# Manual assembly recommendations

## 3D PLUS Modules (SnPb soldering process)

**3300-1300-7**

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<td>§10 updated : degolding and pre-tinning temperature increased</td>
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</table>
TABLE OF CONTENT

1. Scope ......................................................................................................................... 7
2. Documents in reference ............................................................................................ 7
3. 3D PLUS modules storage/assembly flowchart ...................................................... 7
4. Handling ..................................................................................................................... 8
5. Storage ....................................................................................................................... 8
   5.1. Background ........................................................................................................... 8
   5.2. Storage Recommendations .................................................................................. 8
   5.2.1. Module storage preparation recommendations ............................................... 8
   5.2.2. Module storage recommendations .................................................................... 9
   5.2.3. About 3D PLUS modules packaging .............................................................. 10
6. Assembly recommendations .................................................................................... 12
7. Module replacement recommendations ................................................................. 13
   7.1. Module removal .................................................................................................. 13
   7.2. Module replacement ........................................................................................... 13
   7.3. Module leads cutting (SOP, QFP and PoL packages only) .................................. 14
8. Module reinforcement recommendations ............................................................... 15
9. Module tinning recommendations ........................................................................... 16
10. Board coating recommendations ........................................................................... 16
11. Annex 1 : Carriers Description ............................................................................. 17
   11.1. High temperature carriers description .............................................................. 17
   11.2. Low temperature carriers description .............................................................. 18
   12.1. Material ............................................................................................................. 19
   12.2. Modules preparation ......................................................................................... 19
   12.3. Degolding .......................................................................................................... 19
   12.4. Tinning ............................................................................................................... 19
   12.5. Tinned lead geometry (SOP, QFP and PoL packages only) .............................. 20
   12.6. Visual inspection criteria ................................................................................... 20
Figure 1: 3D PLUS modules storage/assembly flowchart ................................................................. 7
Figure 2: Manual soldering only label ............................................................................................ 10
Figure 3: Automatic or manual soldering label for trays .................................................................. 11
Figure 4: Automatic or manual soldering label for plastic boxes ...................................................... 11
Figure 5: Modules leads cutting mechanical drawing ......................................................................... 14
Figure 6: 3D PLUS plastic tray for modules ...................................................................................... 17
Figure 7: Maximum baking temperature indication on trays .............................................................. 17
Figure 8: 3D PLUS plastic mini-tray for modules ............................................................................ 17
Figure 9: 3D PLUS plastic box for modules ...................................................................................... 18
Figure 10: Tinning zone limit drawing ............................................................................................. 20

Table 1: Time equivalence table ........................................................................................................ 9
Table 2: Bake frequency for dry cabinet storage .............................................................................. 9
1. **SCOPE**

This document embodies various recommendations concerning 3D PLUS Modules storage, assembly and rework conditions. **It is only applicable for modules guaranteed by 3D PLUS for manual soldering, stated in 3D PLUS certificate of conformity (CoC) and/or end item data package (EIDP).**

This document addresses to SOP, QFP, PGA packages and to PoL Converter modules.

2. **DOCUMENTS IN REFERENCE**

   RD1 : IPC/JEDEC J-STD-033B.1 Handling, packing, shipping and use of moisture/reflow sensitive surface mount devices

   RD2 : ECSS-Q-ST-70-08C Space product assurance : manual soldering of high-reliability electrical connections, Section 7.2.6. Pre-tinning of component leads and solid-wire conductors
   Section 5.6.7. Soldering irons and resistance soldering equipment

   RD3 : 3300-6560-1 Soldering and pre-tinning tests of 3D PLUS Modules with a thermal camera

   RD4 : 3641-0790 Side staking of a SOP module

   RD5 : 3641-0841 Underfilling of a SOP module

   RD6 : 3300-1303-1 Validation of the mounting of 3D PLUS memory stacks on pcb

3. **3D PLUS MODULES STORAGE/ASSEMBLY FLOWCHART**

   ![Flowchart Diagram](image)

   **Figure 1 : 3D PLUS modules storage/assembly flowchart**
4. **HANDLING**

Components manufactured by 3D PLUS must be handled with care. Operators are requested to wear antistatic gloves and wrist straps.

The use of tools that could damage sides of components is also prohibited.

*Note*: Manual handling may increase the risk of mechanical and/or ESD damage.

5. **STORAGE**

5.1. **BACKGROUND**

The vapor pressure of moisture inside a non hermetic package increases greatly when the package is exposed to the high temperature of solder reflow. Under certain conditions, this pressure can cause internal delamination of the packaging materials from the die and/or leadframe/substrate, internal cracks that do not extend to the outside of the package, bond damage, wire necking, bond lifting, die lifting, thin film cracking, or cratering beneath the bonds. In the most severe case, the stress can result in external package cracks. This is commonly referred to as the “popcorn” phenomenon because the internal stress causes the package to bulge and then crack with an audible “pop”.

