

# Recommendations for Maximum Compressive Force of Heat Sinks

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## Introduction

This application note applies to all Vicor through-hole ChiP™ and SM-ChiP™ devices.

It has been demonstrated that excessive mechanical compressive force in the Z-axis of the Vicor ChiPs has the potential to cause a shift in electrical parameters (such as efficiency and no-load power dissipation) as well as mechanical deformation of the leads (for through-hole ChiPs). Compressive load testing has indicated that keeping compressive z-axis force on ChiPs below 20psi will prevent electrical parameter shift or mechanical deformation outside of product specifications.

Vicor provides a complete set of heat sinks for its products. These heat sinks are specifically designed to properly cool the part under most operating conditions, without applying excessive mechanical stress to the part. However, there are some applications that require a custom-designed thermal solution, such as a coldplate. In these applications, the designer must consider the pressure that the thermal solution applies to the package: some thermal solutions may apply excessive or uneven pressure to the package, or they may apply pressure to the leads. These scenarios must be avoided, since there is a limit to the pressure in the Z-axis that ChiP packages can support.

- Excessive pressure on the package might cause changes the electrical properties of the device; this effect can be minimized by applying even pressure across the entire surface of the package.
- For through-hole ChiPs, the leads are not designed to support any pressure in the Z-axis, so the device must be completely supported by the package, with no Z-axis pressure on the leads.

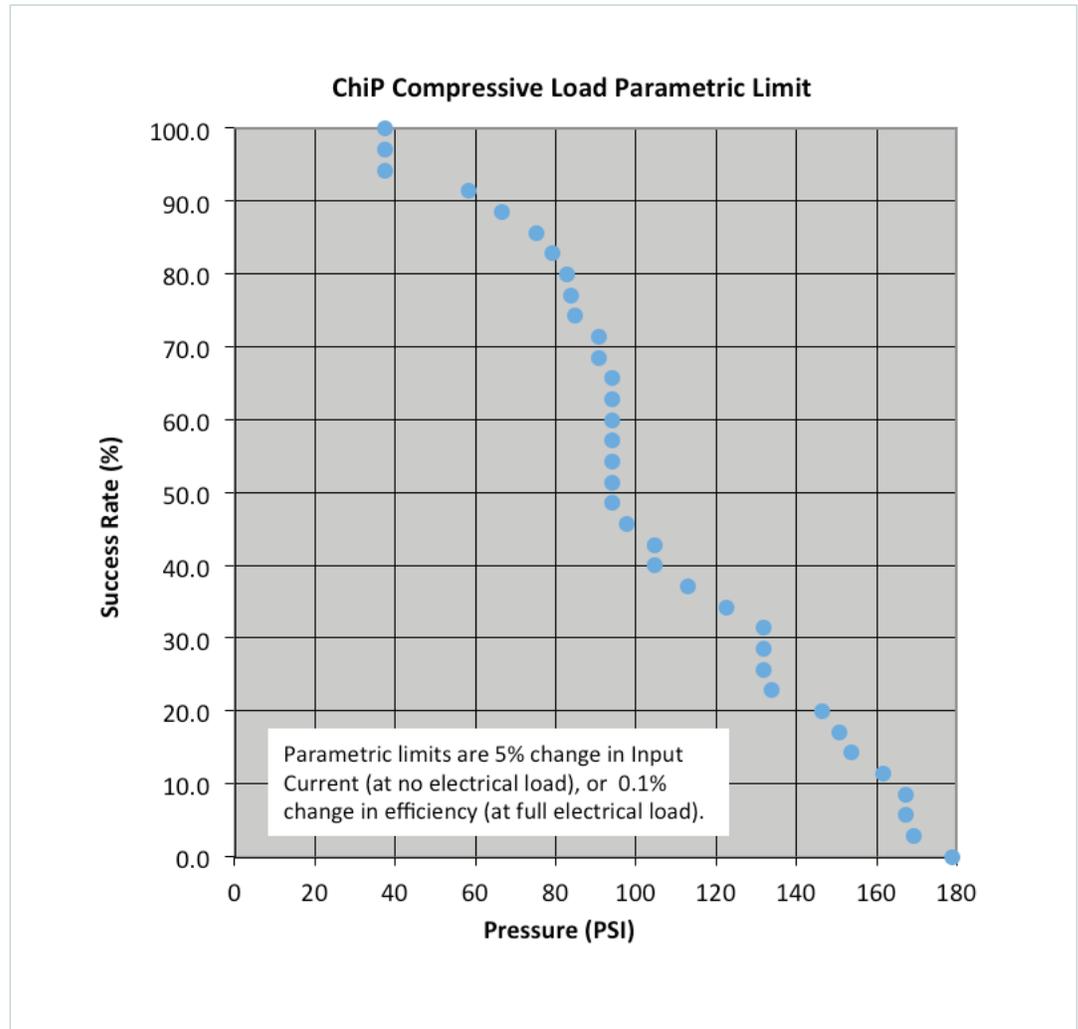
If the thermal solution is carefully designed so that it applies even pressure to the package with no pressure on the leads, there is still a limit to the pressure that can be applied without affecting the electrical specifications.

Figure 1 shows what happens when Z-axis pressure is applied to the entire surface of a Vicor ChiP while measuring its input current and efficiency. The graph shows the percentage of devices that successfully passed the test. (The condition for success was defined as less than 5% change in input current at no load, or less than 0.1% change in efficiency at full load.) According to these results, less than 39psi of pressure resulted in 100% of the devices remaining within specifications. To account for variations due to temperature, aging, part-to-part variability and relatively small sample size used in the test, Vicor recommends that z-axis pressure be kept to less than 20psi.

