** [35]	**1.80** [71]	**0.80** [31]
2	**CAP0816** (0306)	**0.80** [31]	**1.60** [63]	**1.75** [69]	**0.38** [15]	**0.38** [15]	**1.10** [43]	**1.70** [67]	**0.80** [31]	**2.40** [94]	**2.30** [91]	**2.30** [91]	**2.20** [87]
3	**CAP1005** (0402)	**1.00** [39]	**0.50** [20]	**0.60** [24]	**0.30** [12]	**0.60** [24]	**1.10** [43]	**0.60** [24]	**0.70** [28]	**2.30** [91]	**1.10** [43]	**2.20** [87]	**1.00** [39]
4	**CAP1310** (0504)	**1.20** [47]	**1.00** [39]	**1.20** [47]	**0.38** [15]	**1.00** [39]	**1.20** [47]	**1.20** [47]	**0.80** [31]	**2.50** [98]	**1.70** [67]	**2.20** [87]	**1.40** [55]
5	**CAP1320** (0508)	**1.30** [51]	**2.00** [79]	**2.25** [89]	**0.50** [20]	**0.50** [20]	**1.20** [47]	**2.20** [87]	**0.90** [35]	**2.60** [102]	**2.80** [110]	**2.10** [83]	**2.20** [87]
6	**CAP1608** (0603)	**1.60** [63]	**0.80** [31]	**0.95** [37]	**0.50** [20]	**0.85** [33]	**1.50** [59]	**0.90** [35]	**0.90** [35]	**2.90** [114]	**1.50** [59]	**2.40** [94]	**0.90** [35]
7	**CAP1632** (0612)	**1.60** [63]	**3.20** [126]	**3.45** [136]	**0.46** [18]	**0.46** [18]	**1.60** [63]	**3.40** [134]	**0.90** [35]	**3.00** [118]	**4.00** [157]	**2.50** [98]	**3.40** [134]
8	**CAP2012** (0805)	**2.00** [79]	**1.20** [47]	**1.40** [55]	**0.70** [28]	**1.10** [43]	**1.70** [67]	**1.40** [55]	**1.10** [43]	**3.30** [130]	**1.90** [75]	**2.80** [110]	**1.40** [55]

Soldering SMC Components, Point To Point Method

PROCEDURE :

- **Add liquid flux to one pad and Prefill with solder. (See Figure 1).**
- **Clean the area.**
- **Add liquid flux to both pads.**
- **Place the component in position and hold it steady with a wooden stick or tweezers so that the soldering iron won't push the component out of alignment.**

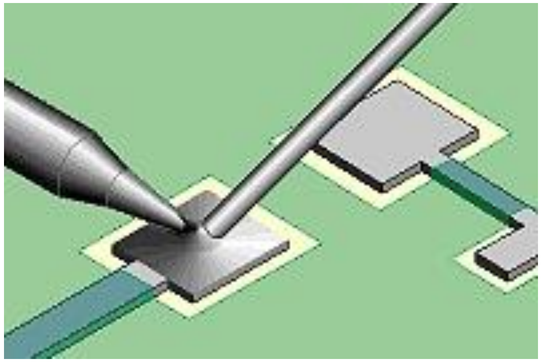


Figure 1:
Prefill one pad with solder.

Soldering SMC Components, Point To Point Method

- **Place the soldering iron tip at the junction between the prefilled pad and component lead.**
- **Flow the solder until the component drops down and is soldered in position. Apply additional solder as needed. (See Figure 2).**

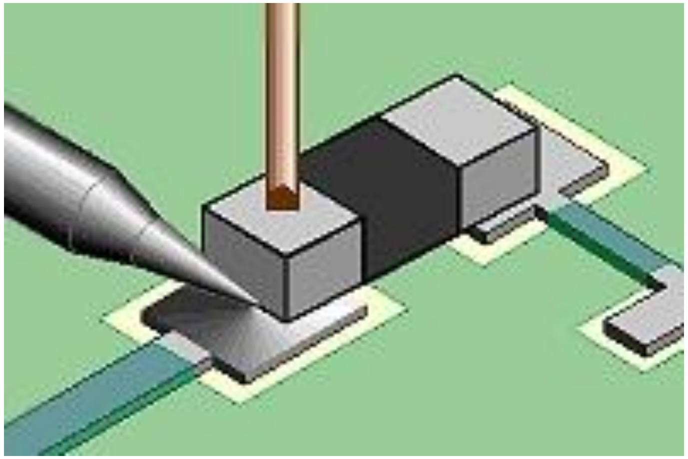


Figure 2:

Soldering SMC Components, Point To Point Method

- **Remove the tip. Wait a moment for the solder to solidify before soldering the other side of the component. (See Figure 3).**
- **Clean, if required and inspect.**

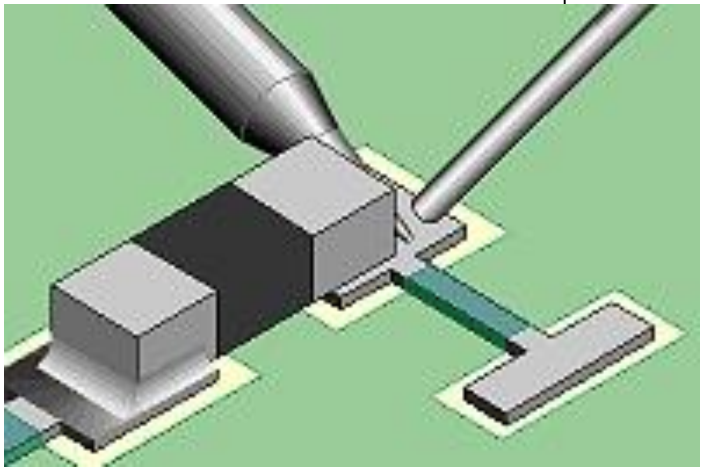


Figure 3