WMP Series
Wireless Microprocessor® / Open AT® Software

Manufacturing Guidelines

Reference : **WM_PGM_WUP_UGD_001**
Revision : **004**

Date : **August 20, 2008**

Powered by Open AT® Software Suites

Document Information

Revision	Date	History of the evolution	
001	25/10/06	Creation	
002	07/06/07	Update and add of underfill	
003	26/07/07	Update	
004	20/08/08	Update	

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Overview

This document explains guidelines for the industrial assembly of a Wireless Microprocessor® component on an application.

It also presents all assembly flow-charts of a standard assembly.

1. Product References

This document concerns the following products:

- Wireless Microprocessor® 50
- Wireless Microprocessor® 100
- Wireless Microprocessor® 150

2. Reference Documents

[1] Wireless Microprocessor® Series Product Technical Specification & Customer Design Guidelines

- WMP50 Reference: WM_DEV_WMP50_PTS_020
- WMP100 Reference: WM_DEV_WMP150_PTS_002
- WMP150 Reference: WM_DEV_WMP150_PTS_002

[2] DWLWin Download Application User Guide

Reference: WM_DEV_TOO_UGD_010

[3] Open AT® Firmware Customer Release Note

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

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

[6] EIA/JESD22-A114E Electrostatic Discharge-(ESD) Sensitivity Testing Human Body Model (HBM)

[7] EIA/JESD22-A115-A Electrostatic Discharge-(ESD) Sensitivity Testing Machine Model (MM)

[8] EIA/JESD22-C101C Field-Induced Chargerd-Device Model (CDM)

3. Design and Material Requirements

3.1 Design Requirements

Refer to the documentation [1] for design requirement details. In particular, refer to the following chapters:

- “Analog audio interface”
- “Real Time Clock”
- “Memory interface”
- “RF interface”
- “Noise and design”

3.2 Material Requirements

To run a production test of the Customer Design including a WMP Series, the following equipment is required:

- Industrial PC Pentium IV-based PC with:
  - OS Windows XP
  - 256 MB SDRAM
  - 1 serial port (115200 bps) with RS232 right cable and the connector (Refer to documentation [1])
  - A Wavecom downloading tool : DwlWin for WMP application
  - A Wavecom dongle for WMP50 or WMP100 series.
- A Power Supply like A66309B, A3631A, or Ki2603 to power the WMP Series.
- The WMP series should be powered as recommended in the Customer Design Guidelines download procedure. (Refer to documentation [1])
- For download stage, to increase the download speed up to 921600 bps:
  - An extension serial card can be used like ACKSYS 8RSPCI-232-9 type (921600 bps Max), or
  - A USB/RS232 cable like NPORT U1110
- For RF testing

  A GSM radio communication tester like R&S CMU200 or Agilent 8960.

4. Incoming Inspection

4.1 Manufacturing Package Content

Manufacturing packages contain the following:

- WMP Series product
- Dongle for product download
- Open AT® software available under the Wavecom website (http://www.wavecom.com/).

4.2 WMP Storage and Handling

4.2.1 Storage Conditions

Wireless Microprocessor® units can be stored in their sealed, original packages, between -40°C and +85°C over the course of up to 1 year.

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

4.2.2 ESD

Wireless Microprocessor® is ESD sensitive, specifically as follows:

- Level class 2 for HBM (2KV)
- Level class B for MM (200V)
- Level class III for CDM (500V)

It is recommended to use standard ESD precautions, as described in JEDEC standard JESD625-A, Requirements for Handling Electrostatic Discharge-Sensitive (ESDS) Devices.

4.2.3 Moisture Sensitivity

Wireless Microprocessor® units are sensitive to moisture absorption.

- MSL 3 , 250 °C

Caution: If tape & reel vacuum pack opens more than 168h, material should be baked at 40°C for 13 days.

It is recommended to follow the standard MSL procedure, as described in IPC/JEDEC J-STD-033A - Handling, Packing, Shipping and Use of Moisture / Reflow Sensitive Surface Mount Devices.

