Guide to Assembly of REC Surface Mount Circulators and Isolators

Introduction

The purpose of this document is to provide guidance to the designers, layout engineers, contract manufacturers, and others responsible for the fabrication and assembly of systems using Renaissance Electronics and Communications (REC) surface mount (SMT) components. With proper handling and installation, the RF performance of these components should be able to be made to replicate identical performance as documented by REC using their test fixtures and test procedures. Appropriate care must be taken when designing and qualifying the assembly process to ensure that parts are not damaged.

Several important factors contribute to the special handling that SMT components may require:

- The top surface of these surface mount components are not sealed, so measures must be taken during cleaning to ensure that moisture is not trapped inside.
- Many components have a larger footprint and taller profile than other SMT components on a board, so the reflow profile must be engineered to reflow the solder without exposing the part to excessive air temperatures.
- The larger footprint and use of castellation vias or through holes separated by a small gap from a larger ground plane mean that if excessive solder paste is used there is a risk of electrical shorts underneath the part.
- REC typically uses a coplanar waveguide test fixture with locating features in volume production to test these devices. The RF performance obtained by pressing down on top of the device is typically found to be consistent after the unit has been soldered to the fixture, as long as there are no air gaps between the device PWB and the fixture PWB.

This paper is intended as a basis for understanding the processes necessary to assemble REC SMT components into systems. It is highly recommended that customers qualify their assembly process well before the volume production stage to ensure that yields are satisfactory. Most assembly problems do not appear as a 100% failure rate, but instead as lower than required production yield.

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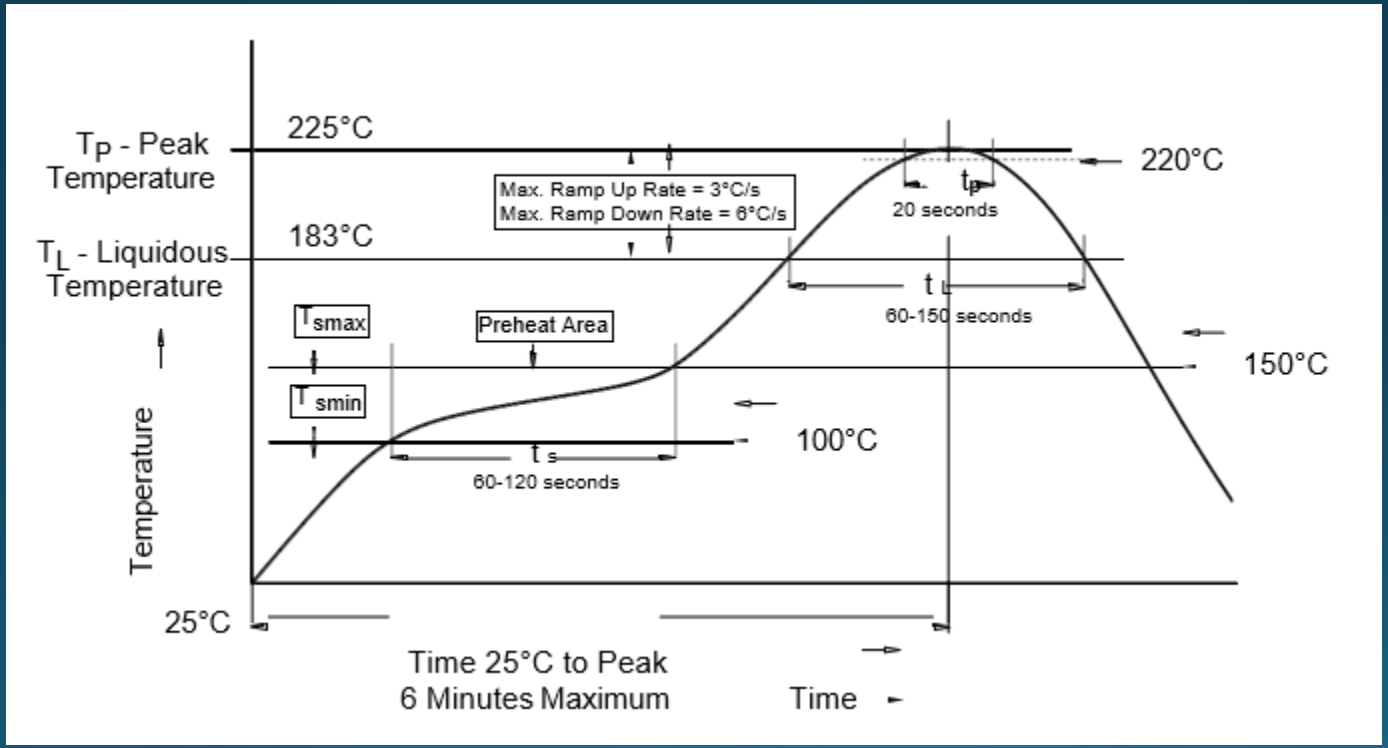
Solder Selection and Reflow

After the cleaning process, reflow temperatures are the second most common cause of failures amongst assembled parts. REC uses high temperature leaded solder (for leaded parts) to solder joints internal to the circulator. The **maximum** temperature and time these parts will **survive** is specified by the reflow profile detailed in IPC/JEDECJ–STD-020D.1.

