PCB Design and Assembly Recommendations for Power Tower Module Technology

Introduction

The Renesas module product family offers a unique high-performance packaging concept, the Power Tower package. This package provides various benefits, including reduced package area and array LGA I/O (lead pitch is 1.1mm) with an integrated dual inductor and two Smart Power Stages (SPS) located on top of the module. Also, the exposed copper ePad technology in the SPSs offers excellent thermal performance. These features make the Power Tower packaged module ideal for many new high-end computing and AI applications where board space, thermal, and electrical performance are essential.

This tech brief provides general guidelines for developing land pattern layouts and solder mounting processes. *Note:* These guidelines are general and should only be considered a starting point in this effort. The user must apply their experiences and development efforts to optimize designs and processes for their manufacturing practices and the needs of varying end-use applications.

Contents

1. Package Construction

1.1 Power Tower Module Packaging Highlights

- Power Tower LGA Laminate technology
  - LGA laminate provides multiple routing layers.
- Power Tower provides superior thermal performance.
  - Power dissipating components are mounted on top of the Power Tower with Top ePads for improved thermal performance.
- Power Tower is flexible.
  - Renesas offers a comprehensive family of Power Tower modules with 5mm thicknesses.
  - The Power Tower connector and laminates can be quickly modified to produce new products.
- Power Tower provides high SMT yields.
  - An Electroless Nickel Immersion Gold (ENIG) lead finish provides excellent solderability.

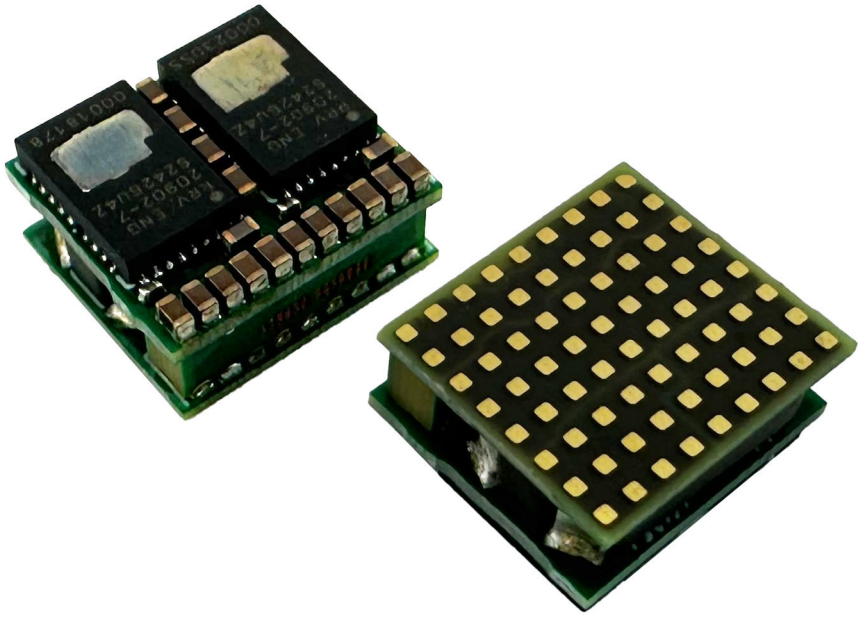

Figure 1. Typical Power Tower Module Photos

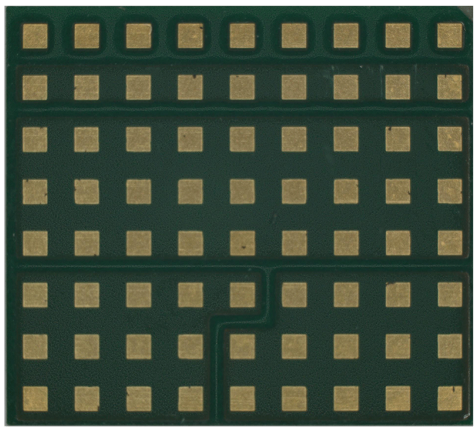

Figure 2. Typical Power Tower Bottom View - RRV29830

Note: The pad finish is Electroless NiAu, Gold Plate (ENIG) for good solderability. The Au finish is 0.05 to 0.15µm thick to prevent gold embrittlement of the solder joint.

