

Application Note AN-303

Qspeed™ Family



RoHS Compliant Soldering Considerations

Abstract

All Qspeed device packages have lead-free, tin-plated leads that comply with RoHS and other environmental requirements. A typical wave soldering profile is described, which should ensure that good solder joints are made to Qspeed device leads, when lead-free solder is used. Hand soldering techniques, tips and precautions are provided. Lastly, printed circuit board (PCB) layout pads are shown and the maximum mounting screw torque and clamp pressures are also given.

Introduction

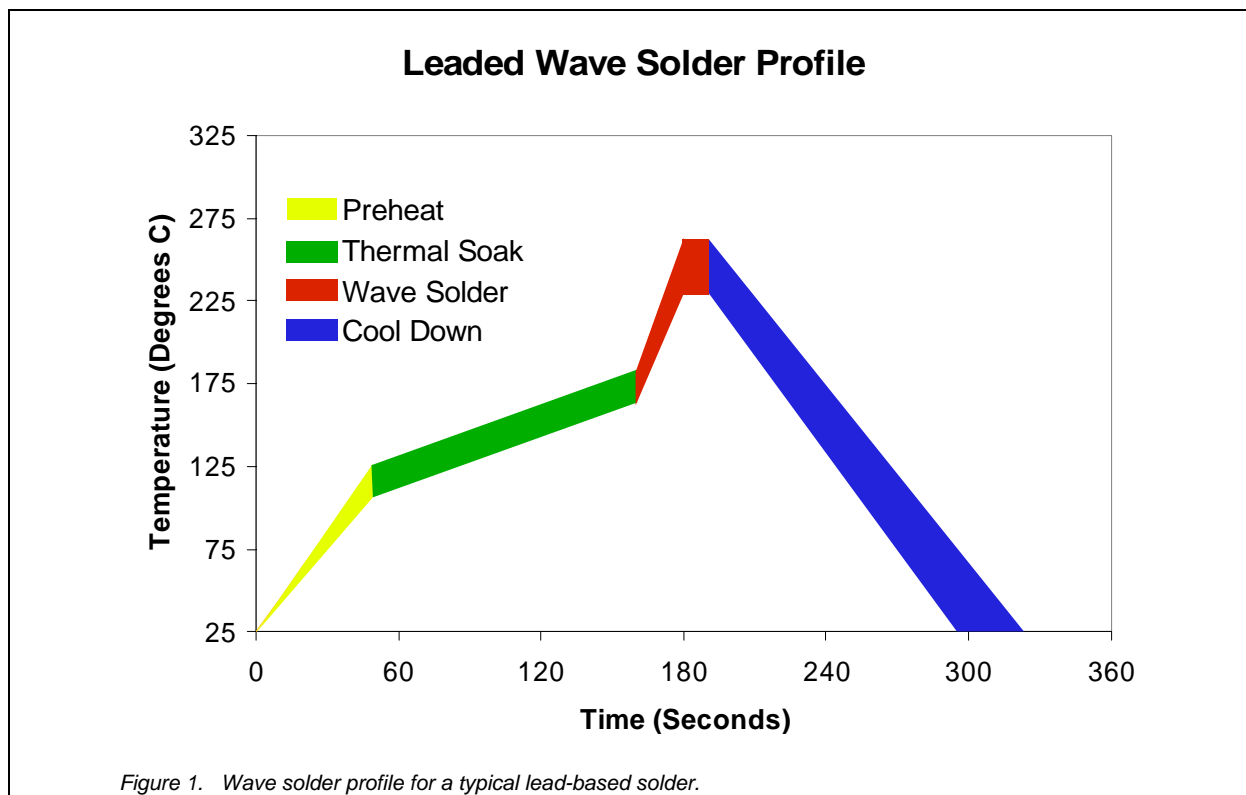
Lead-free solders have higher melting temperatures than lead-based solders do. Therefore, the soldering process subjects RoHS compliant, semiconductor packages to higher temperatures, for longer periods of time, than when lead-based solders were used. That has