4.3 Component Package

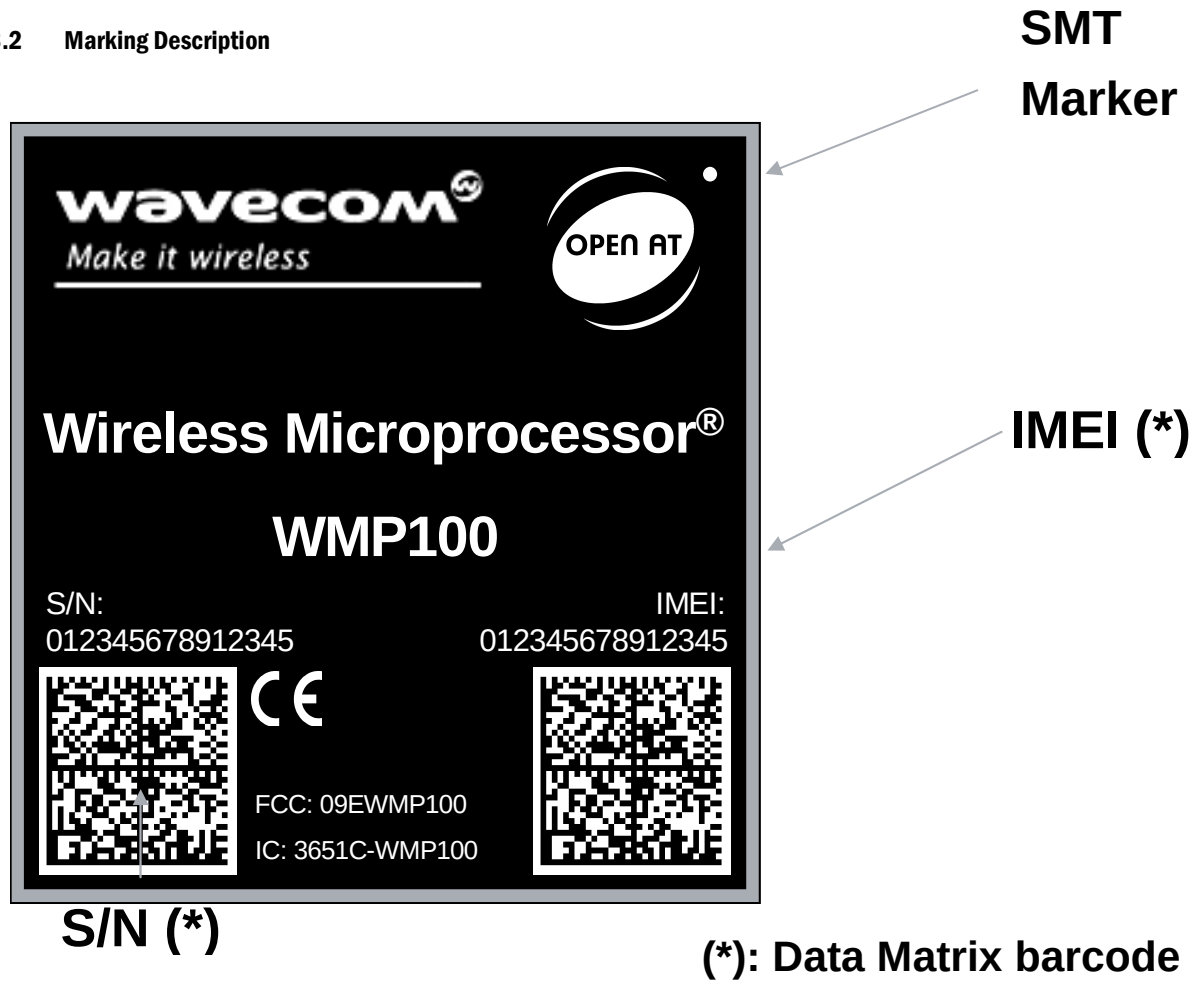
4.3.1 Package Description

The Wireless Microprocessor® is a BGA pins, 25 x 25 mm, pitch 1 mm.

Solder ball material: SAC 105 (Sn98,5 Ag1 Cu0,5)

For additional information, refer to documentation [1].