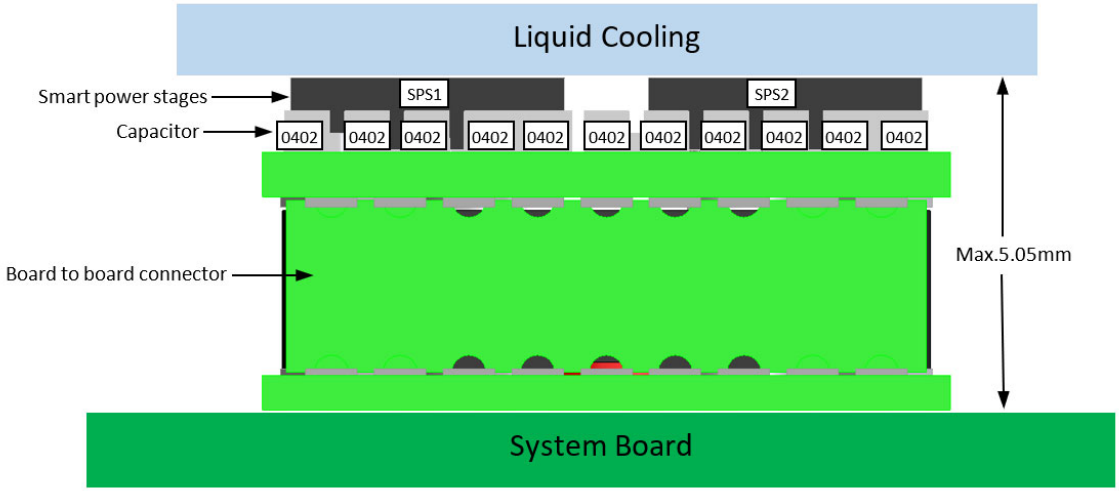

Figure 3. Typical Power Tower Module Cross-Section

2. Moisture Sensitivity

2.1 Moisture Sensitivity Handling, Packing, and Use

2.1.1 Moisture Sensitivity

Power Tower modules are moisture-sensitive devices. All Power Tower modules meet Moisture Sensitivity Level (MSL) 3 per J-STD-020.

Pb-free reflow is qualified per J-STD-020. Peak temperatures vary based on module thickness and volume and are specified on the MSL label.

2.1.2 Packing and Labeling

Renesas packs and labels the Power Tower modules per J-STD-033. Standard packing is in JEDEC trays.

2.1.3 Handling and Use

Customers should handle and use Power Tower modules per J-STD-033. The modules are MSL 3 qualified – do not exceed 168-hour floor life. If floor life is exceeded, bake at +125°C for 8 hours.

3. PCB Design Guidelines

3.1 Power Tower – PCB Design Guidelines

- The Renesas Power Tower package outline drawing in the product datasheet includes a PCB footprint.
- PCB lands in the form of SMD pads are preferred to improve gasketing.
- PCB lands should match the Power Tower pads one-to-one.
- See the Package Outline Drawing (POD) for specific design recommendations.
- Vias in the pad should be filled and plated over (VIPPO) to prevent solder wicking into the vias.
- Electroless Nickel Immersion Gold (ENIG) PCB finish recommended.
- Solder stencil apertures should be slightly smaller than the solder mask openings, 30µm typical.

