Customer Process Guidelines

AirPrime HL Series

SIERRA WIRELESS®

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3.0
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Document History

Version	Date	Updates
1.0	June 04, 2013	Creation
1.1	June 20, 2013	Updated: • 3.2.2 Footprint • 4.1 Stencil Design • Table 1 Solder Reflow Profile
2.0	November 18, 2014	Updated: • Product list in 1.2 Reference Documents • Baking conditions in 2.1.3 Moisture Sensitivity • 2.2.1 Package Description • 2.3.1 Packing Description • 3.2.2 Footprint
3.0	June 08, 2015	Updated: • 2.1.2 ESD • 2.2.2 Marking Description • 3.2.2 Footprint • 5 Rework Guidelines

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1. Introduction

1.1. Overview

This document presents guidelines for the industrial assembly of an AirPrime HL Series Embedded Module on an application.

1.2. Reference Documents

[1] AirPrime HL6528x Product Technical Specification

Reference number: 4114016

[2] AirPrime HL7518 Product Technical Specification

Reference number: 4115834

[3] AirPrime HL7519, HL7548 and HL7588 Product Technical Specification

Reference number: 4116369

[4] AirPrime HL8548 and HL8548-G Product Technical Specification

Reference number: 4114663

[5] AirPrime HL8549 and HL8549-G Product Technical Specification

Reference number: 4115653

[6] JEDEC standard JESD625-A, Requirements for Handling Electrostatic Discharge – Sensitive (ESDS) Devices

[7] ANSI/ESD S20.20: Protection of Electrical and Electronics Parts, Assemblies and Equipment

[8] IPC/JEDEC J-STD-033 – Handling, Packing, Shipping and Use of Moisture / Reflow Sensitive Surface Mount Devices

2. Handling

2.1. Storage and Handling of the AirPrime HL Series Module

2.1.1. Storage Condition

AirPrime HL modules can be stored in their sealed, original packages, for up to 1 year.

They can withstand a storage temperature range between -40°C to +85°C, nevertheless when packed into T&R the upper storage temperature is decreased to +40°C due to T&R packaging material.

Tip: *For optimal results, the recommended storage temperature is +20°C +/- 10 degrees.*

2.1.2. ESD

The AirPrime HL Series unit is ESD sensitive. For ESD level information, refer to the corresponding Product Technical Specification of each product as listed in section 1.2 Reference Documents.

It is recommended to use standard ESD precautions, as described in the following standards:

- JEDEC standard JESD625-A, Requirements for Handling Electrostatic Discharge-Sensitive (ESDS) Devices
- ANSI/ESD S20.20: Protection of Electrical and Electronics Parts, Assemblies and Equipment

2.1.3. Moisture Sensitivity

The AirPrime HL Series module is sensitive to moisture absorption:

- MSL 3, 245 °C, 2 reflows allowed on customer PCB including one for rework of the component

Caution: *Baking conditions differ according to the HL assembly technology (see section 2.2.1).*

For shielded versions, if tape & reel vacuum pack is open for more than 168h, material should be baked at 40°C for 13 days. If parts are on tray, baking conditions are 24 hours minimum at 85°C.

For molded versions, if the vacuum bag is open for more than 168h, material should be baked for 48 hours at 125°C in tray. Nevertheless, it is recommended to store the modules in dry cabinet (<10% RH) once the vacuum bag is opened.

It is recommended to follow the standard MSL procedure, as described in the following standard:

- IPC/JEDEC J-STD-033 - Handling, Packing, Shipping and Use of Moisture / Reflow Sensitive Surface Mount Devices.

2.2. Component Package

2.2.1. Package Description

The AirPrime HL Series module is a scalable QFN (quad flat no lead) package, 22x23x2.5 mm (except for the HL8549 and HL8549-G being 24x25x2.5 mm), pitch 0.8 mm with 146 terminals.

The terminals include:

- 66 inner signal pads
- 8 mechanical corner pads
- 7 signal pads for JTAG
- 1 polarity mark
- 64 ground pads

Inside the HL Series module, different assembly technologies are used. Specifically, HL6528x modules use Sierra Wireless standard assembly process, with a metallic soldered shielding; while HL8548x modules have an overmolding compound + metal sputtering.

