



Basic SMD Soldering

Working with SMT Devices
Basic Electronics Series



Terminology

- SMD Surface-mount devices (active, passive and electromechanical components)
- SMT Surface-mount technology (assembling and mounting technology)
- SMA Surface-mount assembly (module assembled with SMT)
- SMC Surface-mount components (components for SMT)
- SMP Surface-mount packages (SMD case forms)
- SME Surface-mount equipment (SMT assembling machines)



Introduction

- SMD soldering is *not* at all like THT soldering, as you have access to only one surface of the PCB.
- At its best, SMD soldering consists of lap joint connections and has little physical or mechanical strength as a result
- In most cases, solder must be applied to the pads before the device is placed.
- SMD soldering takes patience and is a skill that must be developed over time.
- SMD soldering can be challenging, but also is rewarding when it is well done and the unit functions as designed.



SMD Components

- All SMD devices fit on specific PCB footprints, most of which are industry standards and are the same from one device manufacturer to another.
- Some footprints are described by their sizes, in either English (Imperial) or Metric designations.
- Others use industry-standard footprint designations based on the package type.
- Many variations of the SMD package footprints exist.



Capacitors, Resistors, and Diodes

- Most SMD capacitors, resistors, and diodes are placed on footprints designated by the physical size of the device...
- Imperial sizes are based on decimal dimensions, in the form *length x width*
 - Thus, a 1206 resistor is 0.12" long and is 0.06" wide
- Metric sizes are based on millimeter dimensions, in the form *length x width*
 - Thus, a 0201 resistor is 0.2 mm long x 0.1 mm wide
- A metric size 0201 is equivalent to an Imperial size 008004



Standard SMD Package Sizes - Imperial

SMD Package Type	Dimensions (inches)	Dimensions (mm)
2920	0.29 x 0.20	7.4 x 5.1
2512	0.25 x 0.125	6.3 x 3.2
2010	0.20 x 0.10	5.0 x 2.5
1825	0.18 x 0.25	4.5 x 6.4
1812	0.18 x 0.125	4.6 x 3.0
1806	0.18 x 0.06	4.5 x 1.6
1210	0.125 x 0.10	3.2 x 2.5
1206	0.12 x 0.06	3.0 x 1.5
0805	0.08 x 0.05	2.0 x 1.3
0603	0.06 x 0.03	1.5 x 0.8
0402	0.04 x 0.02	1.0 x 0.5
0201	0.02 x 0.01	0.6 x 0.3
01005	0.016 x 0.008	0.4 x 0.2

