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 Loks are used for printed circuit board retention and thermal management to ensure continued reliability and performance.

Schroff has worked with leading engineers in the industry to develop innovative board retention and cooling products to satisfy requirements for SWaP

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 Lok designs, advanced board retention and thermal performance was only possible with larger profile Card Loks. These larger Card Loks consumed more space in the enclosure, space on the board, and were heavier.

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

HIGH CLAMP FORCE "HC" CARD LOKS

Higher clamp force equates to greater board retention, and additional protection against shock and vibration. SCHROFF'S new 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.

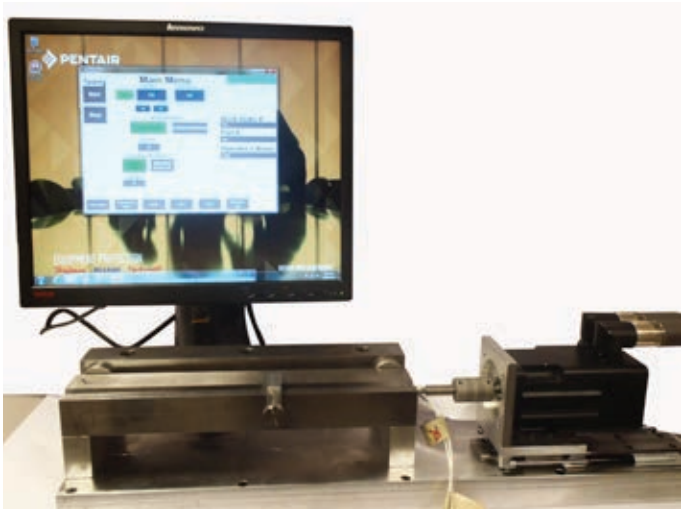
For applications where clamp force is a concern or has been an issue, consider replacing existing conventional Card Loks with the high clamp force Card Lok technology.

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 Loks. 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.

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

Card Lok Technology



Specialized equipment to measure clamp force performance

HIGH THERMAL "HT" 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.

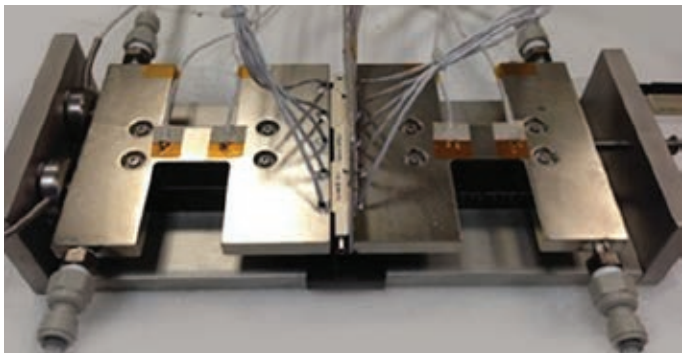
When two surfaces in contact have heat flowing across their junction, a measurable temperature difference arises caused by contact resistance. The value of this resistance is a complex combination of factors including surface finish, hardness, flatness, and contact area and pressure. In order to maximize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

High thermal "HT" Card Lok (top) provides 15% more thermal performance versus similarly sized conventional Card Loks (bottom).

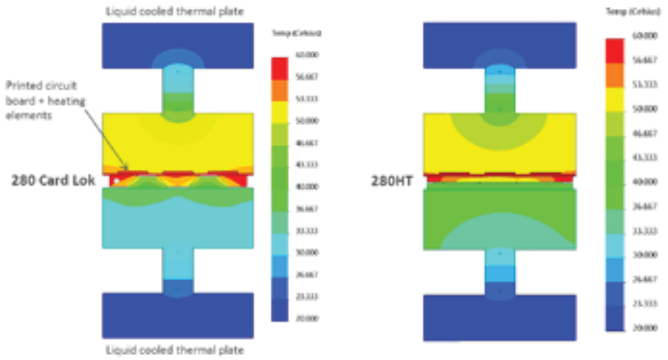
Schroff's High Thermal "HT" Wedge Loks provide up to a 15% thermal performance improvement over conventional Card Loks by minimizing thermal resistance. Unlike a traditional Card Lok, the HT features solid brackets along the length of the Card Lok that provide a continuous and uniform surface along the PCB/ heat frame and along the cold wall. Additionally internal components are designed to minimize the thermal path distance, so heat can flow almost directly from the board to the cold wall. An added benefit provided by the exterior solid bracket is PCB mounting hole location flexibility.

To reliably secure and cool mission critical electronics, high thermal Card Loks should be considered.

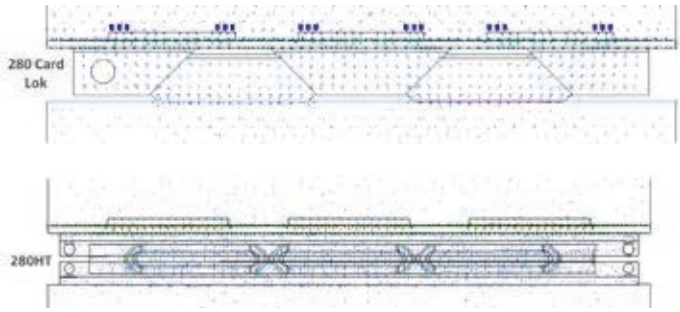
Performance data for high thermal Card Loks can be found here.



Specialized thermal testing fixture to measure thermal performance using liquid cooled thermal plates to simulate the cold wall and polyimide film insulated heaters to simulate hot components. RTD's are placed throughout the fixture to measure temperature.



Thermal testing comparison of how heat flows through 280HT vs. a similarly sized traditional 280 Card Lok. More heat is transferred through the 280HT vs. the 280 Card Lok due to the decreased thermal resistance of the 280HT.



The internal geometry of the 280HT creates more heat paths that enable heat to flow nearly directly across the 280HT Card Lok. Compared to the 280 Card Lok, the 280HT's design provides greater dispersion of the heat flow vectors vs. the limited heat path options the 280 Card Lok.

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A TWO-LEVEL MAINTENANCE APPROACH

Focusing specifically on the military, there has been a push 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, 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 under-torqued, 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 “HT”, 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.