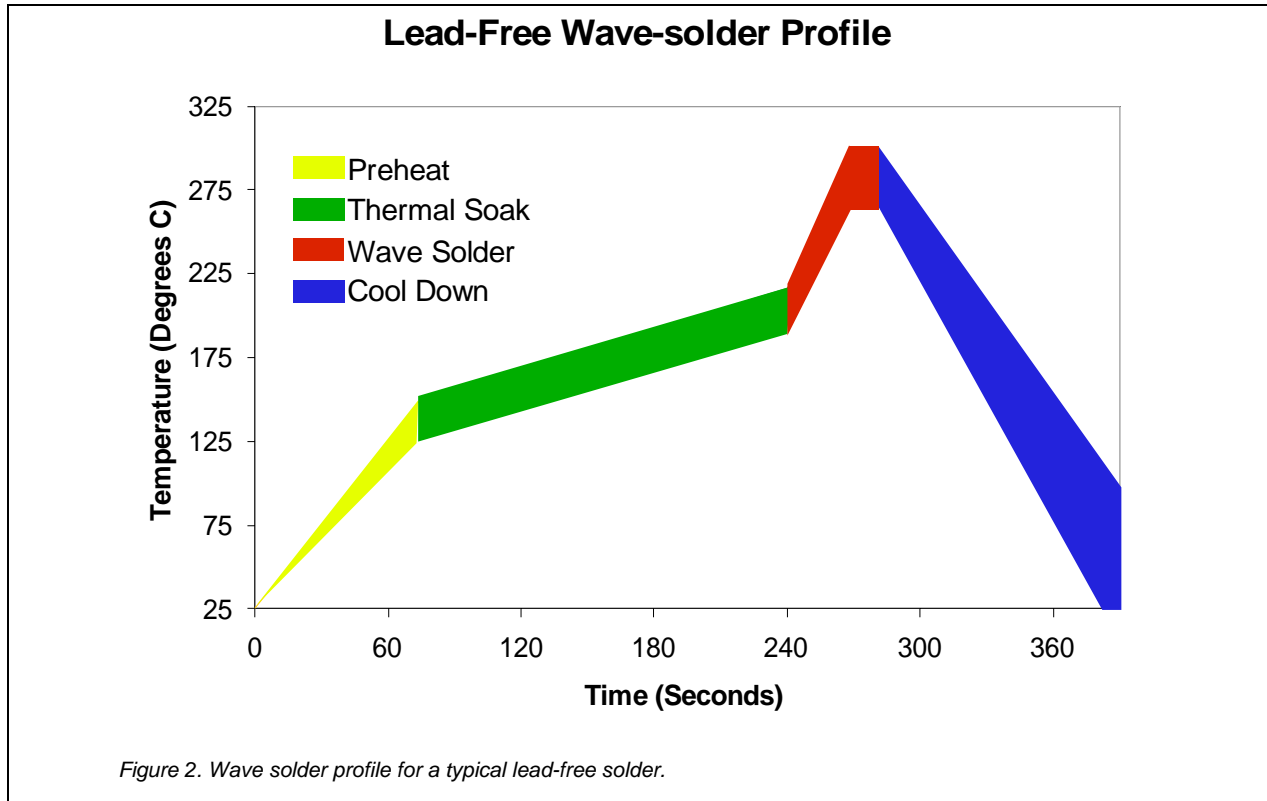
caused semiconductor device manufacturers to revisit their component packages, and to verify that they can withstand prolonged exposure to higher temperatures without damaging the parts, or reducing their long-term reliability.

Qspeed component packages were originally designed to be soldered using lead-free solder on the leads, and extensive testing was done to ensure that the devices would not suffer any detrimental effects from the higher soldering temperatures.

Comparison of Wave Solder Profiles

Figures 1 and 2 show wave solder profiles for typical lead-based and lead-free solders. Standard wave soldering profiles include four distinct stages: pre-heat, thermal soak, soldering, and cool down. The longer exposure time and the higher soldering temperature are readily apparent. The thermal soak time of the





lead-free solder profile is noticeably longer than the equivalent stage for the leaded solder. The longer soak time is required to ensure that the components to be soldered have reached their higher pre-solder temperature.

However, the most critical parameter of the four stages is the soldering stage temperature. The leads of all Qspeed devices must only make contact with the solder wave for a maximum duration of five to ten seconds, and should not be subjected to solder temperatures above 300 °C. A profile, similar to the one shown in

Table I gives the upper and lower control limits for the times and temperatures of the preheat, thermal soak, solder and cool down stages of the profile that should be used for soldering Qspeed devices into a PCB, when a wave solder machine is used.

