ASSEMBLY A WHM AMPLIFIER ON ITS TEST PCB

1. Introduction

The WHM series amplifier modules provide excellent RF performance with drop-in miniature SMT mounting convenience. The correct assemble of the module to a test board is critical to the performance and reliability of a product. In the application note, the solder reflow procedures of the WHM modules are recommended in the both laboratory and production environments.

2. WHM series foot print and its test board

Figure 1 shows the bottom side (foot print) of one product example, WHM25-1525AE 2.1 ~2.6 GHz low noise amplifier. The center metal area serves as the ground pad. Pin 1 is the RF input, Pin 2 and Pin 4 for +5V DC power supply. These two pins are connected internally inside the module. Pin 3 and Pin 6 are non-connection (NC). Pin 5 is the RF output.

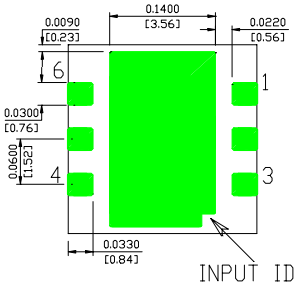

Figure 1 Bottom side (foot print) of WHM25-1525AE

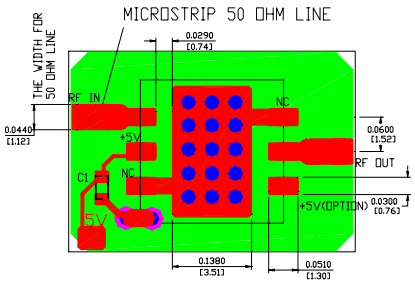

Figure 2 Test board layout for WHM25-1525AE

Figure 2 shows the test board for WHM25-1525AE. There are some ground vias (in blue color) to connect the top ground layer (in red color) to the bottom ground plane of the microstrip. The 0.1 uF capacitor (C1) is the de-coupling capacitor for +5V DC power supply. 50-Ohm microstrip lines are used for both RF input and output to communicate the RF signals to the amplifier module.

3. Solder assembly and reflow in a lab environment

For the evaluation of the WHM series product, the small quantity assembly is needed in the laboratory environment. The regular SMT low temperature solder paste such as SN63 is recommended. The high temperature solder was used for the WHM series module internal assembly itself. The melting temperature point of the high temperature solder is around 218 ^{0}C. Thus, melting temperature of the solder paste should be below 205 ^{0}C for assembling WHM series module on the test board. SN63 solder paste melting temperature point is around 183 ^{0}C and is suitable for the assembly purpose.

The SN63 solder paste can be dispensed by a needle manually or compressed air driven method. **Figure 3** shows the example of the dispensed solder paste pattern. Each solder paste dot is in about diameter of 0.005" ~ 0.010" (0.125 ~ 0.250 mm). **Figure 4** illustrates the assembled WHM25-1525AE before the reflow. Then, the assembly can be put on top of a hot plate which the surface temperature is set at about 215 ^{0}C. Make sure the assembled part is put at the edge of the hot plate to start with and gradually moved toward to the center of the hot plate. These processes simulate the production reflow temperature profile from the low temperature zone to high temperature zone. The edge of the hot plate has lower temperature than that in the central area. The components may move or even jump if the assembled part was put directly on the center hot area right away without the pre-heating process.

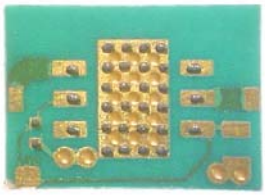

Figure 3 The dispensed solder paste pattern.

The whole assembly then can be washed with regular PCB cleaning process such as water or alcohol.

The other reflow method is directly put the soldering iron tip on the back of the assembly until all the solder paste being melt. However, this is not recommended since there is little control on the reflow temperature.

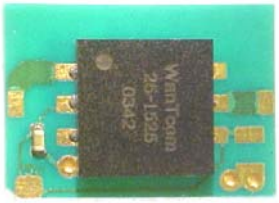

Figure 4 Assembled WHM25-1525AE before reflow

4. Solder assembly and reflow in a high volume production environment

The solder stencil and solder printing process are recommended for the high volume production assembly. The solder stencil is made out a steel sheet with the thickness of 0.003" to 0.005" (0.08 ~ 0.125 mm). The openings are either chemical etched or laser cut per Gerber file of the test board. **Figure 5** shows one example of a 0.004" thick stencil.

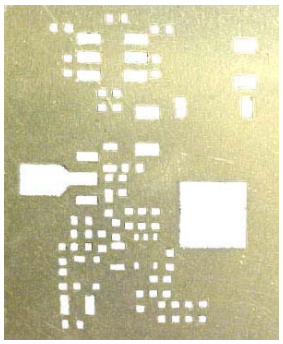

Figure 5 An example of a 0.004" thick stencil.

Figure 6 illustrates a recommended solder reflow temperature profile. The popular one for SN63 solder paste is Ramp-Soak-Spike (RSS) profile. The temperatures are the actual measured temperature on the assembled PCB assembly. The temperature setting of the reflow oven needs to be calibrated accordingly.

As shown in **Figure 6**, the RSS profile starts with a steep ramp up to about 150 ^{0}C within a target time of 90 seconds at a maximum temperature rise rate of 2 ~ 3 ^{0}C/second. Following the ramp zone, the profile soaks the assembly between 150 ~ 170 ^{0}C for approximately 90 seconds. After the soak, the PCB assembly will enter the spike temperature zone, where the PCB assembly will be reflowed above 183 ^{0}C for about 60 seconds. However, the peak temperature should not reach 205 ^{0}C or beyond or the WHM module may be damaged or performance changed due to the fact that the internal solder starts to melt. The last zone is the cool down period. The cool down rate of the profile should be controlled within about 4 ^{0}C/second. The faster cool down rate will result in a finer grain solder structure and a stronger and shinier solder joint. However, exceeding 4 ^{0}C/second cool rate could result in a thermal shock to the PCB assembly.

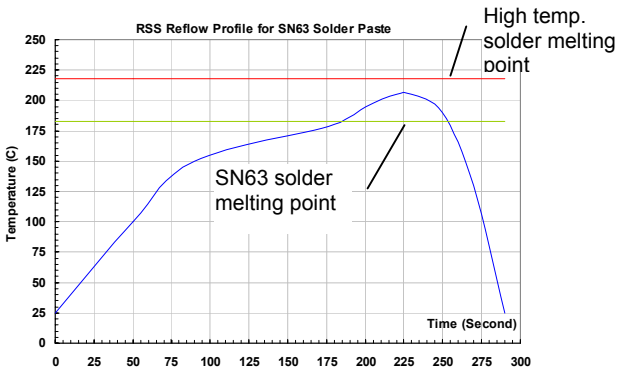

Figure 6 Recommended RSS solder reflow temperature profile.

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