Chapter 3
Surface Mount Components

3.0 INTRODUCTION

Surface mount devices, active or passive, are functionally no different from their conventional through-hole counterparts. Thus the design and electrical function of an internal device is not unique to surface mounting, hence beyond the scope of this book. What is different in surface mounting is the packaging of those devices. Surface-mounted devices (SMDs) or components (SMCs) provide greater packaging density because of their smaller size.

Among many other benefits of surface mounting, the real estate savings is of paramount importance. Since reduced size is the key benefit of SMT, there is a continuous demand for smaller sizes. This has lead to the widespread use of fine pitch (20 and 25 mil pitch) and ultrafine fine pitch (0.5 mm or 20 mil and lower pitch) and ball grid arrays (BGAs). Even chip scale packaging (package size not more than 1.2 times die size) and direct chip attach are becoming more and more common to achieve further densification. All these surface mount packages affect not only the real estate on the board but also the electrical performance of the device and the assembly. Moreover, due to component packaging differences, the parasitic losses such as capacitance and inductance in surface-mounted devices are considerably less than those for the through-hole technology.

The component packages, in addition to saving real estate and providing better electrical performance, serve many other functions. They protect the devices within them from the environment, provide communication links, remove heat, and offer a means for handling and testing.

It is safe to say that when it comes to component packaging, the world of surface mounting is much more complex than that of conventional through-hole mount technology. In this chapter we discuss commonly used passive and active components. We discuss packaging for shipping and handling and procurement specifications for surface mount packages.
We should note that “surface mount package” is defined broadly here to include all types of surface mount packages. There are certainly some differences among standard surface mount technology (50 mil pitch) and fine pitch, ultra fine pitch, and BGA technologies. In this chapter we discuss the details of all these packages.

3.1 SURFACE MOUNT COMPONENT CHARACTERISTICS

Certain characteristics are common to all the many surface mount package types. For example, they all mount on the surface of the substrate instead of protruding through the plated through hole, as is the case in through-hole mount technology (THMT) boards. This means that the solder joint, which provides both mechanical and electrical connections, is very important for reliability of the assembly.

The surface mount packages are designed to meet the requirements of two major types of applications: commercial and military. The commercial applications with benign environments can use nonhermetic packages. The operating temperature requirements are generally from 0 to +170°C.

Military or high reliability applications designed for severe environments require the use of hermetic packages in the −55°C to +125°C range. Of course there are other environments between these extremes for which the designer must choose appropriate packages to meet the reliability requirements.

The hermetic chip carrier is expensive and is intended for high reliability products. It requires substrates of matching coefficient of thermal expansion and is still prone to solder joint failure during thermal cycling.

The surface mount package bodies (and leads) also see much higher temperatures during soldering than the through-hole package bodies. This makes these packages more susceptible to moisture related cracking. They must be designed with this requirement in mind. Because of their smaller size, it is very difficult to provide part markings on them, especially on passive components. If the devices do get mixed, they must be positively identified or thrown away. This almost mandates packaging of these devices to facilitate automated placement.

The packages also mount very close to the surface of the substrate, hence have relatively less clearance off the substrate. To achieve the required cleanliness, therefore, very good process control is necessary.

Since surface mount leads (not package bodies) experience lower temperatures in soldering than through-hole leads, the solderability test