4.3.2 Marking Description

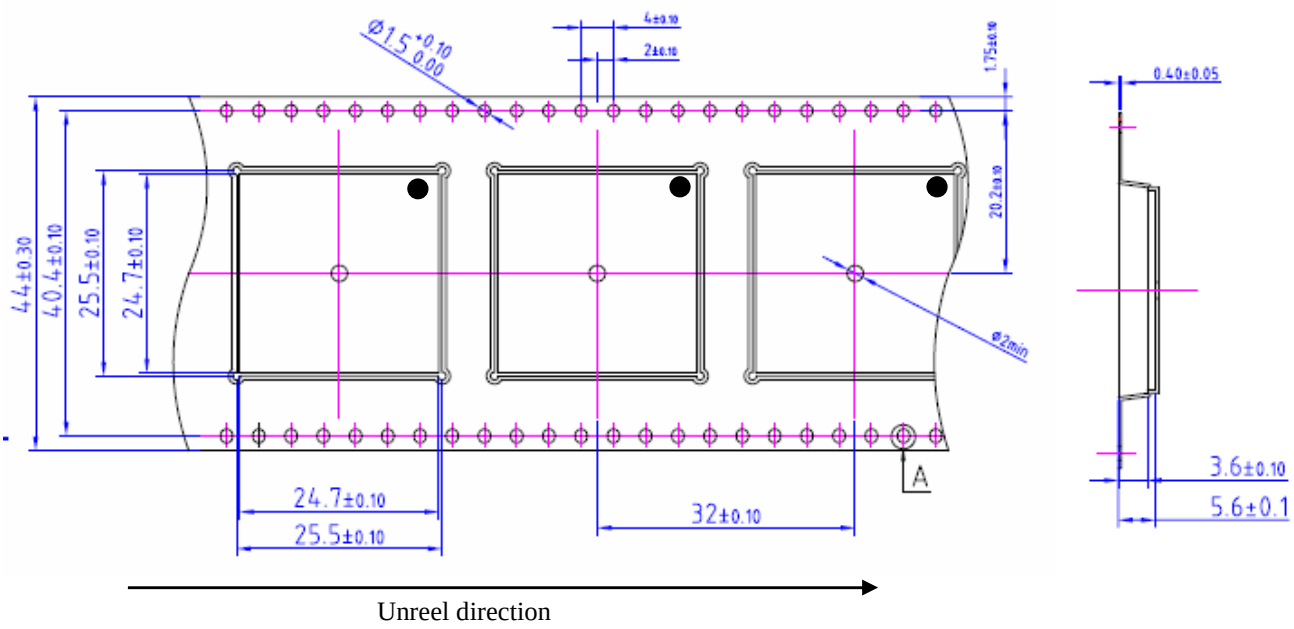


4.4 Component Packing

4.4.1 Packing Description

The Wireless Microprocessor® is delivered in tape and reel.

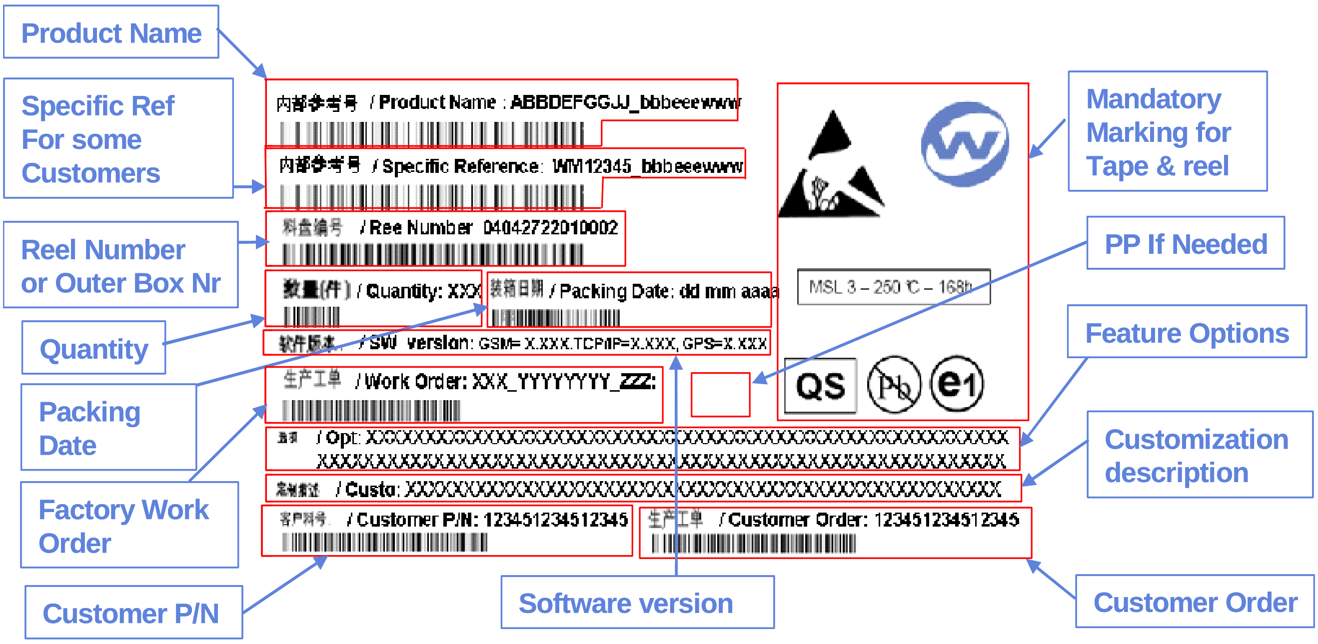
Quantity per tape & reel is 250 (or 25 for prototype).