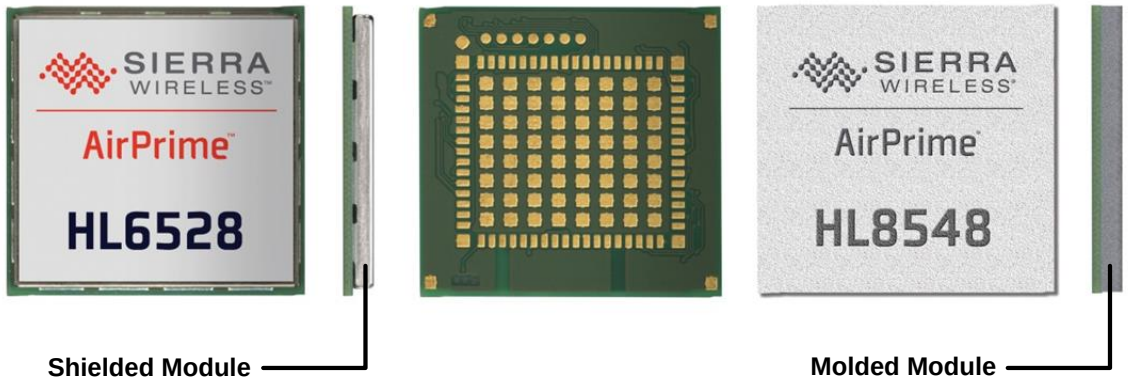

Figure 1. Different Assembly Technologies on AirPrime HL Series Modules

For additional information, refer to the corresponding Product Technical Specification of each product as listed in section 1.2 Reference Documents.

2.2.2. Marking Description

Marking contents and marking methods on the module may differ between each variant of the product family. The marking method can be via paper label or laser-marking.

Common label contents include:

- Model Name
- Serial Number and IMEI or MEID Number (both letters and data matrix bar code)
- Fabrication Country
- Relevant regulatory compliance markings and identification codes (this may be a CE logo, FCC ID number, IC ID number, etc.)
- Pin 1 indicator for solder-down modules

The examples below are not contractual and don't show exact contents of the label. Label contents may also be moved around to fit any additional customer-specific need or market segment and can change without notice at the sole discretion of Sierra Wireless.