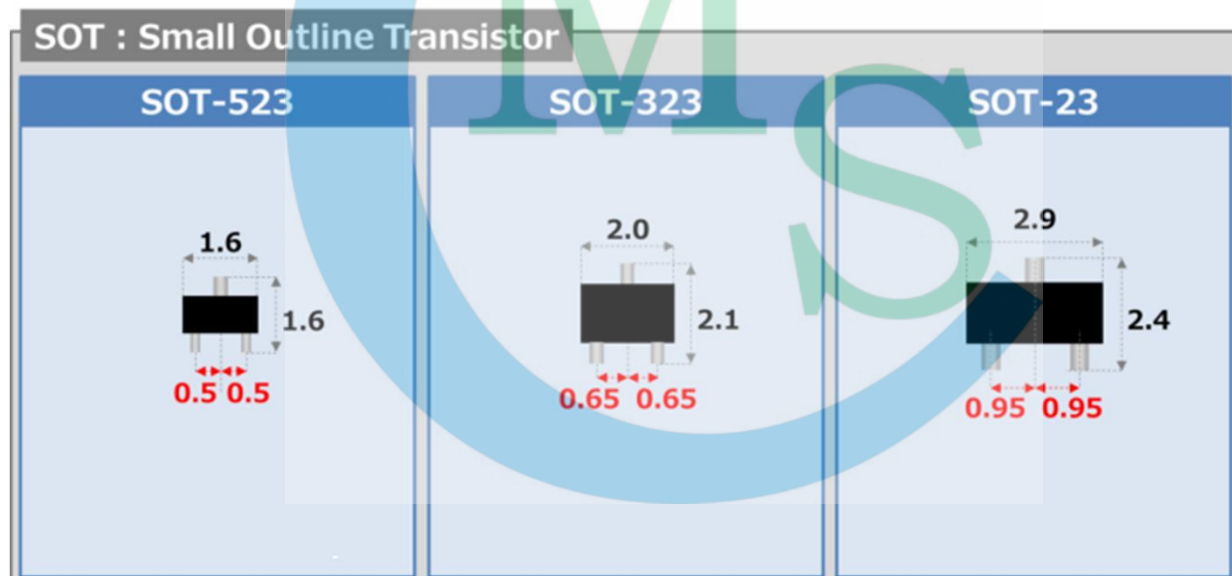
Standard SMD Package Metric Comparison

Metric code component	compared to	Imperial code component
0201	=	008004
03015	=	009005
0402	=	01005
0603	=	0201
1005	=	0402
1608	=	0603
2012	=	0805
2520	=	1008
3216	=	1206
4516	=	1806
4532	=	1812
5025	=	2010
6332	=	2512



SMD Transistor Packages

- SMD transistor packages use the SOT (Small Outline Transistor) sizing system...



SOT CLarifications

- Because certain devices in transistor-like packages may have more than three pins, the SOT designation will usually have a suffix...
 - SOT23-3 will be a three-pin device like a standard transistor
 - SOT23-5 will be a 5-pin device like some IC's
- This scheme is carried through all of the SOT designations
- Example... an SOT23-5 device may be a dual-transistor device with one common terminal as designated on the device datasheet
- The most common pinout for an SOT 3-pin has the collector by itself and the base on the left when the collector is away from you



Other SMD Device Package Information

- There are five main package types for SMD integrated circuits (ICs).
 - Small outline integrated circuit (SOIC)
 - Small outline package (SOP)
 - Quad flat pack (QFP)
 - Plastic leaded chip carrier (PLCC)
 - Ball grid array (BGA).



Other SMD Device Package Information

- In addition, some SMD package types for ICs have multiple styles. SOP packages provide an example.
 - Thin small outline package (TSOP)
 - Shrink small outline package (SSOP)
 - Thin shrink small outline package (TSSOP)
 - Quarter-size small outline package (QSOP)
 - Very small outline package (VSOP)



Other SMD Device Package Information

- There are also different styles of QFP packages for surface mount devices.
 - Low profile quad flat pack (LQFP)
 - Plastic quad flat pack (PQFP)
 - Ceramic quad flat pack (CQFP)
 - Thin quad flat pack (TQFP)
- These aren't the only choices that are available, so it's important to partner with an electronics distributor who can help you to make the right selections for your application.



Soldering SMD Devices

- Sometimes, an SMD device cannot be soldered via conventional methods, and must be board-heated to solder the device.
 - An example of this is the ball-grid array, in which the device terminals are actually ball-shaped protuberances on the underside of the chip.
 - These devices must be placed on solder or solder paste on the pads, and then the entire unit heated to melt the solder and secure the device.
- In other cases, the device can be soldered to the pads which extend beyond the limits of the physical device.
- This is the type of soldering that we will be discussing.



Methods

- Start by applying a small amount of solder to the pads to which the device will be soldered, making sure that the solder applied is as flat as you can make it.
- Place the device onto the pads, being sure to orient it properly as to polarity.
- Holding the device in place using the back of a pair of tweezers pushing downward on the device gently, apply heat to one pad just until the solder on that pad flows and adheres to the device.
- Allow the device to cool for a few seconds, and then apply heat to the next pad, while still pushing downward gently on the device.



