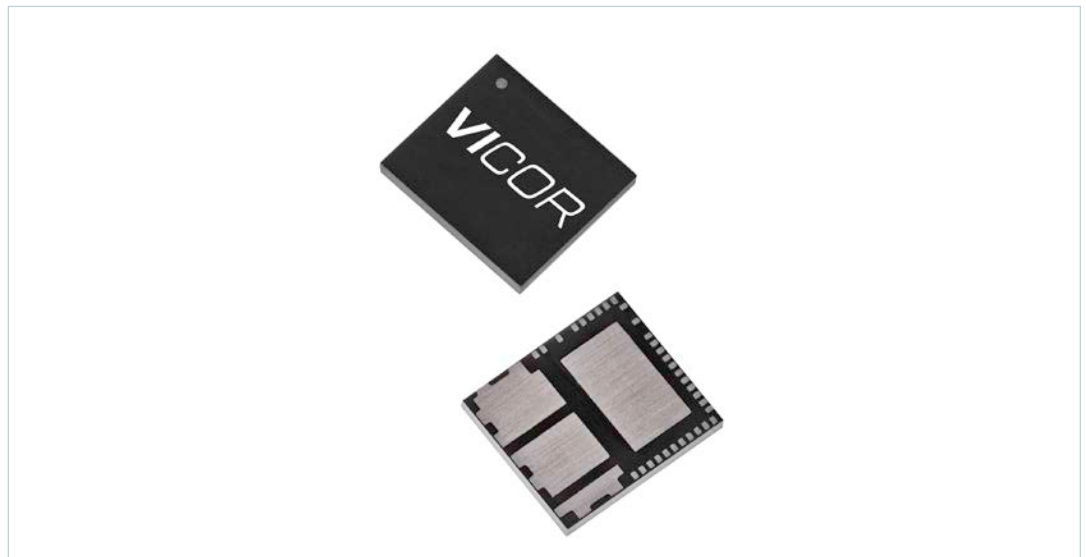


# GQFN SiP Soldering Recommendations

Arthur Russell  
Principal Engineer,  
Product Line Engineering



Contents	Page
<a href="#">Introduction</a>	<a href="#">1</a>
<a href="#">Package Description for Cool-Power 8 x 7mm GQFN SiP</a>	<a href="#">1</a>
<a href="#">Receiving Pad on PCB and PCB Characteristics</a>	<a href="#">1</a>
<a href="#">MSL Handling and Storage</a>	<a href="#">2</a>
<a href="#">Solder Process Design</a>	<a href="#">2</a>
<a href="#">Solder Paste Stencil Design</a>	<a href="#">2</a>
<a href="#">Pick &amp; Place</a>	<a href="#">2</a>
<a href="#">Solder, and Solder Reflow Method</a>	<a href="#">2</a>
<a href="#">Assembly Solder Reflow Guidelines</a>	<a href="#">3</a>
<a href="#">Post-Reflow Process</a>	<a href="#">4</a>
<a href="#">Cleaning</a>	<a href="#">4</a>
<a href="#">Inspection</a>	<a href="#">4</a>
<a href="#">GQFN Rework and Removal</a>	<a href="#">4</a>
<a href="#">Conclusion</a>	<a href="#">4</a>



## Introduction

Vicor 8 x 7mm GQFN (Grid Array QFN leadframe package) products are intended for reflow soldering assembly. The information contained in this document defines the handling procedures and assembly processing conditions required for successful attachment to a PCB. Failure to follow the recommendations provided can result in aesthetic defects, as well as device failure or reduced reliability due to compromised solder joint integrity.

## Package Description for 8 x 7mm GQFN SiP

- Refer to 8 x 7mm Package Drawing
- Recommended footprint is specified in Package Outline Drawing
- Terminal finish is specified in Package Outline Drawing
- Maximum body temperature for tin-lead eutectic soldering  $T_{P\_Sn-Pb} = 235^{\circ}\text{C}$ , and for lead-free soldering,  $T_{P\_Pb-free} = 260^{\circ}\text{C}$
- MSL Rating is specified in the product data sheet

## Receiving Pad on PCB and PCB Characteristics

- Refer to footprint drawing
- OSP, ENIG, ENEPIG, or Ni/Au finish recommended
- Pads may be either Non-Solder Mask Defined (NSMD) or Solder Mask Defined (SMD)
- PCB should be made from FR4 – Tg of 170°C or higher rated material
- Thermal vias are recommended, please refer to specific product data sheet for information
- Silkscreen under the GQFN package is not allowed
- Vias under package should be planarized to minimize voiding  
Per the above, vias under the GQFN package can be planarized by using Via-In-Pad-Plated-Over (VIPPO) structures

---

## MSL Handling and Storage

- Handling of GQFN SiPs must be per JEDEC JESD625 and J-STD-033.
- Components are baked and dry-packed before shipment.
- Components should remain in a dry vacuum bag during storage prior to assembly.
- A MSL label is attached to the outside bag.
- Within the bag is a humidity indicator card and desiccant.
- Shelf life of the components sealed in the bag is 12 months at < 40°C and < 90% relative humidity (RH).
- The MSL label indicates maximum open air exposure and bake times.