4. PCB Assembly Process

4.1 Power Tower – PCB Assembly Process

- Profile with a thermal couple placed under the Power Tower module
- Follow the solder paste supplier's reflow profile, but do not exceed the Power Tower module's qualified peak reflow temp. Pb-free reflow is qualified per J-STD-020:
  - Peak temperature is 245 ±5°C for 10 seconds for Pb-Free assembly.
  - Time above liquidus (221°C) is 60s to 150s maximum.
  - See Table 1 and Figure 11.
- If power tower is installed on bottom of PCB, no need to add glue or fixture support on the power tower during the PCB side components reflow.
- Do not exceed the 168-hour out-of-bag limit (MSL 3 qualified)
  - If the time limit is exceeded, bake per MSL label instructions
- Use the following assembly tooling materials for the SMT process:
  - Electroless Nickel Immersion Gold PCB finish (ENIG)
  - Stainless steel, laser cut stencils with Nano-coating
  - 4 mil or 5 mil stencil thickness
  - No clean, low void, Type 3 or 4 solder paste per ANSI/J-STD-005
- Follow the paste supplier recommendation for air or nitrogen purge during reflow.
- Use suggested Power Tower pick and place pickup tool. See Figure 4 through Figure 8.

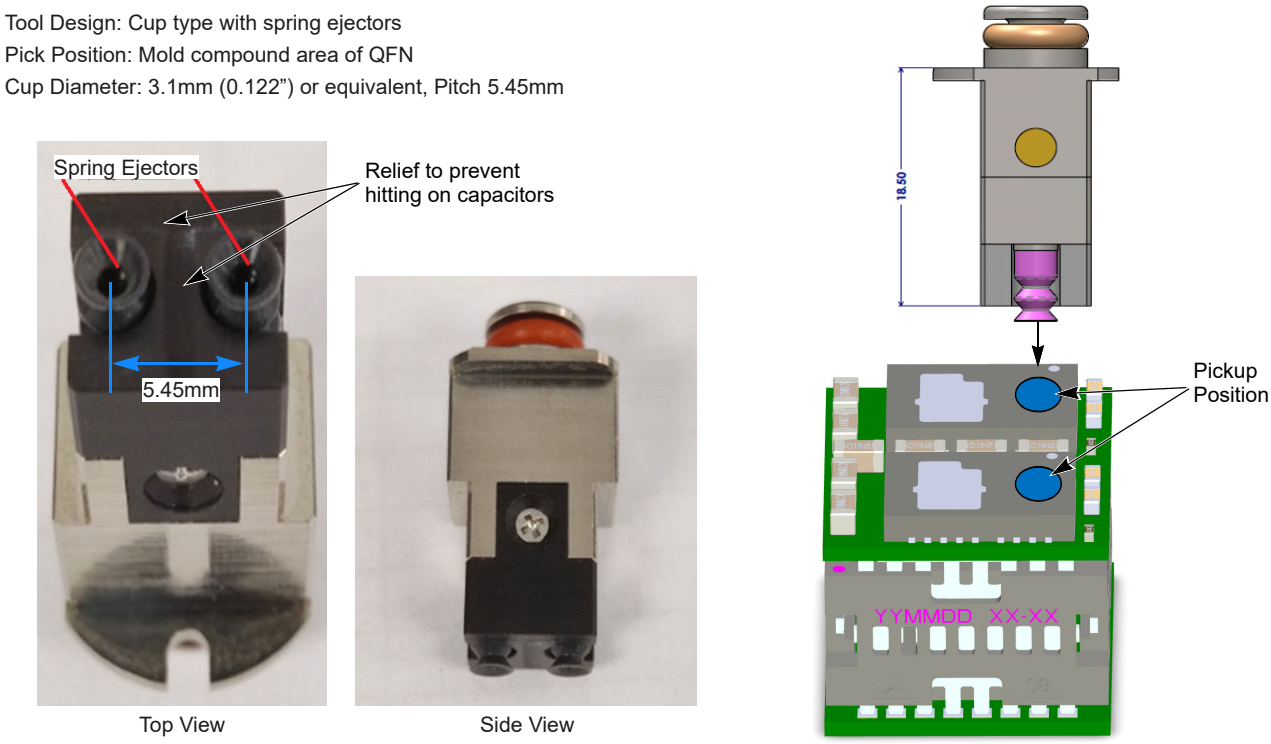

Figure 4. Suggested Power Tower Pickup Tool

Tool Design: Cup type with spring ejectors
Cup Diameter: 3.1mm (0.122”) or equivalent, Pitch 5.45mm