5.2. **STORAGE RECOMMENDATIONS**

In order to avoid degradation due to humidity, components must be handled according to the following procedure. 3D PLUS recommends to store the modules in dry environment (dry sealed bags, dry cabinet) for a better use of its products.

5.2.1. **MODULE STORAGE PREPARATION RECOMMENDATIONS**

Before any storage operation, 3D PLUS modules must be dry. According to the duration of exposure to ambient conditions (30°C/60% RH), different durations of bake should be performed.

- **Short duration exposure (≤ 30 minutes)**: Components, which have only been exposed to ambient conditions below 30°C / 60% RH, and for 30 minutes or less, may be resealed with the original dessicant bag without any drying treatment, or stored in a dry cabinet.
- **Long duration exposure (≤ 30days)**: Components which have been exposed only to ambient conditions of 60% RH for a maximum of 30 days may be adequately dried by high temperature baking at 125°C during 24 hours for re-bake prior to reflow or storage in dry cabinet, or at 125°C during 48 hours for drying prior to dry packing.
- **For longer duration exposure (> 30days)**, a bake for a minimum duration of 48 hours at 125°C is mandatory.
• **Baking at 90°C**

If baking at 125°C is not possible, 3D PLUS modules can be baked at 90°C for a longer time. Below, a comparative table of baking duration according to the oven temperature.

<table>
<thead>
<tr>
<th>Baking at 125 °C</th>
<th>Baking at 90°C</th>
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<tr>
<td>24 hours</td>
<td>5 days</td>
</tr>
<tr>
<td>48 hours</td>
<td>10 days</td>
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Table 1: Time equivalence table

5.2.2. **MODULE STORAGE RECOMMENDATIONS**

After drying up the modules, one can choose to store them either in a dry cabinet or to seal them in a moisture barrier bag with a dessicant bag.

• **Dry cabinet storage:**

Right after the moisture barrier bag opening, 3D PLUS components can be stored in a dry cabinet at 20°C in dried carriers/ ESD plates (low temperature carrier excluded). According to the relative humidity (RH) level in the cabinet, 3D PLUS modules should be baked on a regular basis at 125°C, during 24 hours, then put back in the cabinet. For example, for a ≤10% RH cabinet, at 20°C, modules should be baked every 5 days. The cycle can be repeated as long as needed. Below 5% RH, 3D PLUS modules can be stored indefinitely.

<table>
<thead>
<tr>
<th>RH %</th>
<th>≤ 5%</th>
<th>≤ 10%</th>
<th>≤ 20%</th>
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<tr>
<td>Bake frequency (days)</td>
<td>24 hrs @ 125°C</td>
<td>∞</td>
<td>5</td>
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Table 2: Bake frequency for dry cabinet storage

• **Unopened moisture barrier bag:**

The calculated shelf life for dry sealed packed components is 12 months from the pack seal date, when stored in a non-condensing atmospheric environment of < 40°C and < 90% RH. Beyond this period, the reconditioning is mandatory; modules shall be baked at 125°C during 48 hours.
5.2.3. ABOUT 3D PLUS MODULES PACKAGING

High temperature carriers: Unless indicated otherwise by 3D PLUS, modules shipped in high temperature trays can be baked in the trays at 125°C (see annex 1).

Low temperature carriers: Modules shipped in low temperature carriers (e.g. plastic box, low temperature trays, tape and reel,...) may not be baked in the carriers at any temperature higher than 40°C or stored in a dry cabinet. If a higher bake temperature is required, modules must be removed from the low temperature carriers to thermally safe carriers, baked, then returned to the low temperature carriers (see annex 1).

Labelling: A specific label that details the recommendations is stamped on the sealed bag, see below.

---

WARNING - HAND SOLDERING DEVICES -

1. Storage in sealed bag: limited to 12 months <40°C and <90% relative humidity (RH).
   Beyond this period, please refer to application note 3300-1300.
2. Peak package body temperature ≤183°C
3. After sealed bag opening, within the 12-month limit, devices must be baked 24h at 125 ±5°C before mounting.
   In any other case, please refer to application note 3300-1300.

Note: Device container cannot be subjected to temperature > 50°C, so devices must be baked on another tray.

Bag seal date: 11/01/2013

Note: baking conditions and body temperature defined by application note 3300-1300
http://www.3d-plus.com/assembly-recommendations.php

---

Figure 2: Manual soldering only label
WARNING

1. Storage in sealed bag: limited to 12 months <40°C and <90% relative humidity (R-H)
   Beyond this period, please refer to application note 3300-1301.
2. Peak package body temperature <215°C
3. After sealed bag opening, within the 12-month limit, devices must be baked 24h
   at 125±5°C before mounting.
   In any other case, please refer to application note 3300-1301.

