ADVANCEMENTS IN CARD LOK TECHNOLOGY TO SATISFY SWAP AND SECOND LEVEL MAINTENANCE REQUIREMENTS

Military equipment—such as shipboard, surveillance, mobile artillery and control stations, combat aircraft and unmanned air vehicles—often consists of highly technological and sensitive electronics. It is likely that these electronics could be exposed to harsh environments, including extreme heat, dust, moisture, shock and vibration. Within these harsh environments, Card or Wedge Locks are used for printed circuit board retention and thermal management to ensure continued reliability and performance.

nVent SCHROFF has worked with leading engineers in the industry to develop innovative board retention and cooling products to satisfy requirements for SWaP and Second Level Maintenance.

Schroff Conduction Cooled Assembly and Card Loks

OVERCOMING THE CHALLENGES OF SWAP

SWaP, or reducing size and weight while effectively handling increasing power, continues to be a challenge for defense and aerospace designers and manufacturers. SWaP is especially important in airborne applications where weight equates to cost, or for unmanned vehicles where space is a premium. The need to miniaturize the size of electronics has also been driven by the growing need for electronics that can easily be carried over long distances by operators.

However, improvements in SWaP cannot sacrifice other performance requirements, such as protection against shock and vibration. With conventional Wedge Lock designs, advanced board retention and thermal performance was only possible with larger profile Wedge Locks. These larger Card Loks consumed more space in the enclosure, space on the board, and were heavier.

To overcome this tradeoff, nVent SCHROFF has developed new Wedge Loks that deliver high performance in compact, lightweight designs.

HIGH CLAMP FORCE "HC" CARD LOKS

Higher clamp force equates to greater board retention, and additional protection against shock and vibration. nVent SCHROFF's Calmark High Clamp Force "HC" Card Loks provide three times the clamp force of similarly sized Card Loks, up to 1250 lbs of clamping force depending on series, to withstand the most demanding conditions.

The High Clamp Force "HC" is based on the proven screw-actuated wedge design used for the past 30+ years, but features 30 degree angles. By reducing the wedge angle, the mechanical advantage is increased; for the same torque, more force is transferred into the clamping force.

High clamp force "HC" Card Loks (bottom) provide three times the clamp force versus similarly sized conventional Card Loks (top).

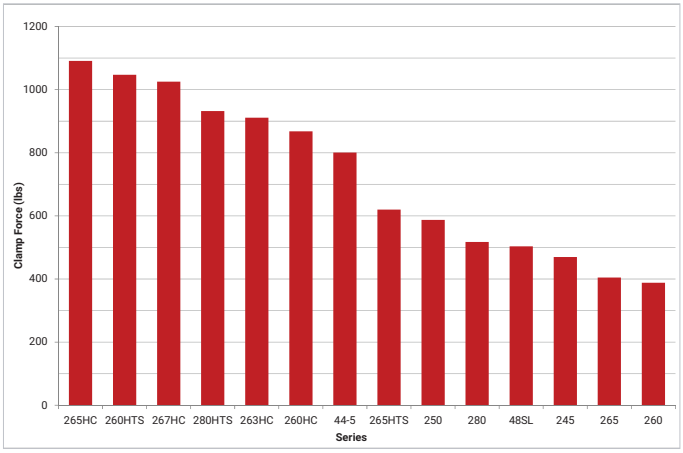
For applications where clamp force is a concern or has been an issue, consider replacing existing conventional retainers with the high clamp force Card Lok technology. Additionally, higher clamp force results in improved thermal performance, depending on the conduction cooled assembly configuration.