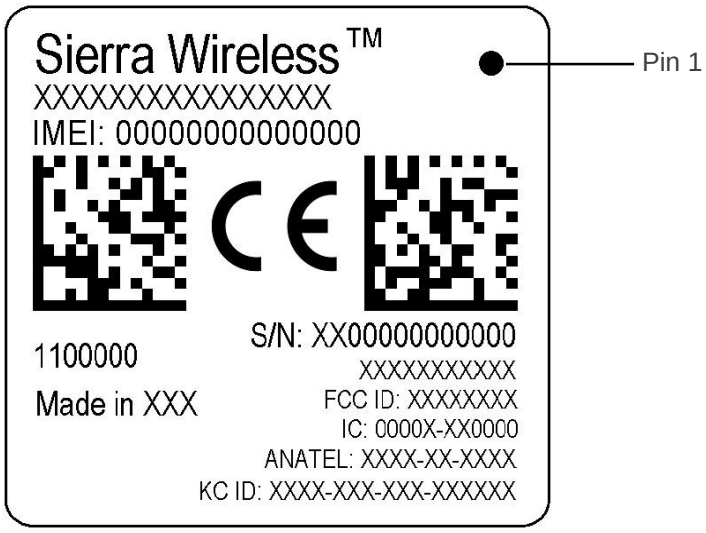

Figure 2. AirPrime HL Series Shielded Product Label Example

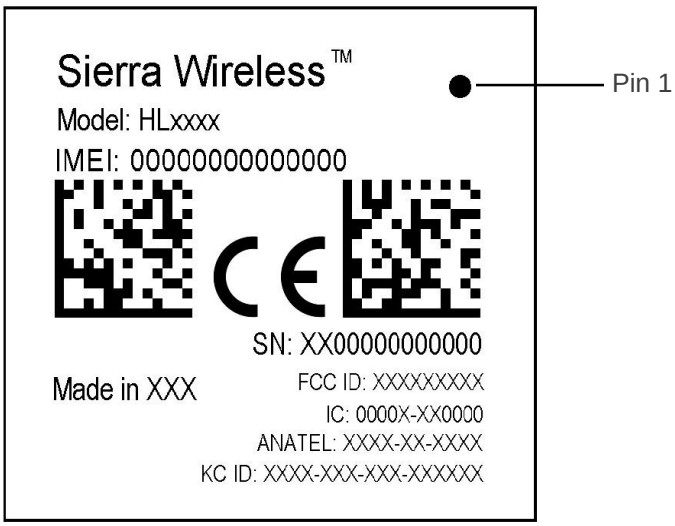

Figure 3. AirPrime HL Series Molded Product Marking Example

2.3. Component Packing

2.3.1. Packing Description

The AirPrime HL Series module is delivered in tape and reel.

Quantity per tape & reel is 500.

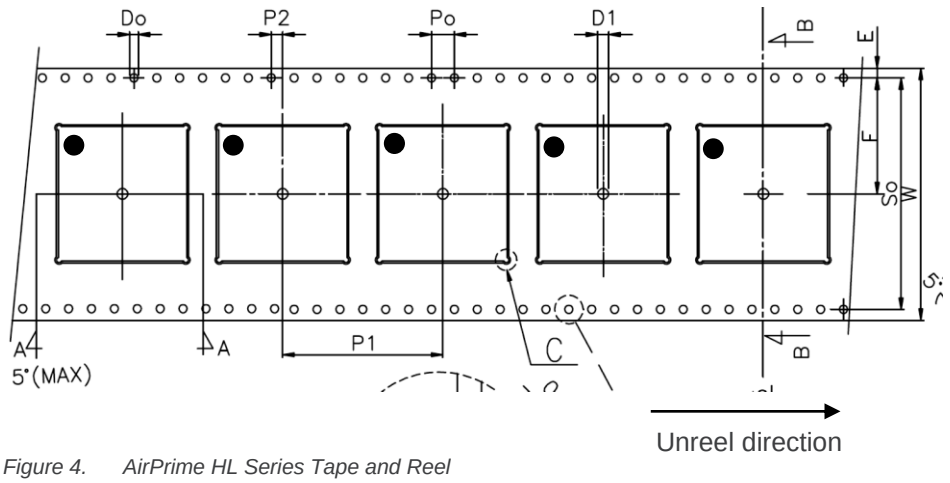

Figure 4. AirPrime HL Series Tape and Reel

P1	P0	W
28.0 mm	4.0 mm	44.0 mm

2.3.2. Packing Label

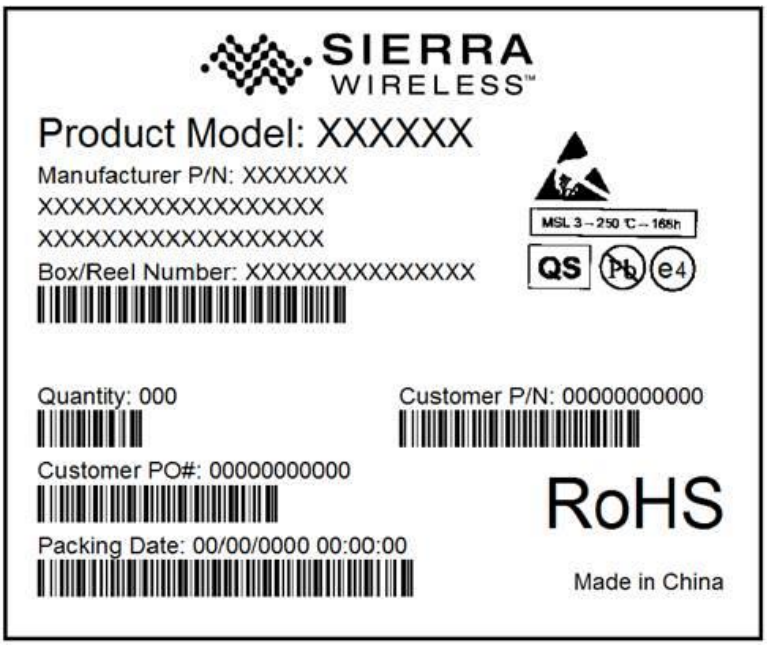

Figure 5. Packing Label

3. SMT Assembly Process

This section presents information and recommendations for the industrial assembly of the AirPrime HL Series module on the application.