CAUTION: The Wireless Microprocessor® orientation inside the tape & reel is turned 90° to the right compared to the original orientation, for the support of the automatic packaging process.

This modification applies for the unit shipped since the 20th of May 2008

4.4.2 Packing Label Details



5. SMT Assembly Process

This section gives recommendations for the industrial assembly of the Wireless Microprocessor® on the application.

The Wireless Microprocessor® should be assembled by reflow process.

5.1 Lead-Free Process

According to the directive 2002/95/CE, Wavecom does not employ the following hazardous substances: mercury (Hg), lead (Pb), cadmium (Cd), hexavalent chromium (Cr+6), polybrominated diphenyl ether (PBDE), polybrominated biphenyl (PBB) and Decabromodiphenyl ether (DecaBDE).

Therefore, Wireless Microprocessor® uses:

- Lead-free terminals (SAC105 balls)
- Lead-free internal materials (components and solder paste)

Therefore, the customer must use a lead-free process to assemble the Wireless Microprocessor®.

5.2 PCB Design Requirements

5.2.1 PCB Surface Finish

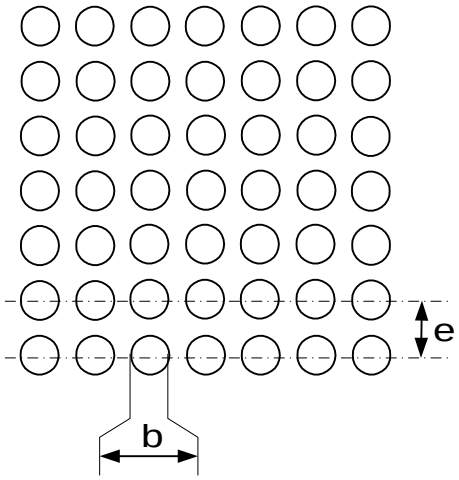
The PCB surface finish recommended is Electroless Nickel, immersion Gold.

Organic Solderability Preservative (OSP) may also be used.

Note: Hot Air Solder Levelled finish (HASL) is not recommended because the process does not give consistent solder volumes on each pad due to poor pad flatness.

5.2.2 Land Pad

In order to produce high assembly yields and a reliable solder joint, the land pad design should be as follows:



(not to scale)

e	
1 mm	
	b
Recommended land pad	∅ 0.5 mm

The recommended manufacturing tolerance for copper pad is ± 30 µm.

5.2.3 Solder Mask

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

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

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

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.

6. Board Mounting Guideline

6.1 Stencil Design

The recommended stencil thickness is 150 µm (125 µm minimum).

The recommended stencil apertures are:

	b
Recommended stencil apertures	Round 0.5 mm

Nickel electroformed stencil is recommended to guarantee a good release of the solder paste. The recommended manufacturing tolerance for stencil aperture is ± 10 µm.