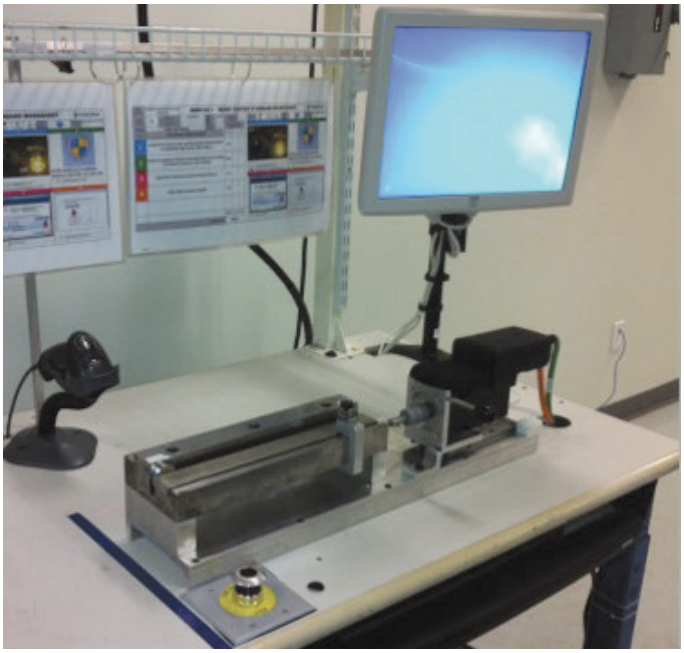
Card Lok Technology

As current designs are required to go into more rugged applications, engineers must also address the challenges associated with re-designs including time and cost. To address this challenge, high clamp force Card Loks maintain the same profile, common options, mounting holes, and footprint as conventional Card Locks.

This enables engineers to upgrade existing applications for more extreme environments without total re-designs.

Performance data for high clamp force Card Loks can be found here.





Specialized equipment to measure clamp force performance

HIGH THERMAL SAWTOOTH "HTS" CARD LOKS

The combination of more powerful processors, higher clock cycles, and greater board density all contribute to the need for advanced thermal dissipation.

Within harsh environments, fanless cooling is often required to shield sensitive electronics from air contaminants, reduced operating noise, and provide the highest level of reliability. Unfortunately, the performance of conduction cooling has been limited. Engineers had two options: limit the performance of their boards or opt for more expensive, less reliable, liquid cooled or heat pipe solutions.

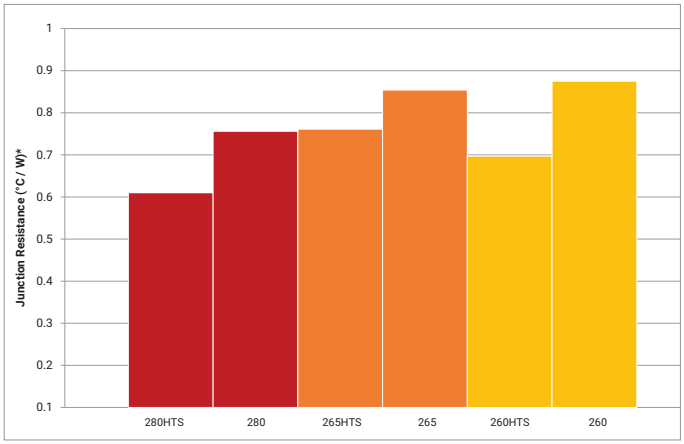
When two surfaces in contact have heat flowing across their junction, a measurable temperature difference arises caused by contact resistance. The value of this resistance is a complex combination of factors including surface finish, hardness, flatness, and contact area and pressure. In order to maximize the thermal flow, resistance must be minimized throughout the heat path.

nVent SCHROFF's Calmark High Thermal Sawtooth "HTS" Card Loks provide up to a 15% thermal performance improvement over conventional Card Loks by minimizing thermal resistance. Unlike a traditional Card Lok, the HTS features a sawtooth profile the length of the Card Lok that provides a continuous and uniform surface along the PCB/heat frame and along the cold wall. Heat can flow almost directly from the board to the cold wall. An added benefit provided by sawtooth profile is PCB mounting hole location flexibility.

High Thermal Sawtooth Card Loks provide up to 15% thermal performance improvement over conventional Card Loks.

To reliably secure and cool mission critical electronics, high thermal Card Loks should be considered. The HTS is available in three profiles and is a drop-in replacement for the 260, 265 and 280 series of nVent SCHROFF Calmark Card Loks.