Note: The HL Series products should be assembled by reflow process.

3.1. Lead-Free Process

In compliance with directive 2011/65/CE, Sierra Wireless products do not contain the following hazardous substances:

- mercury (Hg),
- lead (Pb),
- cadmium (Cd),
- hexavalent chromium (Cr+6),
- polybrominated diphenyl ether (PBDE),
- polybrominated biphenyl (PBB).

The AirPrime HL Series modules are manufactured with RoHS compliant components and processes.

3.2. PCB Design Requirements

3.2.1. PCB Surface Finish

The PCB surface finish recommended is Electroless Nickel, immersion Gold. Organic Solderability Preservative (OSP) may also be used.

Caution: *Hot Air Solder Leveled finish (HASL) is not recommended because the process does not give consistent solder volumes on each pad because of poor pad flatness.*

3.2.2. Footprint

In order to produce high assembly yields and a reliable solder joint, the footprint on the customer application board should match Figure 6 below.

Mechanical drawings of the AirPrime HL Series module's footprint are available in the Product Technical Specification of each product as listed in section 1.2 Reference Documents.

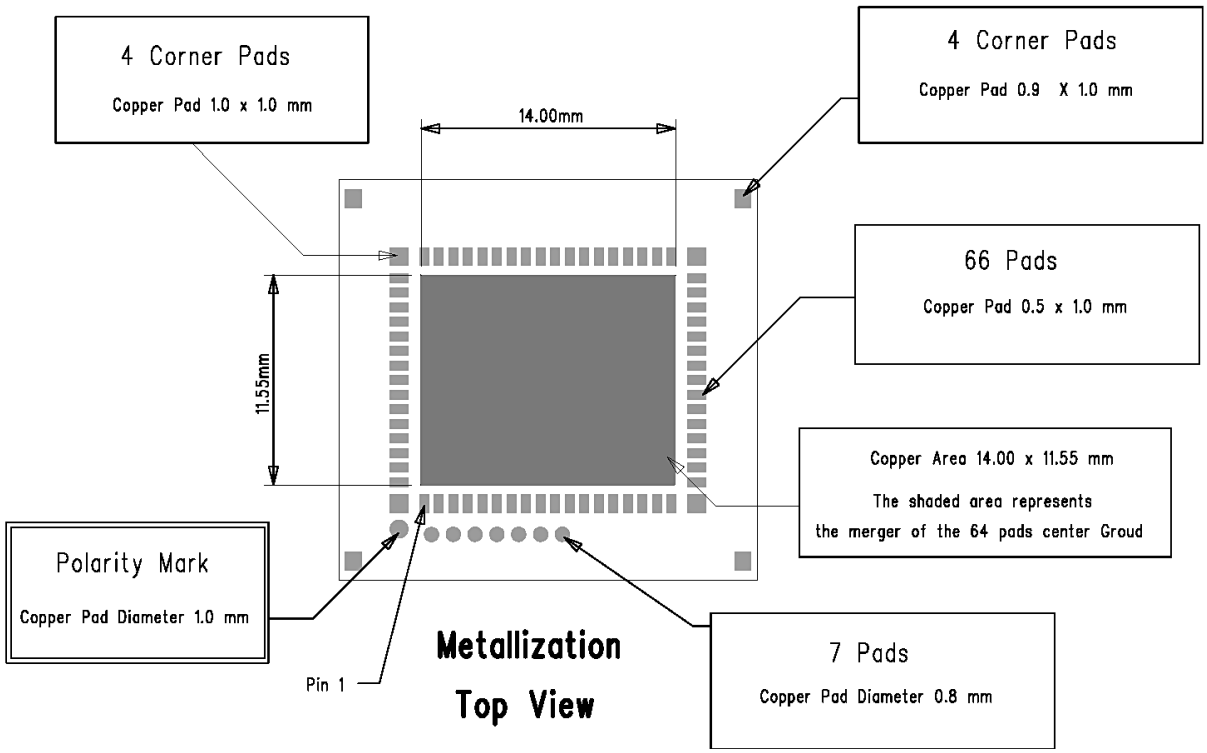

Figure 6. Recommended Footprint – Copper Layout

Note: The 64 inner pads and the 8 corner pads are ground pads.