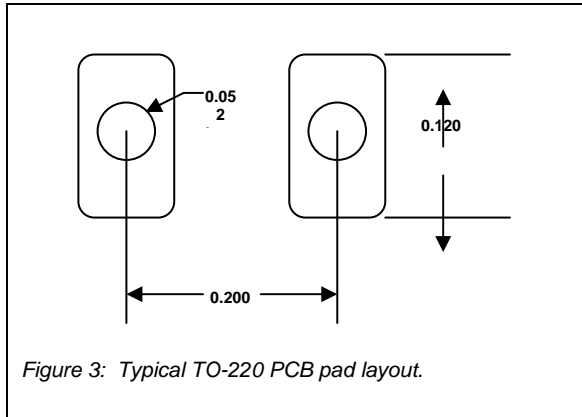
Correct PCB Pads and Layout and Mounting Torque/Clamping Pressure

In order to ensure a good solder connection, double-sided PCBs with plated-through holes are recommended. However, (even if single-sided boards are used), PCB solder pads,

Phase	Start Temperature	End Temperature	Total Time
Preheat	25 °C	125-150 °C	60-80 Seconds
Thermal Soak	125-150 °C	190-220 °C	150-175 Seconds
Wave Solder	190-220 °C	275-300 °C	5-10 Seconds*
Cool Down	275-300 °C	25 °C	100-150 Seconds

Table 1. Wave solder time and temperature profile for using lead-free solder.

similar to the size and shape of those shown in Figure 3, should be used to ensure that solder can properly adhere to the device leads.



If the Qspeed device is to be secured to a heatsink, using a screw that passes through the mounting hole in the tab of the package, a maximum torque of 1 Newton Meter (nm) or 8.8 inch-pounds (lb-in.) should be used to tighten the screw.

If an external clamp is used to press the plastic case of the device against the heatsink, the maximum pressure that the clamp should apply to the case is 12.3 kilogram-force per square centimeter (kgf/cm^2) or 175 foot-pounds per square inch (lbf/in^2).

Hand Soldering Techniques, Tips and Precautions

Hand soldering of electronic components is not usually recommended, due to concerns about

solder joint quality and reliability. However, Qspeed devices may be soldered by hand, as long as a few simple guidelines are followed (see Table II). First, soldering equipment—that has a tip with sufficient thermal mass and adequate heating capability—should be used, to ensure fast soldering of the device leads to the PCB. Second, a fixture that holds the device rigidly to the PCB, during soldering and cool-down is critical for producing a long-lasting solder joint. Third, a robust solder connection can only be achieved with a process that minimizes contaminants.

Not only do contaminants weaken the finished solder joint, but they also restrict heat transfer during the soldering process. This can cause soldering to take longer than it would otherwise, which increases the likelihood of damaging the device by overheating it. Clean PCB pads and package leads allow for fast heat transfer and improve the likelihood of producing a solid solder joint.

Lastly, the maximum duration of elevated lead temperatures must be adhered to. No Qspeed devices should be subjected to lead temperatures greater than 300 °C, and should not be kept at that soldering temperature for more than 10 seconds.

Summary

Soldering Qspeed devices should not present any special challenges compared with other diodes in similar packages, as long as the

Guiding Principle	Reason or Description of Requirements
Soldering iron tip size and heating ability	Tip of iron must have enough thermal mass
Immobilization fixture or Gig	Prevents device movement while soldering
Minimize presence of contaminants	Weakens joint and extends soldering time
Clean PCB pads and package leads	Allows fast heat transfer and a solid joint
Maximum heating time and temperature	10 seconds at 300 °C, maximum

Table 2. Guidelines for hand soldering with lead-free solder.

duration of exposure to elevated temperatures is not violated. Standard wave solder profiles, used within the electronics industry, should provide good results, without modification. Specific Qspeed datasheets should be consulted for the latest, most up-to-date information on each device (see <http://www.qspeed.com/Tech-Info/Technical-Information.cfm> .)

References

1. Various articles by Bob Willis, <http://www.leadfreesoldering.com>.
2. Karl Seelig, "Considerations for Lead-Free Wave Soldering", AIM, June, 2005. <http://www.aimsolder.com/techarticles/Considerations%20for%20Lead-Free%20Wave%20Soldering.pdf>
3. IPC J-STD-006B, Joint Industry Standard, "Requirements for Electronic Grade Solder Alloys and Fluxed and Non-Fluxed Solid Solders for Electronic Soldering Applications", http://www.ipc.org/4.0_Knowledge/4.1_Standards/Free/IPCJ-STD-006BAmendment1.pdf

Revision	Notes	Date
1.0	Released by Qspeed	07/08
1.1	Converted to Power Integrations Document	01/11

For the latest updates, visit our website: www.powerint.com

Power Integrations reserves the right to make changes to its products at any time to improve reliability or manufacturability. Power Integrations does not assume any liability arising from the use of any device or circuit described herein. POWER INTEGRATIONS MAKES NO WARRANTY HEREIN AND SPECIFICALLY DISCLAIMS ALL WARRANTIES INCLUDING, WITHOUT LIMITATION, THE IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NON-INFRINGEMENT OF THIRD PARTY RIGHTS.