SN63 Eutectic Process Temperature Profile
for REC Microwave Surface Mount Devices



Leaded Reflow Profile

Reference: IPC/JEDEC J-STD-020D.1

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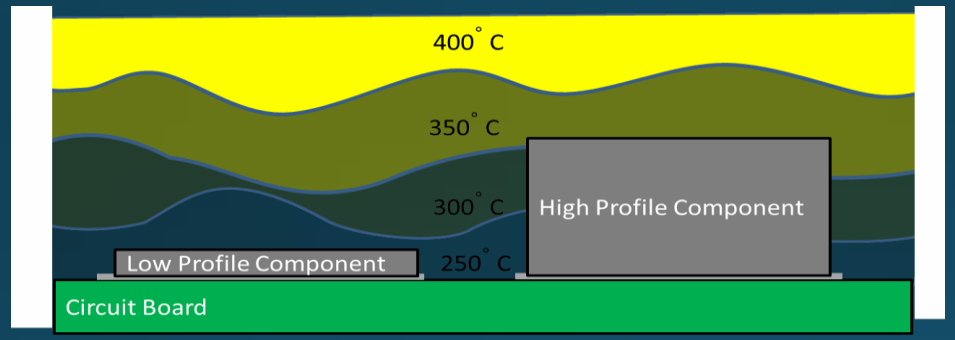
Whenever possible, we strongly recommend the use of no-clean solder with the lowest melting temperature and time above liquidous possible. This will prevent heat damage to REC components that can occur during the reflow process.

The reason that high profile parts can be damaged during the reflow process is that the temperature sensors that control the oven temperature are usually located on the circuit board surface, but the heating in the peak temperature range frequently occurs by use of high temperature forced air method that allows shorter time above liquidous. This causes the top of the part to heat significantly more than the bottom surface, on the bottom PWB. The components inside can experience significantly higher temperatures than other lower profile components.



High temperature exposure of high-profile surface mount components

There is potential of damage caused by parts experiencing temperatures above 300°C to 400°C during a “normal” reflow process. Therefore, we strongly recommend using the lowest temperature solder, with the shortest time period available. For very large, dense, and high thermal conductivity boards, the amount of heat required can be extreme. In these cases, the most reliable method for assembly is to hand solder the components.

To prevent failures, we recommend:

- Using the lowest temperature and shortest time above liquidous compatible with the process goals
- Measuring the temperature on the top of the tallest profile component during reflow
- Heating using methods other than overhead forced air when available

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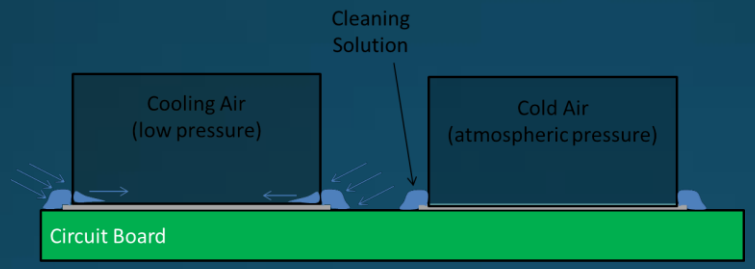
Cleaning

The wide variety of cleaning processes, solutions, drying techniques, and cleaning equipment make this step the most varied and prone to error. This design is NOT moisture sealed and should be kept in consideration for the cleaning procedure's implementation. Typical aqueous cleaning solutions used for cleaning the PWBs can safely be used on 3SMH8BH, but REC recommends a baking cycle of 100°C for 30 minutes.

At times, moisture can become trapped under the cover of the part, causing electrical shorts and other failure modes. This is particularly true when the part is cleaned with room temperature solutions when the board is still hot. The rapid cooling inside the component will cause a pressure differential that will draw moisture inside of the cover. This problem can be mitigated by allowing the board to cool before cleaning.



In general, these failure modes are temporary. Once the moisture is removed the part will return to normal operating specifications. In order to accommodate this, REC recommends the following:

All surface mount components subject to aqueous cleaning should be subjected to a vacuum bake at 100°C to 110°C for half hour.

In general, this will remove all moisture from the package. If a vacuum oven is not available, or if it is desired to bake at a lower temperature, then a longer bake time at a lower temperature at atmospheric pressure is acceptable. Experimentation during process qualification may be required to find the optimal bake time.