Sierra Wireless suggests that customers place a copper pad under the Polarity mark to avoid any risk of short circuits between this pin and the customer layout; however, there is no need to solder it. This mark also eases visual confirmation of the module's correct orientation.

For molded versions, the copper pad should not extend out of the module as the PCA edge side is conductive.

3.2.3. Layout Recommendations

Sierra Wireless' layout recommendations include:

- A GROUND area under the HL series module. This ground area should be a whole area of copper with proper ground vias to provide a good grounding system between the application and the embedded module and improved thermal dissipation. It should be covered by solder resist on the non-soldered area.

  The ground vias may be micro-vias, filled or unfilled. Through-holes can be used in between each of the 64 ground pads (under the solder resist).
- There should not be any SIGNAL trace or hole / micro-via under the AirPrime HL product.
- The antenna pad and its track should be adapted according to RF constraints, based on customer layout. Refer to each corresponding Product Technical Specification for more details.
- Manufacturing tolerance for copper pad is ± 30 µm.
- Leave a component-free area of 2 mm around the HL Series unit for accessing the surrounding components and for scalability with the HL8549.

3.3. Solder Mask

The pads on the printed circuit board are either Solder Mask Defined (SMD) or Non Solder Mask Defined (NSMD).

Since the copper etching process has tighter control than solder masking process, NSMD pads are preferred over SMD pads.

Moreover, NSMD pads with solder mask opening larger than the metal pad size also improve the reliability of solder joints, as this limits the stress concentration at the solder-to mask corner interface.

For external pads, the solder mask opening should be 100 µm to 150 µm larger than the pad, resulting in 50 µm to 75 µm clearance between the copper pad and solder mask. This allows for solder mask registration tolerances, depending upon the PCB fabricator's capabilities.

For ground pads, SMD should be used as the ground area under the AirPrime HL Series module. (Refer to Figure 7).

The recommended solder mask thickness on the top copper is 10 to 30 µm.

4. Board Mounting Guidelines

4.1. Stencil Design

The recommended stencil thickness is 125 µm.

The proposed stencil design is presented in the figure below.

It is highly recommended to monitor the solder paste height, registration and proper placement during the squeegee printing.