Exposure to ambient humidity for periods longer than those specified on the Moisture-Sensitive Caution label will require that the component is baked at 125°C for at least 7 hours prior to assembly to remove moisture from the package. Components may be baked multiple times to remove moisture; however the maximum bake temperature should not exceed 125°C. Exposure time to ambient humidity conditions between reflow cycles is considered cumulative; therefore if a component is to be exposed to a reflow soldering process multiple times, care must be taken to ensure that the total exposure time to ambient conditions does not exceed the MSL rating for the device.

**Note:** Pre-bake components based on component MSL rating prior to assembly per IPC/JEDEC J-STD-020D.1

MSL and reflow temperatures vary by product. Please refer to the specific product data sheet for the appropriate MSL and reflow rating for the product being handled. Failure to follow the MSL handling listed on the data sheet or the bake procedure may result in damage to the component package incurred during the reflow procedure.

## Solder Process Design

### Solder Paste Stencil Design

Recommended stencil is 100µm foil; laser cut fine grain steel, with stainless steel mesh. Advanced Nano Coating is recommended to improve paste release and shape uniformity.

- Apertures for pads 1 – 3 are “windowpanes” having 80% aggregate pad exposure
- Apertures for pads 4 – 36 are 100% of pad dimension

**For 260°C (lead free) Reflow:** SAC 305, either no-clean or water-soluble solder paste should be used. Other types of lead-free solder pastes may be used if the module can be safely reflowed without exceeding its maximum case temperature.

### Pick & Place

Pick and place of the GQFN package should be from the center of the component. The GQFN package should be placed within ±50µm. All people or equipment handling GQFN SiPs should have proper ESD protection to avoid damaging the units during the mounting process.

### Solder, and Solder Reflow Method

Sn-Pb eutectic or Pb-free (SAC305), low voiding solder paste such as AIM WS488, Kester 520A, or equivalent should be used. A forced-air convection oven is recommended for reflow attachment of GQFN components. Other types of reflow methods (Vapor Phase, IR, etc.) have not been qualified for use with GQFN components and should be evaluated for use with these component packages.

## Assembly Solder Reflow Guidelines

Table 1 summarizes the GQFN SiP recommendations for reflow parameters. Some of these parameters may be specified in individual GQFN product data sheets. In the event of a difference between the value specified in the tables here and the values specified in the data sheet, the value in the product data sheet supersedes the recommendation below.