## ChiP™ Compressive Load Parametric Unit

**Figure 1**

Test Success Rate vs. ChiP Compressive Load. Test Success is Defined as Units' Performance Shift Remaining Within the Parametric Limits Listed in the Graph



The graph shows the pressure at which the input current and efficiency begin to be affected to a significant level (i.e., the variation in performance is above the parametric limits set for the test). Actual mechanical failure requires much more pressure. Some applications may require a thermal solution that applies more pressure to the package than the maximum allowed here. If this is the case, the user must do a complete evaluation to determine whether the device performance still meets the system requirements. In this situation, it is highly recommended that the user contact a Vicor Applications engineer for more information.

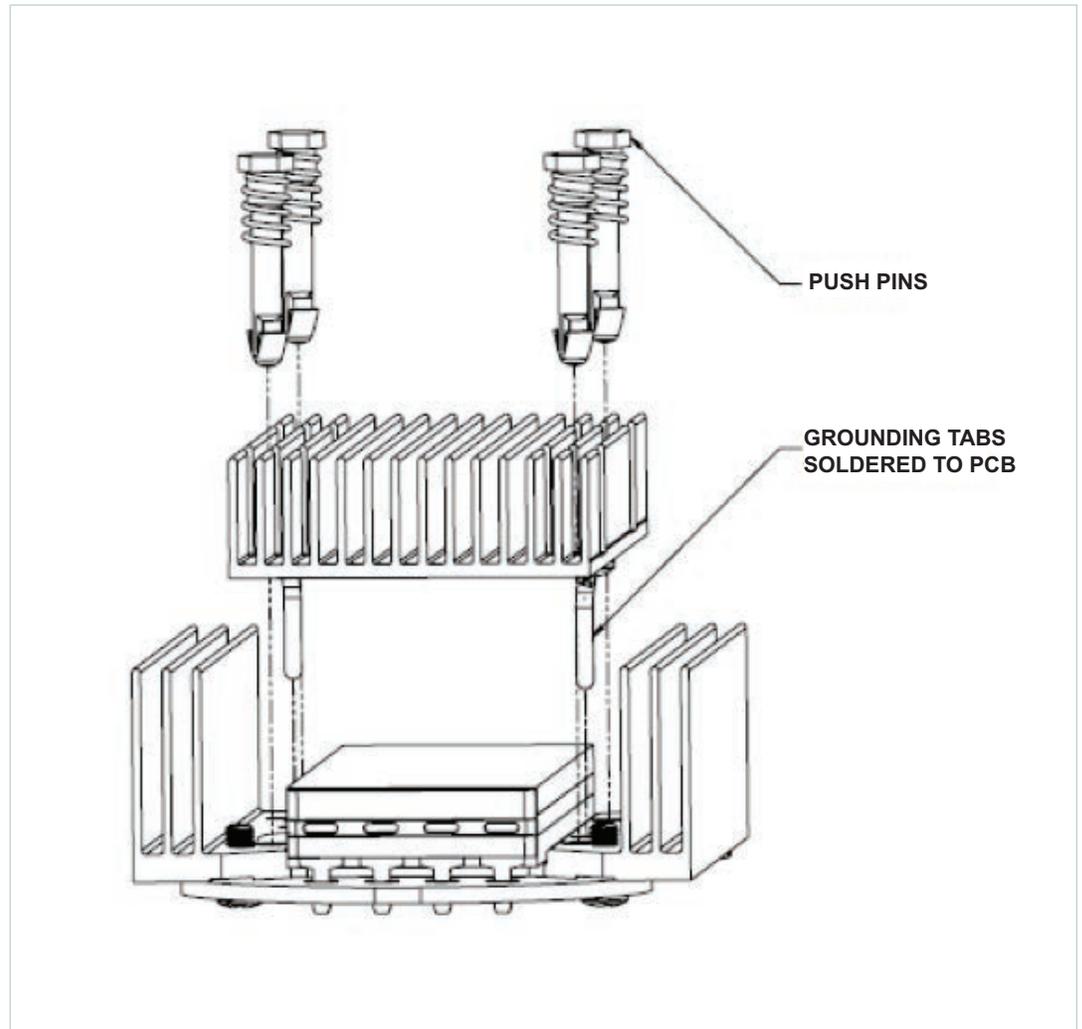
For many applications, the Vicor-designed custom heat sinks are the best solution. Vicor heat sinks fully support the device, so that pressure is evenly applied to the entire top and bottom of the package. With the Vicor heat sink, the applied pressure is primarily due to the springs of the push-pins, which is well below the level that would cause a shift in the electrical parameters. The bottom plate of Vicor heat sinks supports the body of the package, so there is no pressure on the leads (see Figure 2). This helps to keep device performance within specifications, as well as preventing possible long-term effects. More information about Vicor heat sinks may be found at:

[www.vicorpower.com/accessories/thermal-management](http://www.vicorpower.com/accessories/thermal-management).

## Vicor Heat Sink

**Figure 2**

Diagram of Vicor Heat Sink,  
Showing Top Plate, Bottom  
Plate and Push-Pins



A variety of thermal pads, gels, and gap fillers can be used to interface Vicor ChiPs™ to custom heat sinks or coldplates. Vicor recommends working closely with thermal interface material vendors to insure use of appropriate thermal materials that minimize compressive forces while providing adequate fill, coverage and thermal performance.

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