APPLICATION NOTE

# Application Guidelines for Non-Isolated Converters

## AN07-001 Manufacturing Guidelines for TLynx™, DLynx™, DualDLynx™, DLynxII™, BoostLynx™ and ProLynx™ Series Modules

### Introduction

The TLynx™, DLynx™, DLynxII™, DualDLynx™, SlimLynx™ and ProLynx™ series of modules are SMT DC/DC non-isolated converters, that feature a pinless interconnect scheme, where the bottom side of the module has pads called Solder Grid Arrays (SGA), which are used to connect the module to a main PWB in an application. These SGA connections are constructed using Pb-free SAC (Sn/Ag/Cu) solder bumps. This note provides recommendations for assembly and removal of these modules from customer boards. This Application Note can also be used for modules such as the BoostLynx™ which uses block pins instead of SGA.

### Recommended Assembly Process

The TLynx™, DLynx™, DLynxII™, DualDLynx™, SlimLynx™ BoostLynx™ and ProLynx™ series of modules use an open frame construction and are designed for a fully automated assembly process. The modules are packaged in tape and reel packaging. Please consult the specific product data sheets for dimensions and module quantities of the tape and reel packaging.

### Pick and Place

These modules are fitted with a label designed to provide a large surface area for pick and place operations. The label meets all the requirements for surface mount processing, as well as safety standards, and is able to withstand reflow temperatures of up to 300°C.

### Production Location and Date Code

The label also carries product information such as product code, serial number, and the location of manufacture. The serial number is of the form YYLLWWXXXXXX, where YY is the last two digits of the year of manufacture; the LL is a two code for the location of manufacture; the WW is a two digit code for the Gregorian calendar week of manufacture; and the XXXXXX is a sequential serial number assigned at the manufacturing location. Due to space constraints on the label, these products carry a human readable product code, and a machine readable, 2-D bar code containing the serial number.

### Nozzle Recommendations

The module weight has been kept to a minimum by using open frame construction. Variables such as nozzle size, tip style, vacuum pressure and placement speed should be considered to optimize this process. The minimum recommended inside nozzle diameter for reliable operation is 3mm. The maximum nozzle outer diameter, which will safely fit within the allowable component spacing, is 7 mm. Please consult the specific product data sheet for pick and place pickup location information.

## Solder Paste

The customer side PWB should have solder paste printed on with a stencil foil thickness between 0.10mm to 0.15mm (4 to 6 mils). A no-clean solder paste is recommended. Please consult the specific product data sheet for layout location information.

## Moisture Sensitivity Level (MSL) Rating

All modules typically have a MSL rating of 2a. Please consult the specific product data sheet.

## Storage and Handling

The recommended storage environment and handling procedures for moisture-sensitive surface mount packages is detailed in J-STD-033 (Handling, Packing, Shipping and Use of Moisture/Reflow Sensitive Surface Mount Devices). Moisture barrier bags (MBB) with desiccant are required for MSL ratings of 2 or greater. These sealed packages should not be broken until time of use. Once the original package is broken, the floor life of the product at conditions of ≤30°C and 60% relative humidity varies according to the MSL rating (see J-STD-033). The shelf life for dry packed SMT packages will be a minimum of 12 months from the bag seal date, when stored at the following conditions: < 40° C, < 90% relative humidity.

## Reflow Soldering

The TLynx™, DLynx™, DLynxII™, DualDLynx™, BoostLynx™ and ProLynx™ series modules are lead-free (Pb-free) and RoHS compliant and fully compatible in a Pb-free or Pb soldering process. Failure to observe the instructions below may result in the failure of or cause damage to the modules and can adversely affect long-term reliability. ABB has conducted several Solder Joint Reliability studies, per IPC-9701 Performance Test Methods and Qualification Requirements for Surface Mount Solder Attachment, using temperature profile as -40°C to 100°C. Please contact your local ABB Electronics Sales representative to request more information.

## Pb-Free Solder

These products will comply with J-STD-020 (Moisture/Reflow Sensitivity Classification for Nonhermetic Solid State Surface Mount Devices) for both Pb-free solder profiles and MSL classification procedures. The suggested Pb-free solder paste is Sn/Ag/Cu (SAC) The recommended linear reflow profile using Sn/Ag/Cu solder is shown in Fig. 1. Soldering outside of the recommended profile requires testing to verify results and performance.