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

6.2 Solder Reflow Profile

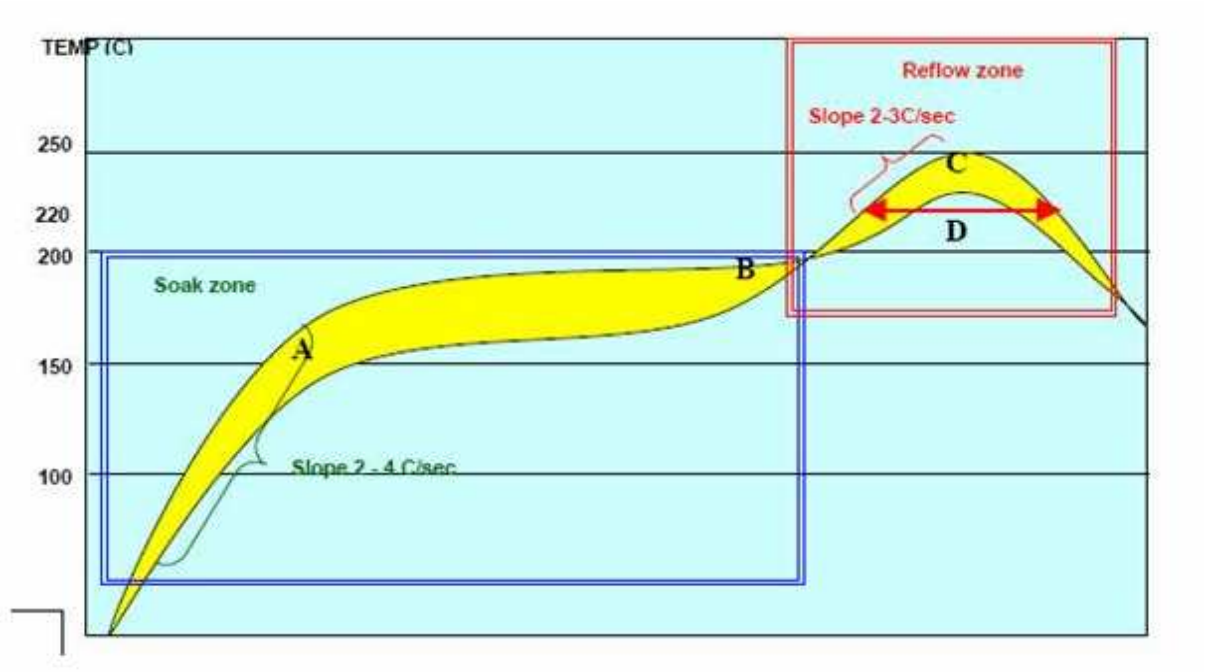
Lead-free SMT reflow profiles should be used to surface mount the Wireless Microprocessor®.

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

Caution: 2 reflows are allowed in customer side including one for rework of the component.

Peak temperature	250 °C max
Melting point (SAC105)	217/225 °C

Example of reflow profile:



	Recommendation
Max slope	2 to 4 °C / sec
Soak time (between 150 and 190 °C)	60 to 120 sec
Reflow time (over 220°C)	40 to 60 sec
Max temperature	235 – 245 °C

7. Download

7.1 Setup

The hardware design to perform download operation is described in document [1], in the "Main serial link (UART1)" chapter, "First download" section.

Customer should use the following download station in a Windows® environment:

- DWLWIN download tool installed on a PC connected to the UART1 of the Wireless Microprocessor® (available on the Wavecom web site)
- Dongle driver installed on the download station (available on Wavecom web site at http://www.wavecom.com)
- Physical dongle plugged into the download station

The document DWLWin Download Application User Guide [2] is describing download procedures and the document Open AT® Firmware Customer Release Note [3] details the files to download.

7.2 First Download

The flash memory associated with the Wireless Microprocessor® has to be downloaded with the firmware package (wpk) at the customer manufacturing line or on prototypes.

The download process on a blank flash pairs the Wireless Microprocessor® with the flash to generate a unique firmware that works only with said associated flash.

The download of the memory should be done through the UART1 of the Wireless Microprocessor®. The hardware design is described in document [1], in the "Main serial link (UART1)"chapter, "First download" section.

Notes:

- For later software upgrades where the flash is not erased, the pairing and therefore the dongle is no longer required.
- The dongle is a secured key (similar to a USB key) that connects to a PC when using the DWLWIN downloading tool. It is available on the development kits or can be ordered directly at Wavecom.
- The DWLWIN Application User Guide [2] describes the download procedures and the document Open AT® Firmware Customer Release Note [3] details the files to be downloaded.
- Download of the flash memory prior to SMT manufacturing (preprogrammed flashes) is under development. Please contact Wavecom for latest information.

7.3 Hardware Debug on Manufacturing Side

7.3.1 JTAG

The Wireless Microprocessor® supports the JTAG interface for hardware debugging on the manufacturing side. (Note that the JTAG can only be used for Software debugging during the prototyping phase).