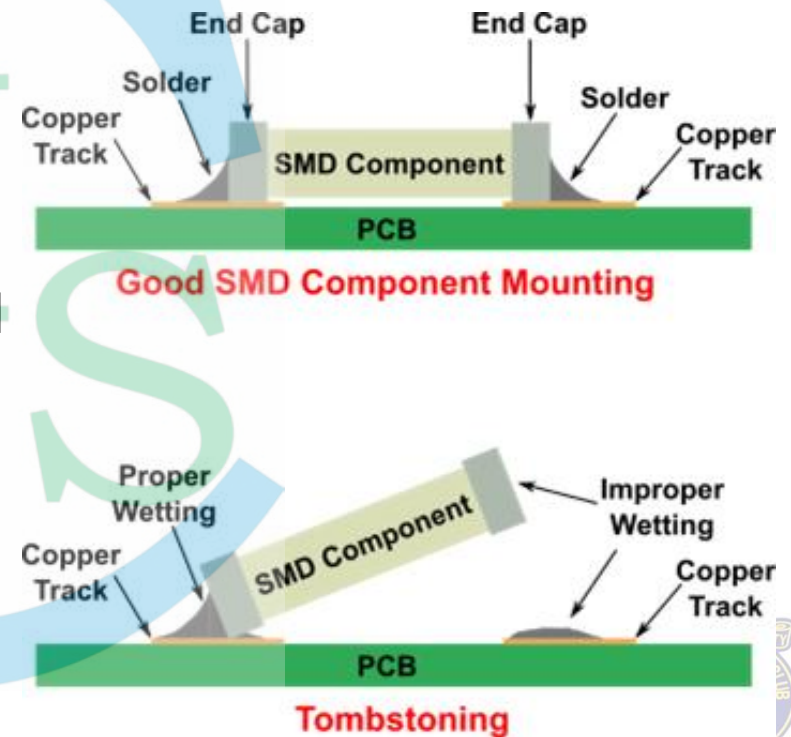
Methods

- Go back to the first pad, and add just enough solder to get a proper fillet of solder at the pad and component lead
- Repeat the operation at the other pad(s) until the device is secure, allowing it to cool between each pad and the next.



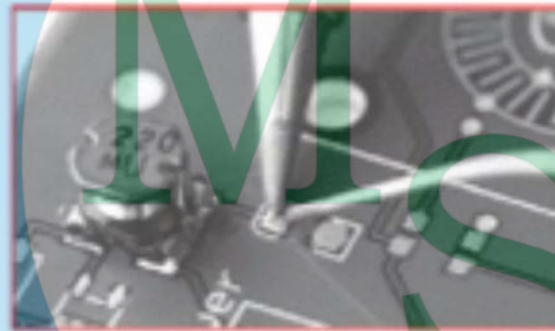
SMD Soldering Profile View

- When properly soldered, an SMD device will have the profile view shown in the upper drawing.
- “*Tombstoning*” occurs when too much pressure is placed on one end of the SMD device and insufficient wetting of the opposite end has occurred
- Reheat the fixed side to correct the condition, pressing the SMD device down onto the board while hot



The Perfect Joint

Perfect solder joint, step 1 of 4



- Hold the iron touching one of the pads for a count of one
- Make sure to touch the side of the iron tip to the pad, not the actual tip of the iron



The Perfect Joint

Perfect solder joint, step 2 of 4



- Feed a tiny bit of solder onto the pad while continuing to hold the iron to the pad
- Feed enough solder onto the pad to cover the pad, but no more



The Perfect Joint

Perfect solder joint, step 3 of 4



- Continue to hold the soldering iron on the pad and pick up your component using the tweezers with your other hand
- Make sure the tweezers are making contact only with the sides of the component that do not have leads, otherwise you may get your tweezers in the solder



The Perfect Joint

Perfect solder joint, step 3 of 4



- Continue to hold the soldering iron on the pad so the solder stays liquid
- Slide the component into the solder from the side while keeping the bottom of the component flat on the PCB
- Make sure you slide the component far enough into the pad so that the pad on the other side of the component is at least half exposed



The Perfect Joint

Perfect solder joint, step 4 of 4



- Continue to hold the component on the pad with your tweezers and remove the soldering iron, wait for the solder to solidify and then remove your tweezers



The Perfect Joint

Oops.



- If you don't slide the component in from the side you may wind up with a component that does not touch pads on both sides
- If this happens just reflow the solder on the first join and replace the component



Using Solder Wick



- Apply flux to the solder you want to remove
- Place the solder wick on top of the solder you want to remove
- Sandwich the solder wick between the solder and your iron until the heat sucks the solder into the wick



Things to Remember...

- Don't spare the flux – it will aid in proper wetting and also will tend to keep the device on place while soldering
- Look for polarity marks on the board... + (plus) signs for capacitors, and either lines or dots for diodes and LED's
- Clean up after yourself... clean off excess flux using 99% IPA
- Allow pads to cool sufficiently between soldering jobs so that the chip doesn't "float" on molten solder
- Use enough solder to properly attach the device to the PCB, but watch out for solder bridges



Watch This...



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A large, light blue 'Q' with a green 'M' and 'S' inside it, forming a background logo for the QMS (Quality Management System) text.

Questions?