These are the recommended soldering profile parameters:

- Preheating rate < 3°C/second
- Minimum dwell time of 45 seconds above 217°C
- Minimum dwell time of 15 seconds above 235°C
- Maximum peak temperature of 260°C
- Cooling rate < 4 °C/second

## Pb Solder

In a conventional Tin/Lead (Sn/Pb) solder process peak reflow temperatures are limited to less than 235°C. Typically, the eutectic solder melts at 183°C, wets the land, and subsequently wicks the device connection. Sufficient time must be allowed to fuse the plating on the connection to ensure a reliable solder joint. There are several types of SMT reflow technologies currently used in the industry. These surface mount power modules can be reliably soldered using natural forced convection, IR (radiant infrared), or a combination of convection/IR. For reliable soldering the solder reflow profile should be established by accurately measuring the modules SGA connector temperatures. An example of connector temperature measurements using thermocouples, is shown later in Figure 7.

The recommended linear reflow profile using Sn/Pb solder is shown in Fig. 2 and Fig. 3. Soldering outside of the recommended profile requires testing to verify results and performance.

These are the recommended soldering profile parameters:

- Preheating rate < 3°C/second
- Soak zone from 30 seconds to 240 seconds
- Heat zone rate < 4°C/second
- Minimum dwell time of 60 seconds above 183°C
- Minimum peak temperature of 220°C
- Maximum peak temperature of 235°C
- Cooling rate < 6°C/second

### Post Soldering Cleaning

The TLynx™, DLynx™, DLynxII™, DualDLynx™, BoostLynx™ and ProLynx™ series modules are compatible with both solvent and aqueous cleaning processes. However, a no-clean process, similar to those for other BGA type devices, is recommended due to the minimal gap between the host PWB and the underside of the series module. Also, a low activity, non-corrosive flux is recommended due to the minimal gap.

## Removal of TLynx™, DLynx™, DLynxII™, DualDLynx™, BoostLynx™ and ProLynx™ Series Modules

### Preparing Modules for removal

In order to preserve the integrity of the components mounted on these modules during removal, it is very important to observe these removal instructions, especially if modules are being returned for FMA procedures. Due to the SGA attachment technology, only hot air BGA removal equipment, such as SRT or Air-VAC, should be used to remove these modules. Soldering irons are not allowed.

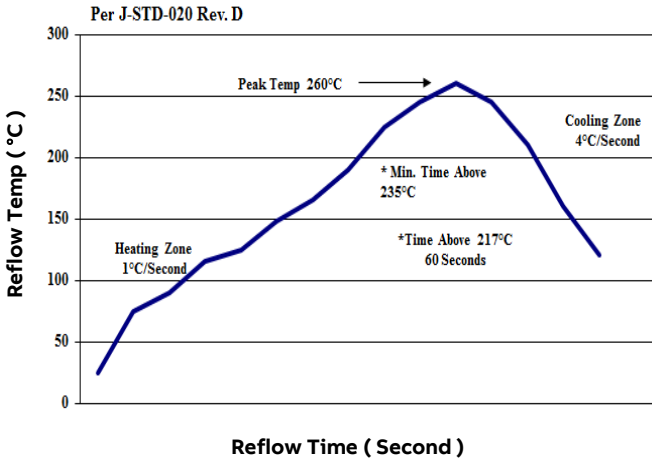


**Figure 1. Recommended linear reflow profile using Sn/Ag/Cu solder.**

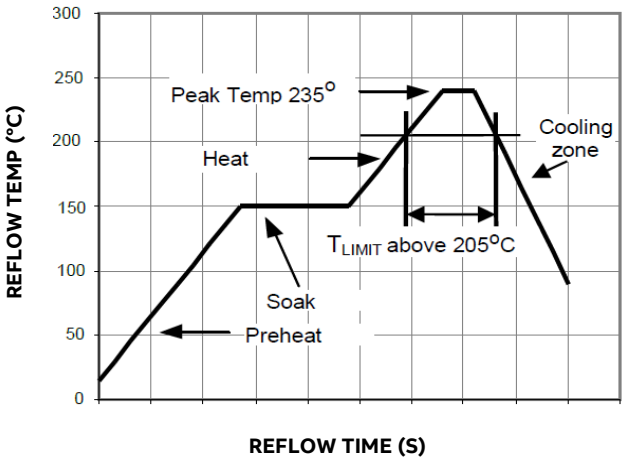


**Figure 2. Recommended reflow Profile for Tin/Lead (Sn/Pb) process.**

The TLynx™ series modules utilize a top mounted inductor that is supported by three metal legs, which are mechanically bonded to the module PWB. In the DLynx™ series of modules, the inductor is attached to the module PWB through soldered connections. In the ProLynx™ series, two electrical and a mechanical connection are used to attach the inductor to the module PWB. Both electrical and mechanical bonds will soften when heated to temperatures necessary to melt the SGA solder attachment.