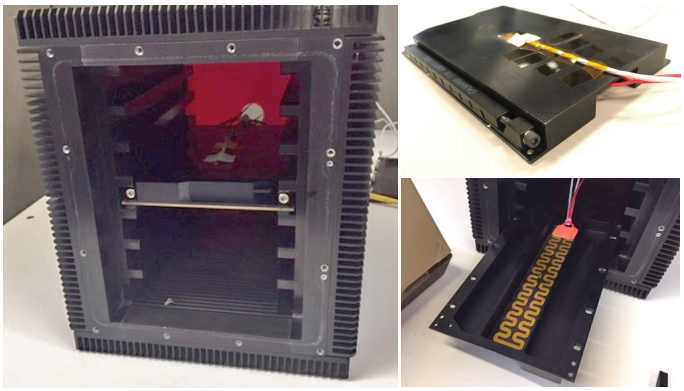
Performance data for high thermal Card Loks can be found here. The high thermal HTS can be machined into the conduction cooled frame or clamshell for even better enhanced thermal performance.



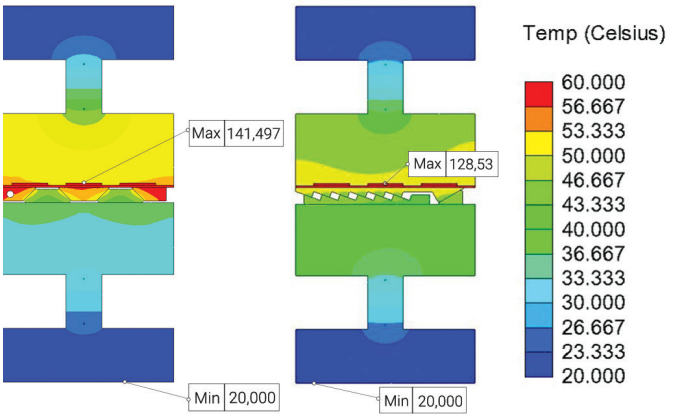
The lower the junction resistance the better the thermal performance

**Thermal performance is based on application and environment factors*
**Performance also depends on finish, Electroless Nickel performs the best*

Card Lok Technology



Specialized thermal testing on chassis level to measure board temperature with option to test multiple module assembly designs as well as primary and secondary side.



Thermal testing comparison of how heat flows through a High Termal Sawtooth (HTS) Cark Lok vs. a similarly sized traditional Card Lok. More heat is transferred through the HTS Card Lok due to decreased thermal resistance. The max temperature at the board is lower (128.5 degrees Celcius) versus the board installation with the traditional Card Lok installed (141 degrees Celcius). This means the HTS design facilitates a better transfer of heat away from the board.

A TWO-LEVEL MAINTENANCE APPROACH

Focusing specifically on military, there has been a push trend towards a two level maintenance system with the goal of streamlining procedures and reducing repair costs and equipment downtime. Those two levels are "sustainment" and "field" maintenance.

Unlike sustainment, field maintenance is accomplished at the military squadron, ship, or unit level—wherever they are located worldwide. When possible, field level maintenance reduces the complexity of the repair process, minimizes cost, and allows for mission-critical equipment to be returned to fully mission capable (FMC) status faster.

Products designed to be field maintenance compliant are generally preferred over sustainment level. Field maintenance tasks don't require specialized tools, are typically a system swap vs. repair, and are basic enough to be successfully completed by the operators.

To satisfy the requirements for field maintenance, nVent SCHROFF has developed torque limiting Card Loks.

TORQUE LIMITING CARD LOK

For all Card Loks, obtaining the specified torque is critical for achieving optimal clamping and thermal performance. If the Card Lok is undertorqued, the clamping force may not provide enough retention, resulting in loose printed circuit boards and poor thermal transfer. If the Card Lok is over-torqued, the cold wall or printed circuit board could be damaged.

Attaining accurate torque is not always simple, especially in rugged, high stress environments, such as the battlefield. In order to achieve optimal results, a conventional Card Lok must be actuated using a torque wrench, the torque wrench must be properly calibrated, and the Card Lok must be torqued to a specified level. In some situations, the operator may not have access to a properly calibrated torque wrench, specifically in cases where the operator's tools are exposed to severe environmental conditions, or the operator may not know the proper torque level, which varies depending on the Card Lok design.

The torque limiting Card Lok was developed to mitigate these risks. It features an integrated ratcheting mechanism which provides highly repeatable and reliable performance. Because the torqueing mechanism is built-in, a calibrated torque wrench is not required for installation; operators can use any standard tool with a hex head. Once the proper torque has been achieved, the ratchet mechanism will "slip" creating an audible and tactile response. This feature not only eliminates risks associated with under- or over-torqueing the Card Lok, but improves the ease of installation.

