

High-Temperature Soldering Requirements for Plug-In Power, Surface-Mount Products

PMP - Plug-In Power

ABSTRACT

The PTH, PTN, and PTB series of surface-mount, plug-in power (PIP) products are designed to be compatible with industry-standard, lead-free (Pb-free) solder reflow processes and aqueous washes. High-temperature reflow compatible products are identified by the Z-suffix in PIP part numbers. This application report identifies requirements for soldering PIP modules to a host printed-circuit board with a Pb-free solder process.

1 Soldering Requirements

1. **High-Temperature Solder Process.** Plug-in power (PIP) modules must be attached to the host printed-circuit board (PCB) using industry-standard, Pb-free solder reflow processes. The solder paste should be 96% tin (Sn), 3.5% silver (Ag), and 0.5% copper (Cu) with a nominal melting point of 217°C.
2. **Quantity of Solder.** A solder paste thickness of 0.006 inch is recommended for PIP modules with solder ball pins.
3. **Reflow Profile.** To avoid component damage and potential opens and shorts due to excessive temperature or internal solder reflow within the product, use the following maximum reflow parameters:
 - a. Preheat and cool-down ramps should not exceed 2°C/s to prevent internal component failures due to thermal stress.
 - b. Do not elevate the product's pin or component temperature above a peak of 260°C.
 - c. The pin or case temperature cannot exceed 217°C (with a maximum of 260°C) for more than 120 seconds.

2 Developing Your Own Reflow Profile

A reliable profile for soldering power modules to a host PCB may be developed using at least three small-gauge (30 to 36 Awg) thermocouples secured to the test unit in the following locations:

- Product signal pin near the module's PCB
- Center of the case
- Product ground pin near customers PCB

Monitor thermocouples as the unit passes through the oven to verify that the pin temperature exceeds 217°C for at least 40 to 60 seconds, and that the soldering requirements detailed herein are not exceeded.

3 Power Module Construction

Lead-free PIP products are constructed on high-temperature laminate PCBs using surface-mount components. The components are soldered in place using 96.5% tin (Sn), 3.5% silver (Ag), and high-temperature Pb-free solder. This solder has a melting temperature of $221^{\circ}\text{C} \pm 4^{\circ}\text{C}$.

Connecting pins use 100% tin (Sn) plating with a nickel (Ni) barrier and are Pb-free. Typical plating is 300 to 500 micro-inches of 100% tin (Sn) over 100 to 200 micro-inches of nickel (Ni). The matte tin plating is reflowed during the assembly process of the module. All soldering surfaces meet and are routinely tested to the solderability requirements of ANSI/J-STD-002, Category 3.

4 Surface-Mount Soldering Qualification

The PTH, PTN, and PTB series of PIP products are qualified to have no degradation from reflow/IR soldering and aqueous washing by verification through rigorous testing. Sample batches are subjected to three passes through a convection reflow oven and an aqueous wash cleaner, with a cool-down between passes to room temperature. The convection reflow oven is set to achieve a 260°C peak temperature on the components. These parts are subsequently used for thermal shock, humidity, and life qualification testing. All products must pass this initial qualification testing with zero failures before being released to production.

5 Additional Considerations

Each host PCB and PIP module assembly may be physically different. Each assembly should be individually verified to be within these soldering requirements.

The PIP modules are designed to be thermally efficient in transferring heat from their components through convection, conduction, and radiation. During soldering, heat therefore flows easily into the power module. As a result, the module's components and solder joints may heat at different rates than the host PCB and its SMT components.

The PTH, PTN, and PTB products have a moisture sensitivity level (MSL) classification of level 3.

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products		Applications	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DSP	dsp.ti.com	Broadband	www.ti.com/broadband
Interface	interface.ti.com	Digital Control	www.ti.com/digitalcontrol
Logic	logic.ti.com	Military	www.ti.com/military
Power Mgmt	power.ti.com	Optical Networking	www.ti.com/opticalnetwork
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
		Telephony	www.ti.com/telephony
		Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments
Post Office Box 655303 Dallas, Texas 75265