Therefore, prior to removal, this bond needs to be strengthened to allow upward force on the inductor to remove the module without separating the inductor from the module. A suitable SMT glue, such as Heraeus PD922 or Loctite 3609 equivalent, should be applied to the mechanical leads of the inductor, as shown in Fig. 4, on both the interior and exterior joints to the module's PWB. The glue material can also be dispensed at the space between the inductor and module's PWB to increase the adhesion force so that the inductor stays on the module during the hot air application for the removal process. For example, as shown in Fig. 4, on an APTH006 module, additional glue is attached to each of the three legs of the inductor on both the interior and exterior joints to the module's PWB. Allow this glue to cure before applying heat to remove the module.

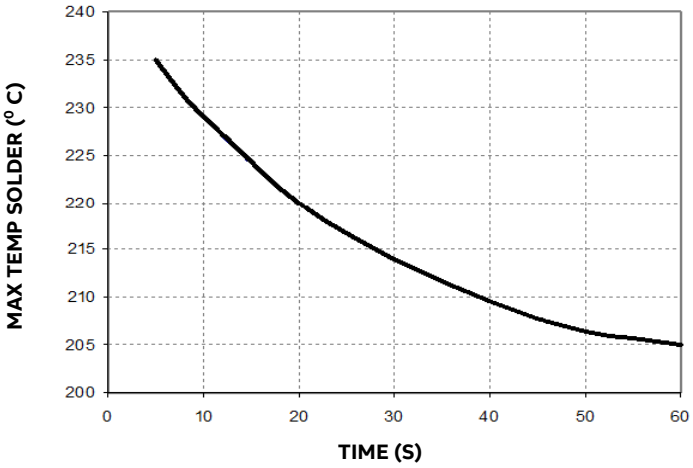


**Figure 3. Time Limit, $T_{LIMIT}$, Curve Above 205°C Reflow for Tin Lead (Sn/Pb) process.**

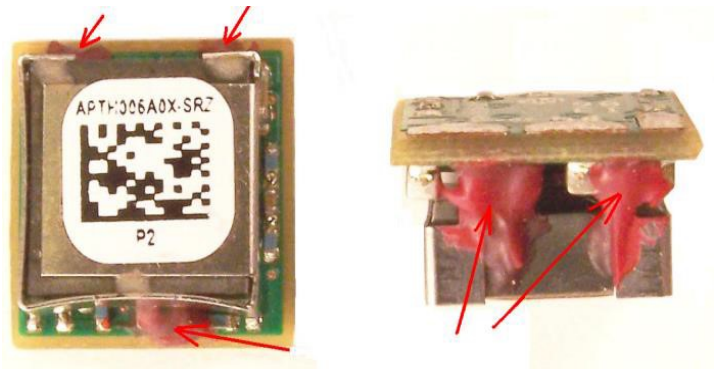


**Figure 4. SMT glue applied to inductor legs.**

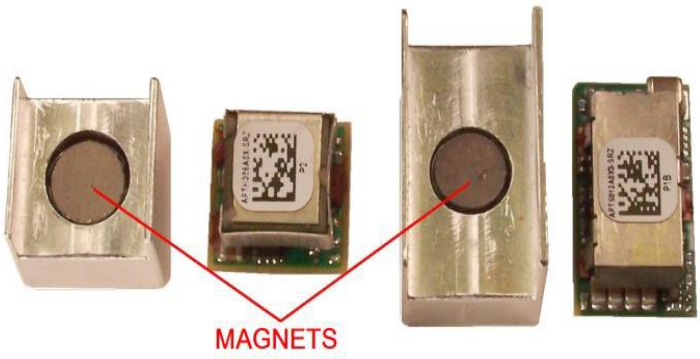


**Figure 5. Heat shields and TLynx series modules.**

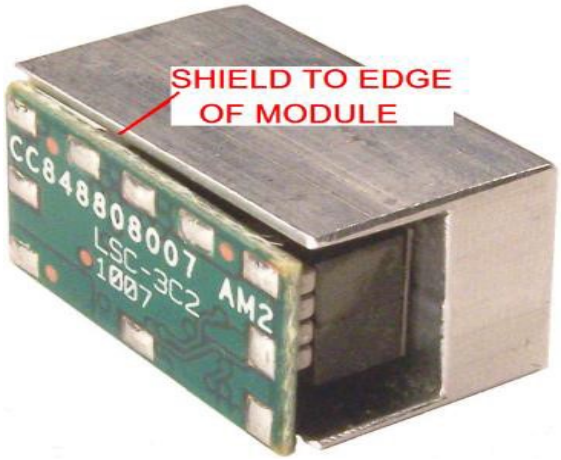