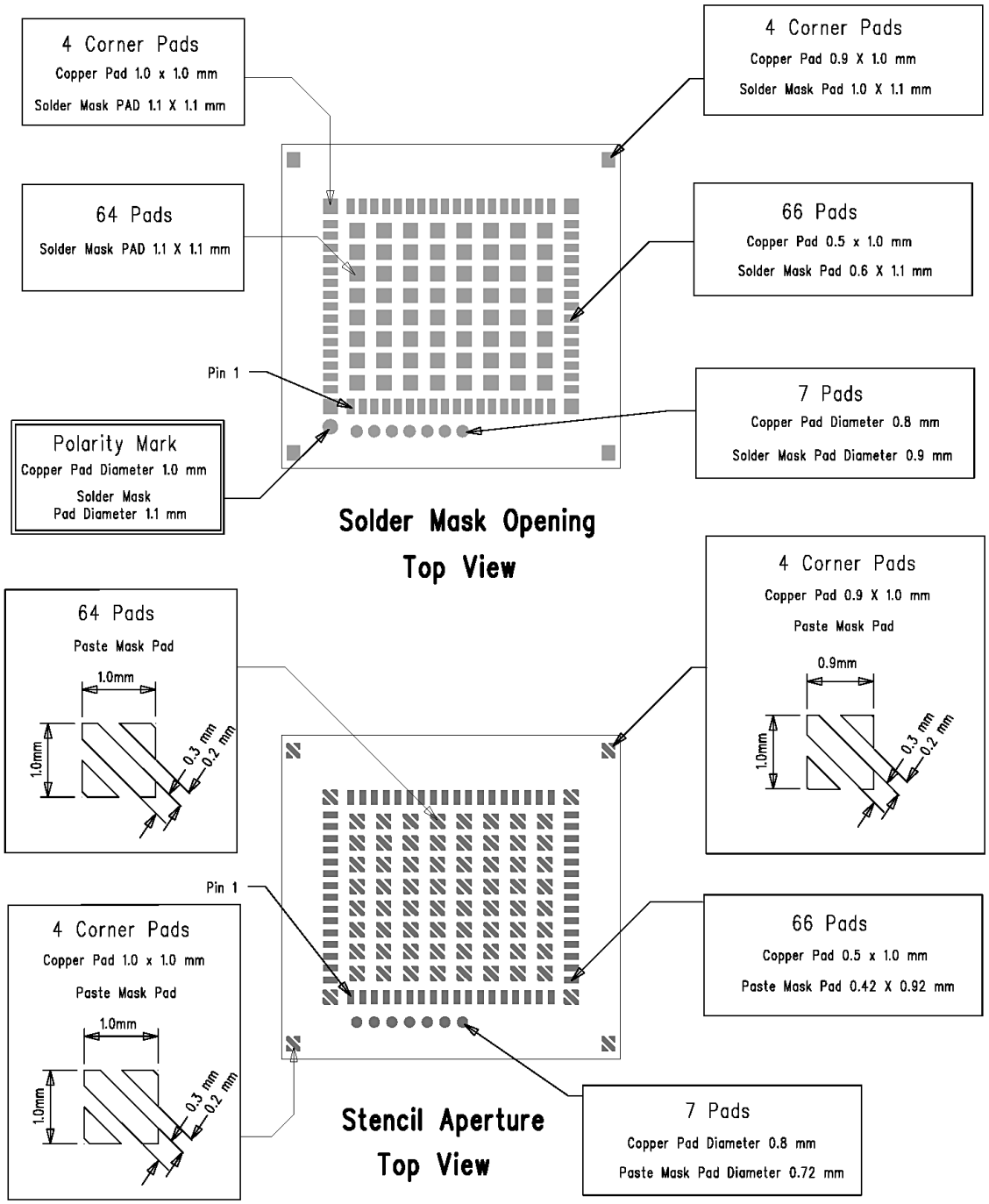

Figure 7. Recommended Solder Resist and Paste Mask Layout

4.2. Solder Reflow Profile

Lead-free SMT reflow profiles should be used to surface mount the AirPrime HL Series module.

The reflow profile depends on PCB density and type of solder paste being used. The paste manufacturer's recommendation should also be considered to determine the proper reflow profile.

Table 1. Solder Reflow Profile

Peak Temperature	245°C max
Reflow Time (over 220°C), for molded versions	60 sec max

2 reflows are allowed on the customer PCB including one for rework of the component if necessary.

The figure below is an example of reflow profile.