We recommend the customer routes the JTAG pin of the Wireless Microprocessor® on their system to facilitate the hardware debug through the JTAG port.

Boundary scan capability is available on the Wireless Microprocessor® series, and can be accessed via the JTAG port using the related BSDL file. We recommend customers develop their boundary scan test vectors to test the physical connection of the UART, memory and/or others components of their system.

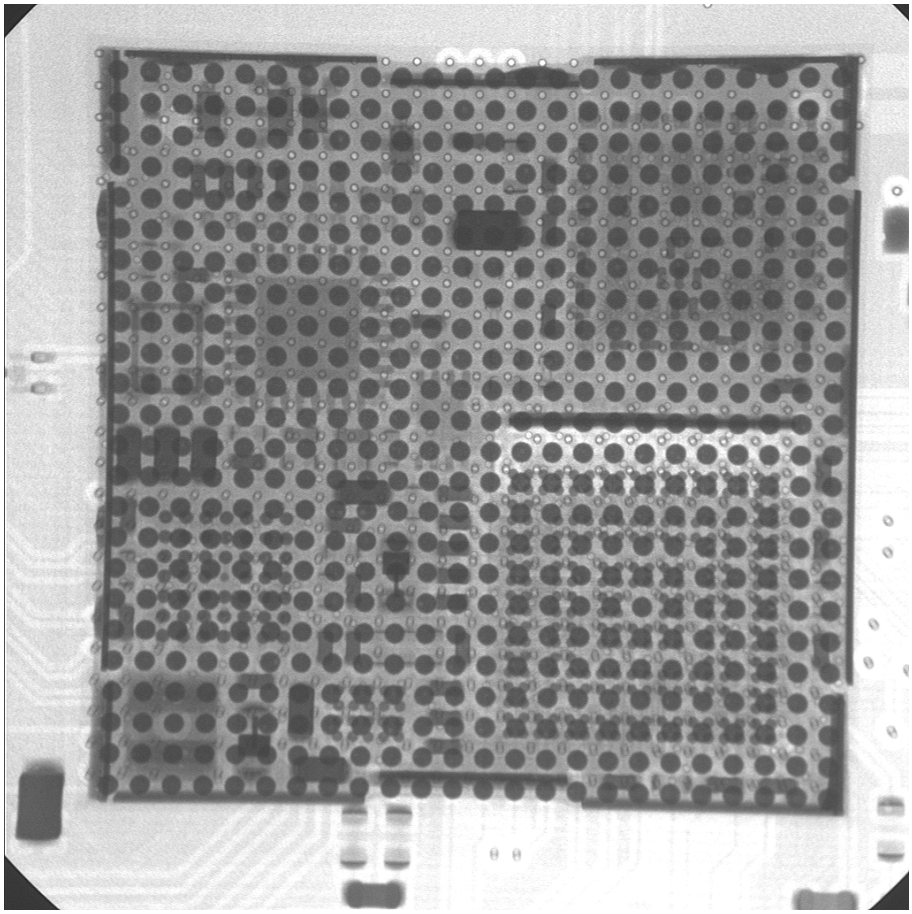
7.4 Troubleshooting

Refer to the documentation [1] and [2] for more information when troubleshooting.

The Wavecom Tool DWLWin sends a status of the downloading. The current possible errors and steps to correct them include the following:

DWLWin Download Error	Typical Solution
"The serial Port is already in use or not available"	1. Check the serial port 2. Check the power supply
"Boot Failure: cannot connect with target"	1. Check the serial link connection 2. Check the process of the Power Supply 3. Start DWLWin 4. Make a hard reset of the WMP Series
"Could not decrypt Inilock: Problem with dongle"	1. Check that the dongle is correctly installed and configured in the DWLWin advanced panel if necessary. 2. If a WPK file is downloaded, the dongle is not configured in DWLWin.
"No binary download file"	Check the configuration of DwlWin
"Flash error"	Be sure to use a flash memory supported by the WMP100
"The target is no longer responding"	1. Check the serial link connection 2. Check the process of the Power Supply 3. Start DWLWin 4. Make a hard reset of the WMP Series

- An X-ray inspection is recommended to check any process issue. Below is an example of a WMP Series X-ray.



8. RF Test

8.1 Set-Up

Minimal functional tests can be performed on the application using the Wireless Microprocessor® to check the product assembly.