**Figure 6. Heat shield attached to a Micro TLynx series module.**

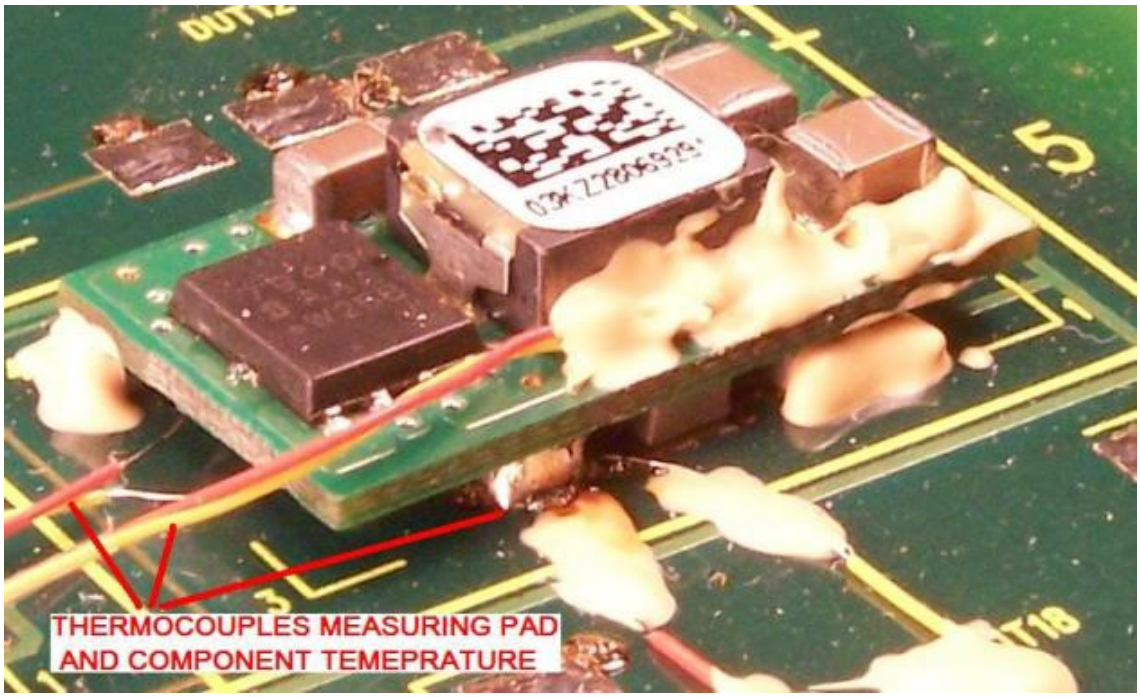


**Figure 7. Thermocouples for temperature profile**

## Heat Shields

An aluminum heat shield is necessary to protect the top side components on the TLynx series module during removal. The heat shield will also have an internal magnet that will attach to the module inductor top surface (same surface used for pick and place pickup nozzle point, see individual TLynx series data sheet for location drawing) that will exert upward force to lift the module from the main board when the SGA solder becomes molten. The heat shield should be shaped in a U or channel that has sides which extend down from the top surface of the module to the edge of the module PWB, and that will shroud the long sides of the module from direct exposure to the hot air flow from the removal equipment. Figure 5 shows the shapes and construction of heat shields, and Figure 6 shows the alignment of the side of the heat shield with the edge of the module. Please refer to specific TLynx series module data sheets for module dimensions to construct these heat shields. ABB does not provide heat shields.