PATENT INFORMATION

The products and applications illustrated herein (including transformer construction and circuits external to the products) may be covered by one or more U.S. and foreign patents, or potentially by pending U.S. and foreign patent applications assigned to Power Integrations. A complete list of Power Integrations' patents may be found at www.powerint.com. Power Integrations grants its customers a license under certain patent rights as set forth at <http://www.powerint.com/ip.htm>.

The PI Logo, TOPSwitch, TinySwitch, LinkSwitch, DPA-Switch, PeakSwitch, CAPZero, SENZero, LinkZero, HiperPFS, HiperTFS, Qspeed, EcoSmart, Clampless, E-Shield, Filterfuse, StackFET, PI Expert and PI FACTS are trademarks of Power Integrations, Inc. Other trademarks are property of their respective companies. ©Copyright 2011 Power Integrations, Inc.

Power Integrations Worldwide Sales Support Locations

WORLD HEADQUARTERS

5245 Hellyer Avenue
San Jose, CA 95138, USA.
Main: +1-408-414-9200
Customer Service:
Phone: +1-408-414-9665
Fax: +1-408-414-9765
e-mail:
usasales@powerint.com

GERMANY

Rueckertstrasse 3
D-80336, Munich
Germany
Phone: +49-89-5527-3911
Fax: +49-89-5527-3920
e-mail:
eurosales@powerint.com

JAPAN

Kosei Dai-3 Building
2-12-11, Shin-Yokohama,
Kohoku-ku, Yokohama-shi,
Kanagawa 222-0033
Japan
Phone: +81-45-471-1021
Fax: +81-45-471-3717
e-mail: japansales@powerint.com

TAIWAN

5F, No. 318, Nei Hu Rd., Sec. 1
Nei Hu District
Taipei 114, Taiwan R.O.C.
Phone: +886-2-2659-4570
Fax: +886-2-2659-4550
e-mail:
taiwansales@powerint.com

CHINA (SHANGHAI)

Rm 1601/1610, Tower 1
Kerry Everbright City
No. 218 Tianmu Road West
Shanghai, P.R.C. 200070
Phone: +86-021-6354-6323
Fax: +86-021-6354-6325
e-mail:
chinasales@powerint.com

INDIA

#1, 14th Main Road
Vasanthanagar
Bangalore-560052
India
Phone: +91-80-4113-8020
Fax: +91-80-4113-8023
e-mail:
indiasales@powerint.com

KOREA

RM 602, 6FL
Korea City Air Terminal B/D, 159-6
Samsung-Dong, Kangnam-Gu,
Seoul, 135-728
Korea
Phone: +82-2-2016-6610
Fax: +82-2-2016-6630
e-mail: koreasales@powerint.com

EUROPE HQ

1st Floor, St. James's House
East Street, Farnham
Surrey GU9 7TJ
United Kingdom
Phone: +44 (0) 1252-730-141
Fax: +44 (0) 1252-727-689
e-mail:
eurosales@powerint.com

CHINA (SHENZHEN)

Rm A, B & C 4th Floor, Block C,
Electronics Science and
Technology Building
2070 Shennan Zhong Road
Shenzhen, Guangdong,
P.R.C. 518031
Phone: +86-755-8379-3243
Fax: +86-755-8379-5828
e-mail:
chinasales@powerint.com

ITALY

Via De Amicis 2
20091 Bresso MI
Italy
Phone: +39-028-928-6000
Fax: +39-028-928-6009
e-mail:
eurosales@powerint.com

SINGAPORE

51 Newton Road,
#19-01/05 Goldhill Plaza
Singapore, 308900
Phone: +65-6358-2160
Fax: +65-6358-2015
e-mail:
singaporesales@powerint.com

APPLICATIONS HOTLINE

World Wide +1-408-414-9660

APPLICATIONS FAX

World Wide +1-408-414-9760