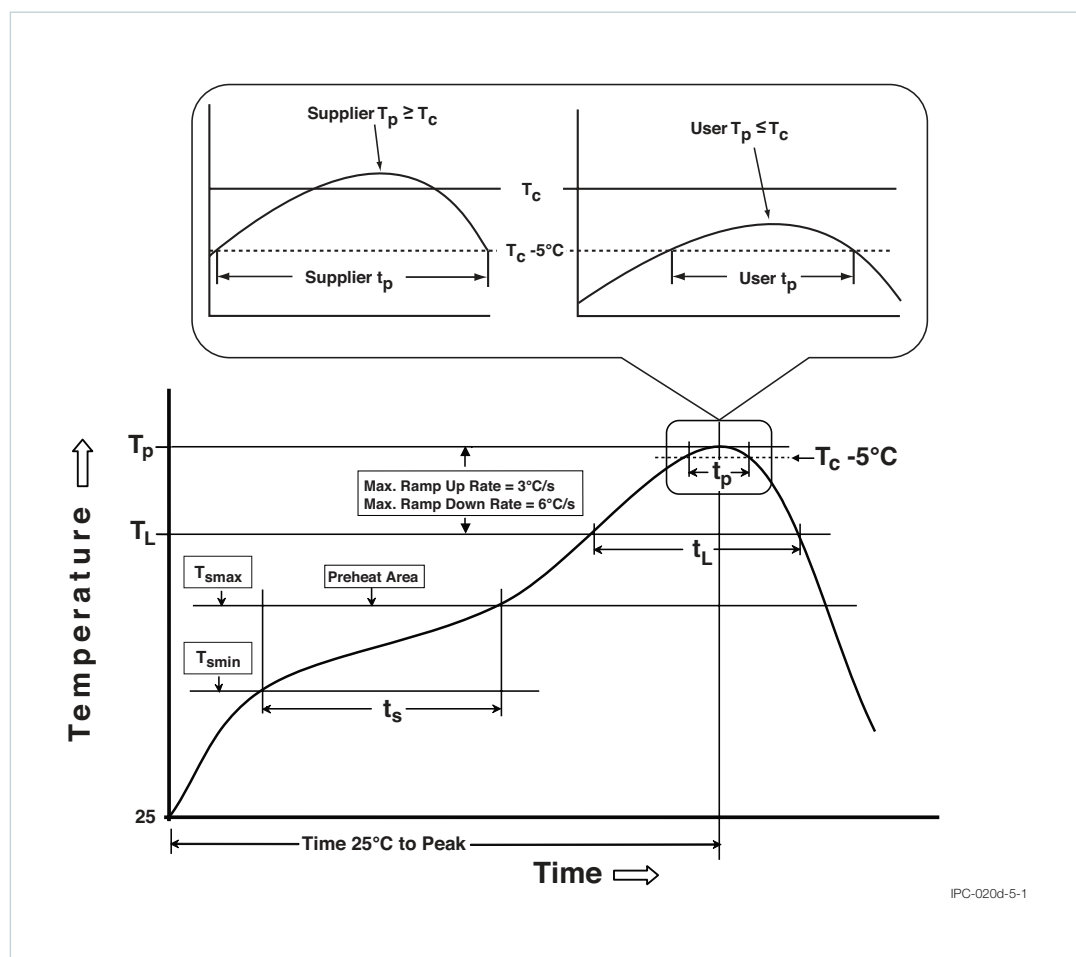
**Table 1**  
Reflow Profile  
Recommendations  
(JEDEC/IPC J-STD-020D.1)

Reflow Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Preheat temperature minimum ( $T_{S-MIN}$ )	100°C	150°C
Preheat temperature maximum ( $T_{S-MAX}$ )	150°C	200°C
Preheat time ( $t_s$ ), from $T_{S-MIN}$ to $T_{S-MAX}$	60 – 120 seconds	60 – 120 seconds
Liquidus temperature ( $T_L$ )	183°C	217°C
Ramp-up rate from $T_L$ to $T_p$	3°C / second, maximum	3°C / second, maximum
Time ( $t_L$ ) above liquidus temperature ( $T_L$ )	60 – 150 seconds	60 – 150 seconds
Peak package body temperature ( $T_p$ ) <sup>[a]</sup>	Refer to $T_{p\_Sn-Pb}$ specification for package <sup>[a]</sup>	Refer to $T_{p\_Pb-Free}$ specification for package <sup>[a]</sup>
Time ( $t_p$ ) within 5°C of peak temperature ( $T_p$ )	20 seconds	20 seconds
Ramp-down rate ( $T_p$ to $T_L$ )	6°C /second, maximum	6°C /second, maximum
Time 25°C to $T_p$	6 minutes, maximum	8 minutes, maximum

<sup>[a]</sup> The GQFN SiP is an 8 x 7mm package with 0.85mm thickness, and approximately 50mm<sup>3</sup> volume. These package characteristics determine the peak package body temperature,  $T_{p\_Sn-Pb}$  and  $T_{p\_Pb-Free}$ .

All package volumes exclude the external terminations such as balls, bumps, lands and leads. All temperatures refer to the topside of the package, measured at the center of the package on the body's surface. The tolerance for  $T_p$  is defined as a supplier's minimum and a user's maximum.

**Figure 1**  
Standard Graph of Critical  
Reflow Parameters.  
Reflow Classification Profile  
(JEDEC/IPC J-STD-020D.1)



---

## Post-Reflow Process

### Cleaning

Following reflow, flux residue must be removed from underneath the GQFN package, otherwise this residue could become electrically conductive and cause failures over time.

Aqueous cleaning is recommended, using a saponifier or ultrasonic DI water spray for under GQFN cleaning.

If the GQFN package need to be subjected to a reflow cycle after water washing, it must be first be run through a bake cycle (at least 24 hours at 125°C) to remove moisture from the package.