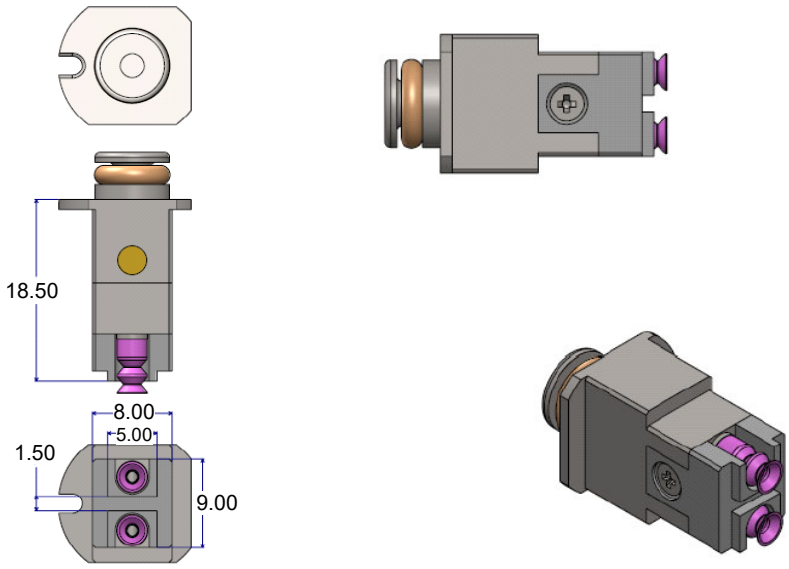

Figure 5. Suggested Power Tower Pickup Tool – Detail 1

Tool Design: Cup type with spring ejectors
Cup Diameter: 3.1mm (0.122”) or equivalent, Pitch 5.45mm