## Conformal Coating

Modules are suitable for conformal coating with dip or vapor deposition. Usually conformal coating does not adhere to the ferrite core / plastic bodies of components. This is a cosmetic issue since ferrite/plastic do not have electrical function.

## Removal Reflow Profile

Prior to removal of a TLynx™, DLynx™, DLynxII™, DualDLynx™, BoostLynx™ or ProLynx™ series module, it is recommended to instrument the module with thermocouples, as shown in Figure 7, and measure the module's temperatures to determine if the heating profile meets recommended limits.

## Pb-Free Solder

The recommended linear removal heating profile using Sn/Ag/Cu solder is shown in Figure 8. Deviations outside of this recommended profile requires testing to verify results and performance.

These are the recommended removal temperature profile parameters:

- Target temperature: 240 C
- Cool down temperature: 180 C
- Maximum reflow time: 60 seconds
- Minimum soak temperature: 130 C
- Maximum soak temperature: 170 C
- Minimum reflow time: 20 seconds
- Vacuum pressure force: 35 grams

## Pb Solder

The recommended linear removal heating profile using Sn/Pb solder is shown in Figure 9. Deviations outside of this recommended profile requires testing to verify results and performance.

These are the recommended removal temperature profile parameters:

- Target temperature: 200 C
- Cool down temperature: 170 C
- Minimum soak temperature: 130 C
- Maximum soak temperature: 160 C
- Minimum reflow time: 20 seconds
- Vacuum pressure force: 35 grams
- Maximum reflow time: 60 seconds

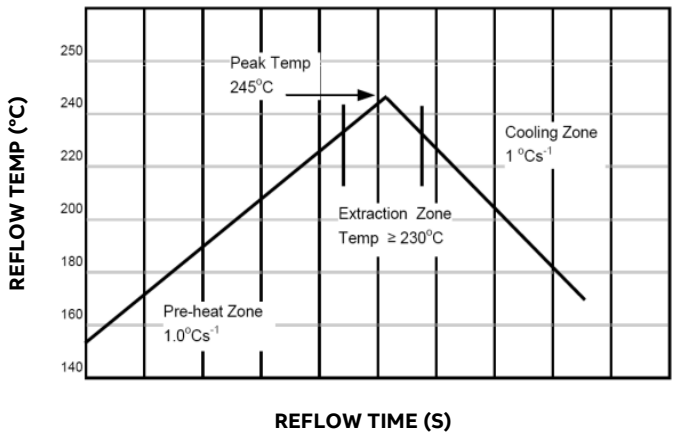


**Figure 8. Recommended removal temperature profile using Sn/Ag/Cu solder.**

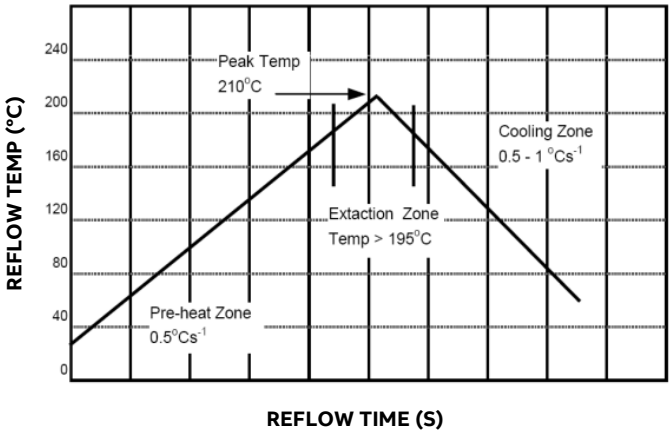


**Figure 9. Recommended removal temperature profile using Sn/Ag/Cu solder.**

## Summary

The TLynx™, DLynx™, DLynxII™, DualDLynx™, SlimLynx™ and ProLynx™ series modules are SMT DC/DC non-isolated converters, that feature a pin less interconnect scheme, where the bottom side of the module has pads called Solder Grid Arrays (SGA), which are used to connect the module to a main PWB in an application. These SGA connections are constructed using Pb-free SAC (Sn/Ag/Cu) solder bumps. This note provides recommendations for assembly and removal of these modules from customer boards. It can also be used for modules such as the BoostLynx™ which uses block pins instead of SGA.


## Contact Us


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