Note: Device container cannot be subjected to temperature > 130°C.

Bag seal date: 11/01/2013

Note: baking conditions and body temperature defined by application note 3300-1301
http://www.3d-plus.com/assembly-recommendations.php

Figure 3: Automatic or manual soldering label for trays

WARNING

1. Storage in sealed bag: limited to 12 months <40°C and <90% relative humidity (R-H)
   Beyond this period, please refer to application note 3300-1301.
2. Peak package body temperature <215°C
3. After sealed bag opening, within the 12-month limit, devices must be baked 24h
   at 125±5°C OUT FROM DEVICE CONTAINER before mounting.
   In any other case, please refer to application note 3300-1301.

Note: Device container cannot be subjected to temperature > 50°C, so devices must
be baked on another tray.

Bag seal date: 11/01/2013

Note: baking conditions and body temperature defined by application note 3300-1301
http://www.3d-plus.com/assembly-recommendations.php

Figure 4: Automatic or manual soldering label for plastic boxes
6. **ASSEMBLY RECOMMENDATIONS**

*Note: 3D PLUS modules leads must be tinned before assembly operation, please refer to annex 2 for leads tinning operation.*

After sealed bag opening, 3D PLUS modules have to be baked 24 hours at 125°C. If taken out from a dry cabinet within their storage cycle (see 4.2. Storage Recommendations: dry cabinet storage section), 3D PLUS modules may be soldered right away.

The maximum storage duration under environmental conditions ≤ 30°C and < 60% RH is 6 hours. Beyond 6 hours, a new 24-hour bake at 125°C has to be performed on modules.

*The use of any scotch tape (e.g. Kapton) on the side of the module during assembly is prohibited.*

A wide range of tin-lead solder paste is available in the industry. The solder alloy selected should be non-hazardous, mechanically reliable, thermal fatigue resistant, good wetting, and must be compatible with a variety of lead-bearing and surface coatings.

3D PLUS recommends Sn_{63}Pb_{37} solder paste or solder wire with melting point at 183°C (eutectic point), or Sn_{62}Pb_{36}Ag_{2} solder paste or solder wire with melting point at 179°C.

Furthermore, 3D PLUS recommends the use of leads tinning as specified on annex 2.

The temperature of soldering equipment must be defined so that the temperature, measured on body module, is below 183°C. If the profile exceeds the time-temperature limitations beyond the scope of this specification, 3D PLUS should be consulted.

**For SOP and QFP packages**, the recommended soldering iron temperature is 280 °C, from 250°C up to 310°C, with a maximum soldering time of 4s per lead at this temperature.

**For PGA and PoL packages**, the maximum recommended soldering iron temperature is 280 °C, with a maximum soldering time of 4s per lead at this temperature.

Module cleaning after manual assembly must be done with isopropyl alcohol preferentially, or with de-ionized water otherwise. For other cleaning products, please consult 3D PLUS for further information.

*Note: local heating by using a heating plate at 80-100 °C can be used to ease the soldering operations.*
7. **MODULE REPLACEMENT RECOMMENDATIONS**

The replacement process of 3D PLUS modules typically consists of the following steps:

- Thermal pre-heating depending on board structure
- Removal of defective component
- Cleaning of the area
- Solder replenishment or flux application
- New component placing
- Manual reflow soldering
- Post-reflow inspection

#### 7.1. MODULE REMOVAL

- Solder from each lead shall be removed with the soldering iron and desoldering braid to remove solder.
- Soldering iron temperature is +310°C maximum for SOP and QFP packages, +280°C maximum for PGA and PoL packages.
- Module has to be carefully removed from the board.

For these steps the flux recommended is: Pure Rosin Flux (ROL 0); solvent: Isopropyl Alcohol.

#### 7.2. MODULE REPLACEMENT

After cleaning the pads and the leads of the removed module, a new module may be re-soldered on the board according to the Reflow Guidelines (see §6 of this document).

The replacing modules should be baked prior to reflow if they have been exposed to moisture (see §5 of this document).

Module cleaning after assembly must be done with isopropyl alcohol preferentially, or with de-ionized water otherwise. For other cleaning products, please consult 3D PLUS for further information.
7.3. **MODULE LEADS CUTTING (SOP, QFP AND PoL PACKAGES ONLY)**

According to the ESA memo TEC-QT/2012/206/CV, in order to facilitate hand soldering and ensure solders reliability, the length of 3D PLUS modules leads should be kept below or equal to 3.10 mm, as illustrated below. Therefore, in case of greater length of leads, 3D PLUS recommends to cut the leads to ease the manual soldering process.