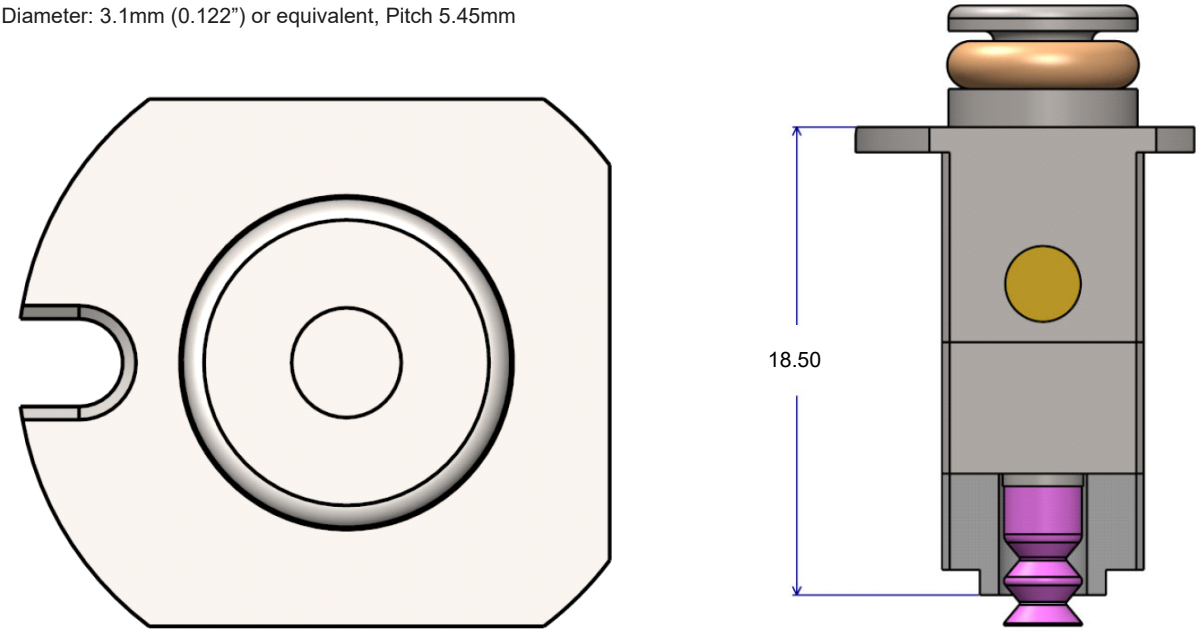

Figure 6. Suggested Power Tower Pickup Tool – Top and Side View

Tool Design: Cup type with spring ejectors
Cup Diameter: 3.1mm (0.122”) or equivalent, Pitch 5.45mm

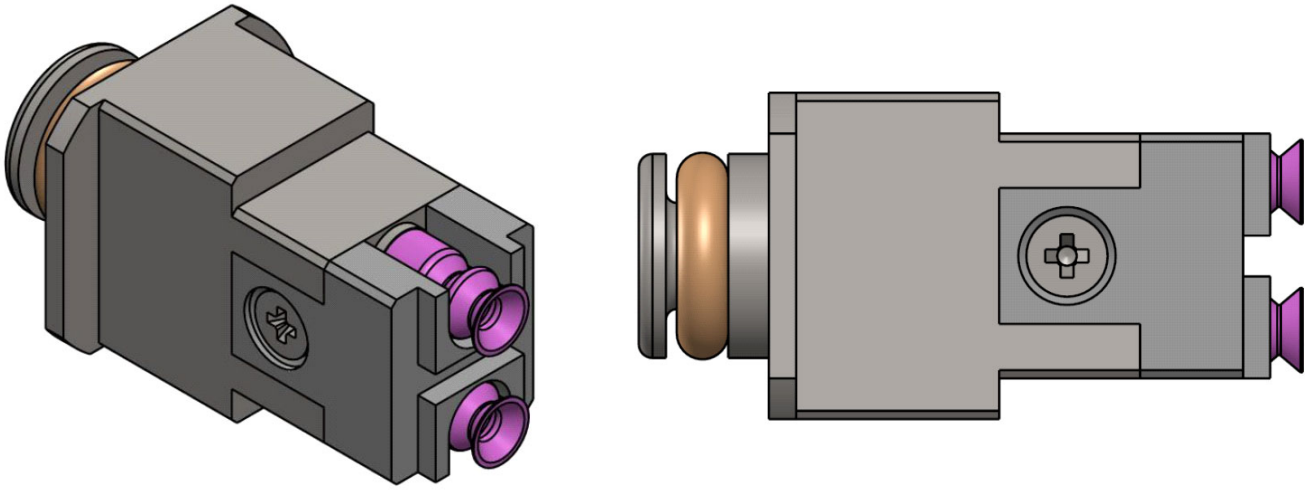

Figure 7. Suggested Power Tower Pickup Tool – 3D and Side View

Tool Design: Cup type with spring ejectors
Cup Diameter: 3.1mm (0.122”) or equivalent, Pitch 5.45mm

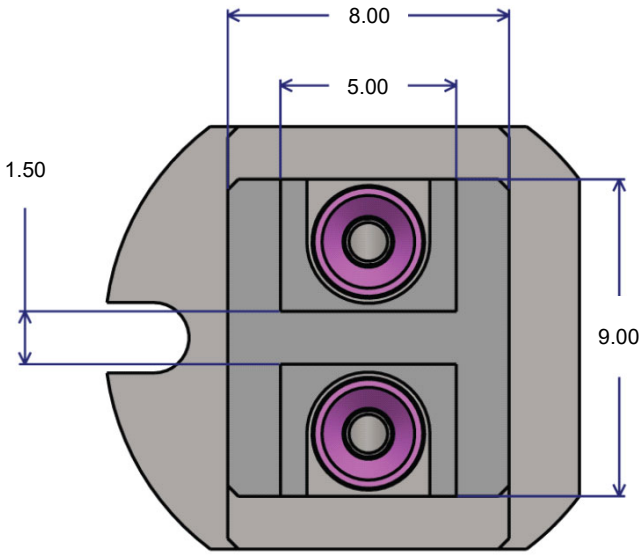

Figure 8. Suggested Power Tower Pickup Tool – Bottom View

- Solder Print Inspection (SPI) is recommended to ensure consistent solder deposit area, height, and volume.