### Inspection

#### *Package Level:*

Both a package and a solder-joint inspection should be performed following a reflow operation. Package level inspection should confirm that the component package is approximately parallel to the surface of the PCB, that there is no evidence of tomb-stoning of surrounding components, and no gross migration of solder from underneath the package. X-ray inspection may be used to confirm that the package is well registered to the PCB land pattern. Alternately optical inspection may be used to evaluate the position of the package to local fiducial marks or other PCB features which remain visible post assembly.

#### *Solder Joint Inspection:*

X-ray inspection is recommended for solder joint inspection. Up to 25% area voiding per pad is acceptable.

### GQFN Rework and Removal

- Rework maximum temperature should never exceed the  $T_p$  given in Table 1
- Removed GQFNs should not be reused

If a part adjacent to the GQFN package is to be removed or reworked, the temperature of the GQFN must be kept below the Preheat temperature minimum ( $T_{S-MIN}$ ) during that rework process. If it is not possible to keep the GQFN below  $T_{S-MIN}$ , then the entire printed circuit card board must be baked dry prior to neighboring rework and/or component removal per section 6.2 of the JEDEC standard J-STD-033C. During this baking process, the GQFN must be at 125°C for a minimum of 7 hours.

## Conclusion

The GQFN package requires careful, yet well-established practices when being reflow soldered onto a board. This document presents guidelines for MSL handling, reflow, post-reflow cleaning, and inspection of GQFN package products. While every design and manufacturing process will be unique, using these guidelines when attaching GQFN products to a printed circuit board will minimize the risk of poor solder joints and failures due to improper soldering.

---

## Limitation of Warranties

Information in this document is believed to be accurate and reliable. HOWEVER, THIS INFORMATION IS PROVIDED "AS IS" AND WITHOUT ANY WARRANTIES, EXPRESSED OR IMPLIED, AS TO THE ACCURACY OR COMPLETENESS OF SUCH INFORMATION. VICOR SHALL HAVE NO LIABILITY FOR THE CONSEQUENCES OF USE OF SUCH INFORMATION. IN NO EVENT SHALL VICOR BE LIABLE FOR ANY INDIRECT, INCIDENTAL, PUNITIVE, SPECIAL OR CONSEQUENTIAL DAMAGES (INCLUDING, WITHOUT LIMITATION, LOST PROFITS OR SAVINGS, BUSINESS INTERRUPTION, COSTS RELATED TO THE REMOVAL OR REPLACEMENT OF ANY PRODUCTS OR REWORK CHARGES).

Vicor reserves the right to make changes to information published in this document, at any time and without notice. You should verify that this document and information is current. This document supersedes and replaces all prior versions of this publication.

All guidance and content herein are for illustrative purposes only. Vicor makes no representation or warranty that the products and/or services described herein will be suitable for the specified use without further testing or modification. You are responsible for the design and operation of your applications and products using Vicor products, and Vicor accepts no liability for any assistance with applications or customer product design. It is your sole responsibility to determine whether the Vicor product is suitable and fit for your applications and products, and to implement adequate design, testing and operating safeguards for your planned application(s) and use(s).

VICOR PRODUCTS ARE NOT DESIGNED, AUTHORIZED OR WARRANTED FOR USE IN LIFE SUPPORT, LIFE-CRITICAL OR SAFETY-CRITICAL SYSTEMS OR EQUIPMENT. VICOR PRODUCTS ARE NOT CERTIFIED TO MEET ISO 13485 FOR USE IN MEDICAL EQUIPMENT NOR ISO/TS16949 FOR USE IN AUTOMOTIVE APPLICATIONS OR OTHER SIMILAR MEDICAL AND AUTOMOTIVE STANDARDS. VICOR DISCLAIMS ANY AND ALL LIABILITY FOR INCLUSION AND/OR USE OF VICOR PRODUCTS IN SUCH EQUIPMENT OR APPLICATIONS AND THEREFORE SUCH INCLUSION AND/OR USE IS AT YOUR OWN RISK.

## Terms of Sale

The purchase and sale of Vicor products is subject to the Vicor Corporation Terms and Conditions of Sale which are available at: (<http://www.vicorpower.com/termsconditionswarranty>)

## Export Control

This document as well as the item(s) described herein may be subject to export control regulations. Export may require a prior authorization from U.S. export authorities.

Contact Us: <http://www.vicorpower.com/contact-us>

**Vicor Corporation**  
25 Frontage Road  
Andover, MA, USA 01810  
Tel: 800-735-6200  
Fax: 978-475-6715  
[www.vicorpower.com](http://www.vicorpower.com)

### email

Customer Service: [custserv@vicorpower.com](mailto:custserv@vicorpower.com)  
Technical Support: [apps@vicorpower.com](mailto:apps@vicorpower.com)