![Figure 5: Modules leads cutting mechanical drawing](image-url)

< 3.10 mm recommended
8. **MODULE REINFORCEMENT RECOMMENDATIONS**

To guarantee a high level of mechanical requirements (vibrations, accelerations, and shocks), modules may be reinforced with epoxy adhesive products. 3D PLUS recommends the use of 3M 2216B/A Gray Scotch-Weld™ epoxy adhesive. **Eccobond 285 with catalyst 11 seems to be a good alternative, with greater workability and closer CTE to module’s, but it has only been tested on one 3D PLUS product.**

Two methods are proposed:
- Underfilling of a SOP module
- Side staking of a SOP module

For further information on the process, please refer to [RD4] [RD5].

These documents are available on 3D PLUS website or on demand.

For mechanical reinforcement of QFP, PGA or PoL packages modules, or for any other questions, please contact 3D PLUS.
9. **Module Tinning Recommendations**

Upon customer request, modules may be delivered with tinned leads.

**Caution**: Tinned leads are sensitive to oxidation. Storage conditions and duration impact modules’ tinning quality and solderability. 3D PLUS does not guarantee its tinned modules solderability after delivery.

Consequently, 3D PLUS modules should be tinned right before assembly (see annex 2 for more information on the tinning process).

10. **Board Coating Recommendations**

Upon customer request, modules may be delivered coated with MAPSIL 213B, SOLITHANE 113 or ARATHANE 5750. In that case, customers must check the compatibility of module coating products with their products.

Note that ARATHANE 5750 is not covered by 3D PLUS Process Identification Document.
11. ANNEX 1: CARRIERS DESCRIPTION

11.1. HIGH TEMPERATURE CARRIERS DESCRIPTION

Figure 6: 3D PLUS plastic tray for modules

Figure 7: Maximum baking temperature indication on trays

Figure 8: 3D PLUS plastic mini-tray for modules
11.2. LOW TEMPERATURE CARRIERS DESCRIPTION

Figure 9 : 3D PLUS plastic box for modules
12. **ANNEX 2 : LEADS TINNING**

### 12.1. MATERIAL

In order to tin the leads of 3D PLUS modules, one shall need:

- An oven at +125°C or a heating plate
- A degolding bath of Sn$_{62}$Pb$_{36}$Ag$_2$ (or Sn$_{63}$Pb$_{37}$) heated at 230°C – 250°C. A large bath has to be used (at least 20cl or 200cc) in order to maintain a relatively low concentration of gold after the treatment of several hundreds of modules.
- A tinning bath of Sn$_{62}$Pb$_{36}$Ag$_2$ (or Sn$_{63}$Pb$_{37}$) heated at 230°C – 250°C
- Flux : ROL 0 or ROL 1 flux
- Isopropyl alcohol (IPA)

### 12.2. MODULES PREPARATION

After sealed bag opening, 3D PLUS modules have to be baked 24 hours at 125°C. If taken out from a dry cabinet within their storage cycle (see §5.2. Storage Recommendations: dry cabinet storage section), one might proceed to degolding step right away.

In the following steps, the modules must be warm at all times, taking out the parts one by one from oven, or at least by keeping them warm on a heating plate at 125°C.

### 12.3. DEGOLDING

- Flux the modules leads by dipping them in a flux bath or by using a brush,

- Dip the leads for 2-4 seconds per row inside a solder bath of Sn$_{62}$Pb$_{36}$Ag$_2$ (or Sn$_{63}$Pb$_{37}$) heated at 230°C - 250 °C.

The dipping is made row by row. The epoxy body of the module must not be in contact with the liquid solder bath.

- 3D PLUS recommends to proceed to tinning (see 10.3.) after a 10-second transition time, however a storage for a short time (1…2 minutes at 125°C on a heating plate) before pre-tinning is possible.

### 12.4. TINNING

- Flux the leads

- Dip the leads for 2-4 seconds per row inside a solder bath of Sn$_{62}$Pb$_{36}$Ag$_2$ (or Sn$_{63}$Pb$_{37}$) heated at 230°C - 250 °C. The dipping is made row within a maximum time of 3-4 seconds per row. The epoxy body of the module must not been in contact with the upper surface of the liquid bath,

- Clean the leads with Isopropyl alcohol
12.5. **Tinned Lead Geometry (SOP, QFP and PoL Packages Only)**

The leads will be tinned in accordance with the following drawing: the tin limit must be within 500μm from the bottom of the module:

![Tinning zone limit drawing](image)

**Figure 10**: Tinning zone limit drawing

12.6. **Visual Inspection Criteria**

a) No traces (tooling marks, scratches...) on the module sides,
b) No «solder splash» on the module sides,
c) No tin on the bottom of the module,
d) No damaged leads,
e) No contaminants on the module,
f) Respect of the tin limit (see §12.5 above),
g) No flux traces on the leads,
h) Tin aspect must be smooth and bright.