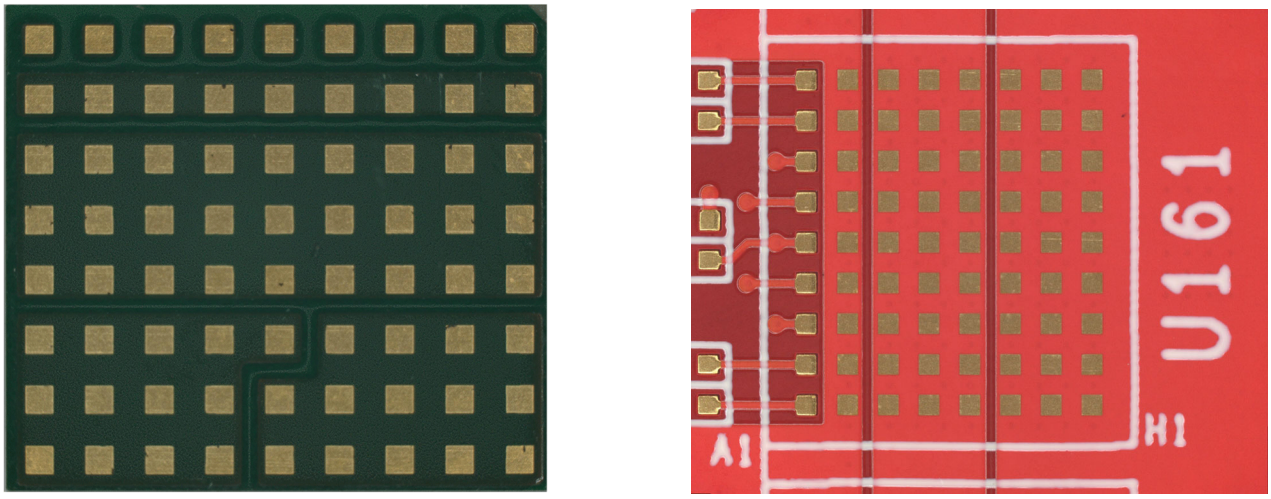

Figure 9. Typical Power Tower Module Photos

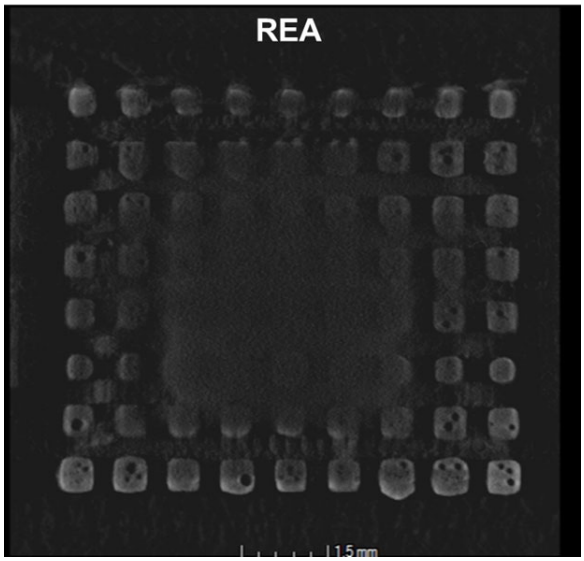

Figure 10. Power Tower Sample X-Ray

Table 1. Reflow Profiles

General Reflow Process Specification		Pb-Free, SAC305
Average Ramp-Up Rate ($T_{PRODUCT}$)	-	3°C/second maximum
Typical Solder Melting Temperature	T_L	221°C
Min/Max. reflow time above TL	T_{PIN}	60 to 150 seconds
Minimum Pin Temperature	T_{PIN}	235°C
Peak Product Temperature	$T_{PRODUCT}$	245°C
Average Ramp-Down ($T_{PRODUCT}$)	-	6°C/second maximum
Maximum time 25° C to peak	-	8 minutes