- Connect to the application the following:
  - A GSM power supply
  - A serial link (Tx, Rx, CTS, RTS minimal signals)
  - A radio-communication tester to the RF output
  - A remote software (as HyperTerminal)
- Power-on the Wireless Microprocessor®
- Send an "AT" command
  Confirm that response is "Ok".
- Without SIM card, send an "ATD112;" command.
  Confirm the synchronization with radio-communication tester.
- With a Test SIM Card, send an "ATD**xxx**;" with **xxx** being a valid number for this test. Confirm the synchronization with radio-communication tester.
- Perform any additional RF tests with the radio-communication tester including maximum power, sensitivity, phase error, switching, versus power...
- Test RF performance verification:
  - In order to execute quality testing, some dedicated applications are used to make some RF references to test the other board.
  - An RF reference reveals the exact losses between the radio-communication tester and the RF Output of the Application (50 Ohms)
  - Usually the references applications are used in coupling to make some cross-measurements and have the good RF losses.

9. Rework Guidelines

In most applications, Wireless Microprocessor® is mounted on small, thin and highly populated PCB, in which case rework should be done according to the procedure described in the following subsections.

CAUTION: This operation is possible without damaging adjacent components only if a component-free area around the Wireless Microprocessor® is respected as recommended in the PTS/CDG references to [1].

Rework tools and operating parameters are customer / application specific. Rework tools, heating profiles and rework process should be designed to ensure for optimum results.

Prior to any rework, if the component has exceeded its floor life (MSL3: 168h after vacuum pack opening), it is highly recommended to bake the PCB in order to remove moisture from the assembly. See paragraph 6 - Board rework of the document IPC / JEDEC J-STD-033A. For the PCB and the other components of the board, apply 125°C during 16 hours. The pre-baking process prevents damage to any component due to moisture vapour pressures caused during reflow.

9.1 Component Removal

Prior to the removal, the shielding of the Wireless Microprocessor® must be glued to the Wireless Microprocessor® substrate with glue that is able to withstand the reflow profile.

Then reflow of 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 liquids 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. In this case, 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 airflow should also be avoided, as this causes the component to overheat.

After 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.

9.2 Pad Redress

After 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 de-soldering braid.

When 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.

9.3 Flux Deposit

After the PCB is properly cleaned and inspected, flux should be applied on the solder land and on the connection balls. A no-clean flux is recommended.

If necessary, some solder paste should be added on the solder land with a mini-stencil having the same thickness and apertures as the stencil used for the original attachment.

9.4 New Component Placement

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

9.5 New Component Soldering

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

10. Underfill Process

Mounting the Wireless Microprocessor® device using the steps described above will produce good mechanical and thermal properties. However, in some instances, strength of the solder joints will be overcome by forces generated on the device. In order to enhance the thermal cycling performance and shock resistance of the BGA bond, the process of underfill can be implemented.

Underfill is a liquid polymer, silica filled epoxy that is dispensed along edges of a BGA or flip-chip. Surface tension forces draw the material under the BGA.

The underfill process takes place once the board is assembled, after functional test.

10.1 Underfill Dispensing

A reliable dispensing process should guarantee certain quality requirements:

- Package needs to be completely underfilled
- No voids within the underfill layer
- Uniform filling around the package

Motherboard should be pre-heated and heated during underfill dispensing to minimize moisture outgas, and facilitate the flow of the underfill.

Underfill is usually dispensed in an L-pattern along two adjacent sides of the BGA. The “L” shape is suitable for large BGA such as Wireless Microprocessor® and helps to reduce the underfill cycle time. High reliability applications may require a second “L” shape for the opposite side to form a uniform filling on all four sides (after a sufficient time delay to finish the flow of the first “L” shape).

It is recommended to apply the underfill at the opposite sides of the RF ball.

The underfill is drawn under the chip by capillary action.

Parameters for underfill dispensing should be adapted according to the underfill material supplier recommendations.

This step requests a keep-out area for the underfill filling and for the nozzle accessibility. It must be determined according to the underfill material and machine requirements.

10.2 Underfill Curing

The recommended cure conditions through heat exposure are dependant on the underfill material.

Typical cure conditions are 150-165°C for 3 to 10 minutes.

10.3 Rework

Some underfill materials are reworkable. The rework flow-chart is the same as that described in the previous chapter.