BOOSTING TELECOM AND DATACOM SYSTEM PERFORMANCE

Faster Data Rates and Bigger Volumes are Turning up the Heat

Wayne Eng
Henkel Corporation

Telecom and datacom systems, once considered distinct ecosystems, are now interdependent networks of wireless devices and cloud hyperscale data services. Collectively, high-performance computing, optical networks and 5G broadband connectivity underpin the digital experience -- and the expectations for speed, reliability and functionality are intense. The electronic system devices that enable the storage, processing and transfer of data across cities, countries and continents and facilitate data access via mobile handheld devices, desktops and smart home systems are increasingly complex and powerful. Enhancing their performance is central to delivering on the data processing and accessibility demands of low latency, high volume and ultra-fast transfer rates. While there are many aspects to achieving these ambitions, the ability to effectively control operational heat is a primary element of electronic system optimization to maximize efficiency and extend lifetime function.

Taking a deep dive in to the cloud hyperscale data center and to elements of the 5G telecom network infrastructure, this paper will share use cases on thermal strategies that allow maximum heat removal at the system level and complement other passive environmental and fan-based active cooling techniques.

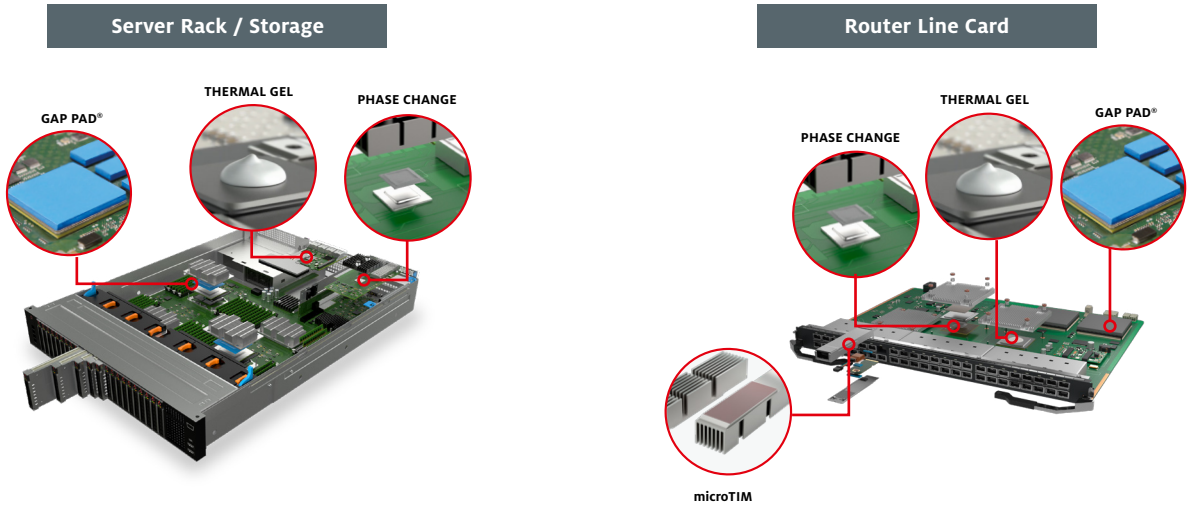

Figure 1 – Thermal interface materials improve performance across data center systems.

Inside the Cloud Hyperscale Data Center

Whether moving data via routers/switches, storing and analyzing it with high capacity HHDs and SSDs or processing it via high-performance server CPUs and GPUs, cloud and hyperscale data center systems form the heart of high-speed data management. Removing heat from critical components boosts performance by making operation more efficient and preventing overheating-related failure. There are numerous areas within the data center where advanced thermal interface materials (TIMs) are employed (Figure 1); one recent innovation solves a challenge posed by the move to higher-power optical transceivers.

Application Case: Pluggable Optical Modules (POMs)

Optical transceivers – or pluggable optical modules (POMs) – form the foundation of data movement. With the industry quickly transitioning from the 100 Gigabit Ethernet (GbE) standard to 400 GbE and 800 GbE to cope with accelerating data rates and volumes, new solutions are required to ensure functional optimization. Part of the performance improvement comes from robust thermal management, as newer, higher-power modules create higher operational temperatures. POMs leverage a riding heat sink to dissipate heat and have traditionally not employed a thermal interface material, but only the metal-to-metal contact to facilitate heat transfer. While this is a workable approach for 100 GbE POMs, a metal-to-metal interface is not optimal for higher power transceivers.