For applications with critical board clamping for thermal transfer requirements or where high availability and rapid deployment are required, torque limiting Card Loks should be considered to support field level maintenance. Existing designs can benefit from the torque limiting technology since conventional Card Loks can be easily upgraded to torque limiting Card Loks for drop-in replacements.

Torque limiting Card Loks include an internal ratcheting mechanism, which provides highly repeatable and reliable clamping force and thermal performance.

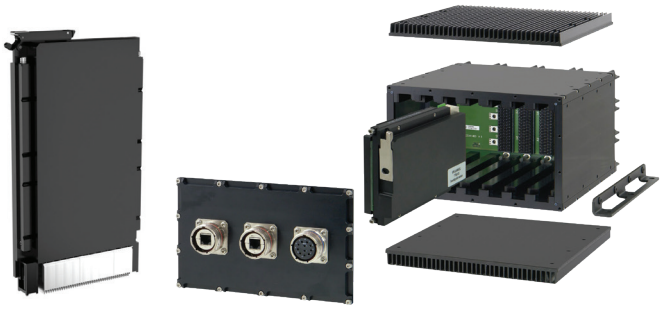
DROP-IN REPLACEMENTS

Conveniently, the High Clamp "HC", High Thermal Sawtooth "HTS", and torque limiting "TLC" Card Loks have been designed to be a drop-in replacement for most applications, with similar expansion, mounting hole locations, and optional features such as a visual indicator and lock patch. This enables engineers to upgrade their system without a costly redesign of the board or chassis.

Card Lok Technology

CONDUCTION COOLED ASSEMBLIES

Conduction Cooled Assemblies and Code Keys Conduction-cooled assemblies (CCAs) are generally used when passive free air convection or active forced air cooling is not possible, such as in space applications, or where creating airflow with moving parts might affect the reliability of the system.



Featuring a robust, lightweight aluminum design, CCAs deliver high thermal conductivity, while ensuring sufficient structural support. CCAs consist of a conduction-cooled frame, backing plate, extractors and card-loks. They are designed for PCBs requiring cooling in severe environments where convection cooling is not practical.

CCAs are available in numerous configuration sizes and finishes to provide structural support in extremely high shock and vibration applications. CCAs may be configured for various platform and application requirements, including, but not limited to 3U or 6U VME, VPX, IEEE 1101.2 and VITA 30.1 applications. Code keys are attached to the PCB or CCA to mitigate the risk of inadvertent PCB insertion into an incorrect slot within the electronic assembly.

A COMPLETE ASSEMBLY FOR OPTIMAL PERFORMANCE

nVent SCHROFF offers all components for a complete conduction cooled assembly to protect and connect the PCB: Heat frame and clam shell, Card Lok, extractors, conduction cooled keys and other components.

Based on preconfigured CAD assembly templates to meet standards such as mentioned above or assemblies based on individual designs and finishes, modifications such as cutouts, silkscreen and heatsinks to complement the individual board layout and cooling needs of the PCB are easily possible.

Depending on the requirements, whether it is advanced clamp force, advanced thermal performance or 2nd level maintenance, the CCA can be complemented with the required Card Lok. For applications where optimal thermal performance is required, the Card Lok can be machined directly into the heat frame or clam shell to remove a thermal interface, resulting in a higher performing assembly. Additionally, a Tolerance Compensating Extractor was developed to meet Vita 48.2 with 10:1 mechanical advantage for insertion and extraction of printed circuit boards with high density connector contacts. The latching inserter/extractor provides positive pressure to connectors during insertion preventing disconnects due to shock and vibration. Still compliant with 2nd level maintenance, it can be operated with a gloved hand and no specialized tools are required.

A full assembly can be tailored to the specific PCB and cooling requirements with experienced design engineers, thermal simulations and optimized designs to meet size, weight and power concerns and ordered under one part number as a full kit.

The kit is then managed by one part number simplifying supply chain management and offering a more cost effective alternative to sourcing the parts separately.

SCHROFF-WPCS-H83403-CardLok-EN-1911