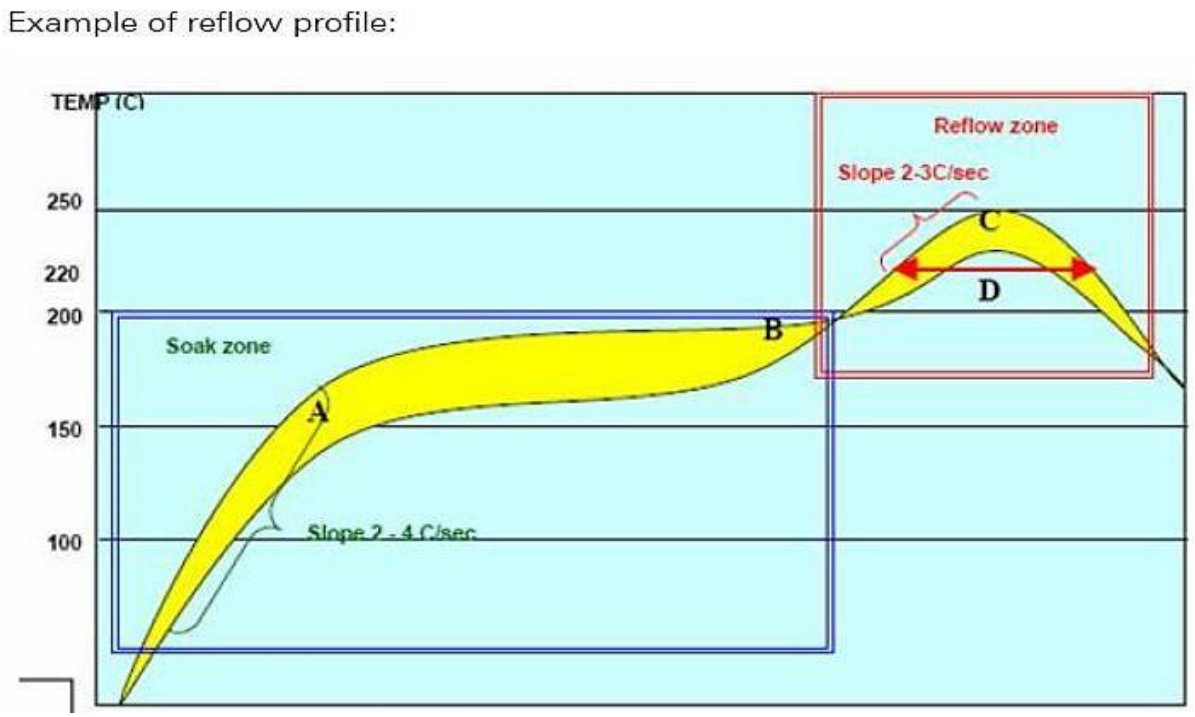

Figure 8. Recommended Reflow Profile

Additional recommendations are presented in the table below for consideration.

Factor	Recommendation
Max slope	2 to 4°C / sec
Soak time (between A and B: 150 and 190°C)	60 to 120 sec
Reflow time (D: over 220°C)	40 to 60 sec
Max temperature (C)	235 – 245°C
Cooling down slope	1 to 3°C / sec

It is recommended to perform reflow in a nitrogen atmosphere.

5. Rework Guidelines

Rework tools and operating parameters are customer/application specific. Rework tools, heating profiles and the rework process should be tailored to these specific needs for optimum results.

Prior to any rework, if the component floor life has been exceeded, it is highly recommended to bake the PCB in order to remove moisture from the assembly. (See JEDEC J-STD-033 paragraph 6 - Board rework. If possible for the PCB and the other components of the board, apply the same baking conditions as per section 2.1.3).

The pre-baking process will prevent damage to any component due to moisture vapor pressures caused during reflow.

Prior to removal, the metal shielding of the AirPrime HL Series shielded module must be glued to the module substrate, by using glue able to withstand reflow profile.

5.1. Component Removal

The step consists of reflowing the solder joints attaching components to the PCB. Ideally, the reflow profile for part removal should be the same as the one used for part attachment. However, the time above liquidus can be reduced as long as the reflow is complete.

In the removal process, it is recommended that the board should be heated from the bottom side using convective heaters and hot gas, or hot air or IR should be used on the top side of the component. Special nozzles or IR lens should be used to direct the heating in the component area and heating of adjacent components should be minimized.

Excessive hot airflow should also be avoided, as this causes the component to overheat.

Once the joints have reflowed, the vacuum lift-off should be automatically engaged for pick-up during the transition from reflow to cool down.

Warning: *If heating conditions are not properly controlled during manual hot removal from PCB assembly, package integrity can be damaged from overheating.*

5.2. Pad Redress

Once the component has been removed, the site and pads need to be cleaned properly. It is better to use the combination of a blade style conductive tool and a fluxed desoldering braid.

Once the residual solder has been removed, the land pads should be cleaned with a solvent. The solvent is usually specific to the type of solder paste used in the original assembly and the paste manufacturer’s recommendations should be followed.

5.3. Solder Paste Deposit

Once the PCB is properly cleaned and inspected, solder paste should be applied on the solder land (on the component itself or on the customer PCB) with a mini-stencil which has same thickness and apertures as the stencil used for original attachment.

5.4. New Component Placement

A slip-beam optical system should be used to align the component to the PCB. This method will display an image of the land pad overlaid on the mating footprint and aid in proper alignment. Similar to paste printing, the alignment should be done under magnification of 50x to 100x.

5.5. New Component Soldering

The reflow profile developed during original attachment or removal should be used to attach the new component.

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