To overcome the next-generation POM heat dissipation challenge – as conventional thermal pads or films are not conducive to numerous transceiver insertions and pulls – a new TIM coating was developed to provide a gap filling thermal interface to facilitate more efficient and effective heat transfer from the transceiver surface to the heat sink. In testing, the microTIM durable coating showed a thermal resistance improvement of 0.3°C/W versus a standard metal-to-metal interface. Based on this data, a high-power density POM that requires 15W power dissipation will operate at approximately 5.0°C cooler with the microTIM durable coating versus no coating and a metal-to-metal interface. Solutions like this will be imperative as higher power, faster transceivers are integrated into next-generation cloud and hyperscale data center systems.

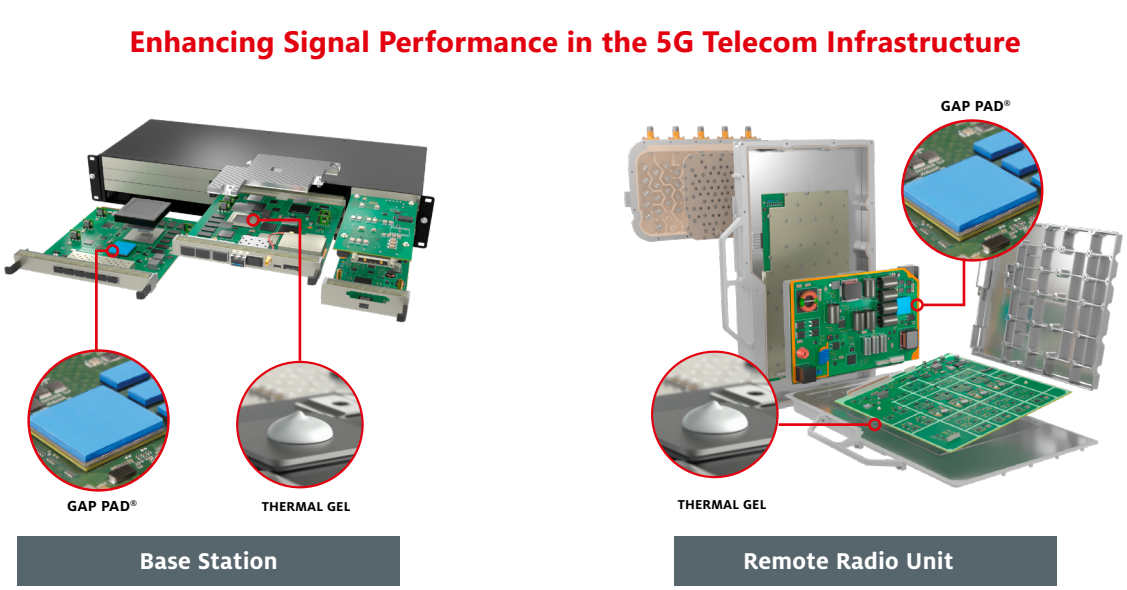

Figure 2 – Reliability is essential for telecom equipment and is enhanced with robust thermal management materials.

Application Case: 5G Base Band Units, Remote Radios and Antennas

To enable 5G connectivity across applications – from ultra-fast high-resolution video streaming to automotive ADAS, smart home systems and more – infrastructure systems including base stations, remote radios and antennas are more complex and powerful in order to manage the 10x increase in cellular data transfer capability. More data to process, higher 5G bands with greater signal attenuation and the resulting requirement for higher-capacity electronics are compelling the integration of more powerful components in greater numbers.

Tackling several thermal control challenges within 5G telecom infrastructure systems, a rugged thermal interface material (TIM) capable of withstanding environmental conditions and delivering high heat dissipating capacity was designed for use across applications. Highly versatile and reliable, the thermal gel delivers on several requirements, including:

- Volume production-friendly with automatic dispensability of varying volumes for high UPH
- Deposition adaptability: capability to deposit small amounts (mass deposits of ≥ 0.2 g) all the way up to large surface area volumes to enable heat dissipation across an entire assembly
- High thermal conductivity > 6.0 W/m-K
- Heat transfer capabilities accommodate for no active cooling with operational efficiency during peak use
- Ability to mitigate for various component dimensional tolerances and coefficient of thermal expansion (CTE) differences
- Exceptional vertical gap stability (gaps up to 3.0 mm); once dispensed, pre-cured liquid gel stays in place even in a vertical orientation

Today, this thermal solution has been globally deployed within 5G remote radio units, base band units and antennas and is providing excellent performance.

Many Solutions from One Source

Throughout data center systems, and wireless and fixed mobile infrastructure devices, thermal control has emerged as a predominant element of performance efficiency. Micro-thermal interface coatings and thermal gels are just two of hundreds of examples of Henkel's thermal management ingenuity. Leveraging several decades of pioneering thermal material development, Henkel's extensive portfolio of TIMs in multiple formats – liquids, adhesives, pads, greases and phase change solutions – is delivering the solutions required for state-of-the-art datacom/telecom network technology.

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