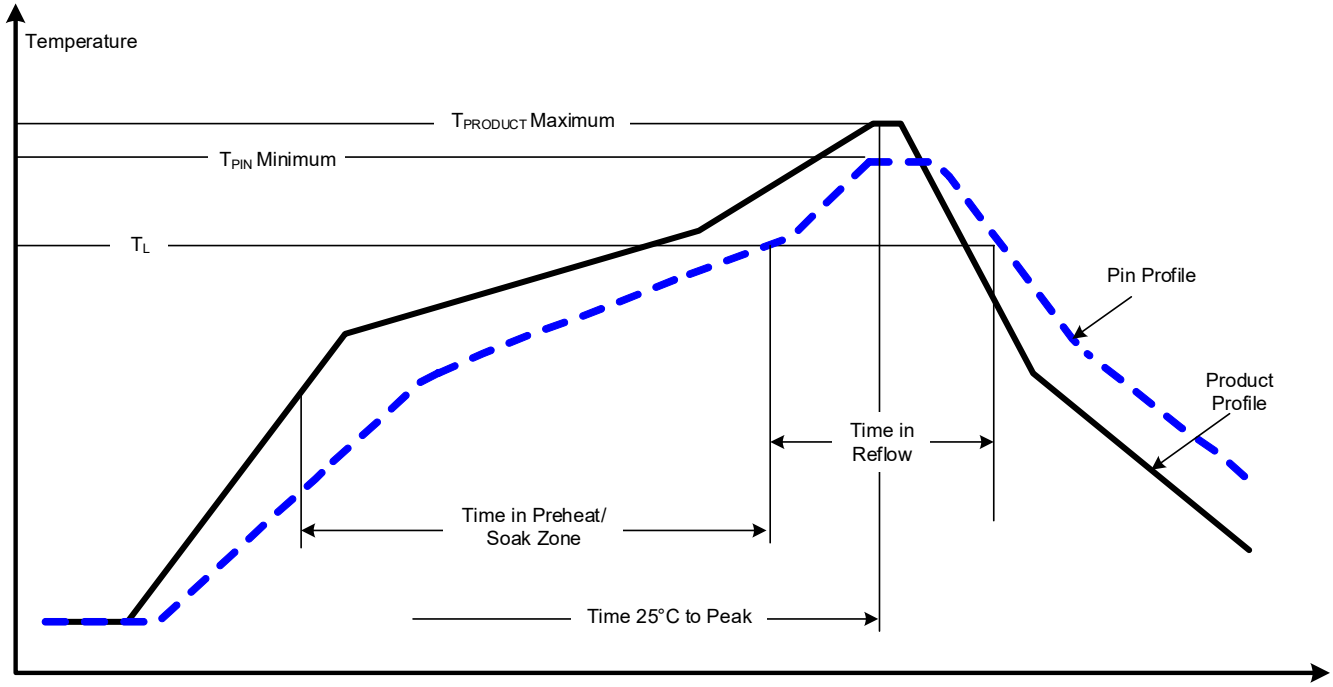

Figure 11. Peak Reflow Profile

4.2 PCBA Solder Joint Voiding Recommendations

- There are no IPC standards for solder joint voids for bottom-terminated components
- Renesas recommends using 25% maximum solder voids.
- Recommended reflow profile is derived from J-STD-020 with parameters optimized for SMT of power tower module at 245°C peak temperature while ensuring robust solder joints with minimal voiding.
- Increase soak time T_{smin} - T_{smax} to 150s to further reduce solder joint voids for high voiding applications.

5. Revision History

Revision	Date	Description
1.00	Feb 28, 2025	Initial release.

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