Raising Reliability of Devices for the 5G Telecom Infrastructure

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The coming era of 5G mobile communications has users excited about the possibilities and broadband system designers and manufacturers a bit nervous about the realities. Deployment will come in phases – the first this year, with scaled rollout of broader deployment expected to begin in 2020. To deliver on the 5G promise, wireless infrastructure and optical transport network must be able to manage the huge amounts of data and speeds required to satisfy demands of enhanced mobile broadband and faster data response times (lower latency). The move from 4G to 5G is more than a step change; it's a leap. Current projections are that 5G will be able to handle 1,000 times more traffic and will provide data download speeds at 10x the rate of 4G LTE. To put that in context, 4G+ download speeds, on average, are about 60Mbit/second. 5G is projected to deliver anywhere between 1,000 – 10,000 Mbit/second (1 -10 Gbit/sec). You'll be able to download an HD movie onto your phone in less than a second. And, with the addition of ultra reliable low latency communications (URLLC), new mission-critical services like autonomous vehicles and remote active patient monitoring can be realized.

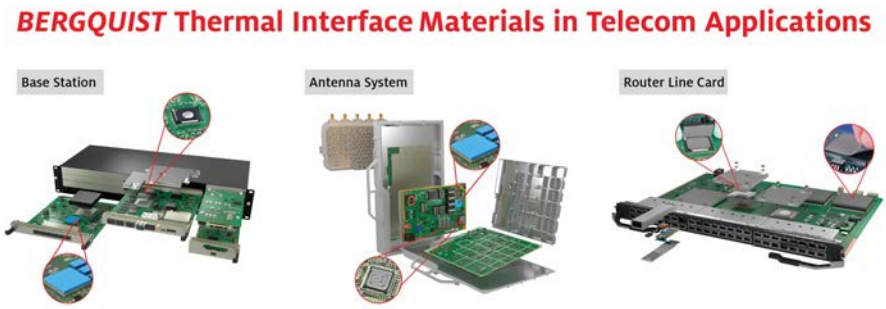
4G has almost tapped its limit, and with more users, devices and new wireless applications being added on a daily basis, 5G technology is required to accommodate the increased data processing and transporting loads. This means more of everything from an infrastructure standpoint: additional radios and base stations, higher capacity routers and switches and more reliable high power components to process the data volume and speeds 5G is promising. Currently, there is no one approach or solution that has emerged as the 5G single enabler. Instead, the new capability will comprise a broad heterogeneous network and is likely to include some or all of the following:

More base stations – Not only will more 5G radios and base stations be in play, but a higher volume of smaller base stations, often called small cells, will be deployed and can help with the greater signal attenuation challenges posed by high-frequency millimeter waves and offer a reliable solution for improved signal transmission.

More antenna transmitters and receivers, and directed signal transmission – Massive MIMO (multiple-input, multiple-output) allows for substantive increases in signal throughput transmission by increasing the number of antennas for the transmit and receive streams in remote radio units However, with this comes increased interference, which requires beamforming to accurately focus and send data packets in a concentrated beam to the required destination. Beamforming also offers solutions to mmWave transmission and interference challenges.

Higher power devices – Like nearly all electronic equipment designs, the challenge of power density is more prevalent as functionality expands with increased device integration into a smaller (or similar-sized) form factor. The same holds true for 5G telecom; radio and base stations, routers and switches will have to churn and move data faster than ever. Greater capacity doesn't necessarily mean bigger boxes, just higher power devices in the same footprint. Expect a huge increase in the number of high powered processors/ASICs and hardware components.

Once in place, 5G will expand the efficient use of connected life and business – from our mobile phone experience to connected home devices, virtual and augmented reality applications, autonomous driving, the Internet of Things (IoT), the Industrial Internet of Things (IIoT) and a multitude of future technologies not even on the horizon. As customers, we expect it all to work on-demand, 24/7/365. Reliable function of 5G network infrastructures is critical; and, at the foundation of all 5G devices are the electrical connections, protection of electronic devices and thermal control needed to ensure dependable, on-call operation. Delivering the reliability required for systems that will be subjected to the demands of indoor and outdoor environments, temperature extremes, and high in-use temperatures is central to 5G transformation. One of the most critical elements of consistent performance is thermal control and, with the variety of components used and environments experienced, requires multiple approaches.



Thermal pads, such as Henkel's BERGQUIST® GAP PAD® ultra-low modulus portfolio, offer extremely high thermal conductivity and low assembly stress which, traditionally, have been difficult properties to deliver in a single solution. With a variety of pad-based thermal interface material (TIM) systems that offer thermal conductivity levels from 3.0 W/m-K to 7 W/m-K -- and a soon-to-be-released 10 W/m-K and 12 W/m-K products -- ultra-low modulus GAP PADs are ideal for high power devices such as core chip and system-on-a-chip (SOC) devices found within 5G-capable telecom base band units, routers and switches. Phase change TIMs and liquid gels that provide application versatility and customizable flow characteristics provide the adaptability needed for applications such as radio frequency ICs, power amplifiers, FPGAs/ASICs and power supplies.

Not surprisingly, many 5G infrastructure devices are placed in outdoor locations and must withstand the challenges of vertical positioning and various weather conditions. Functional reliability is critical, as service and repair of faulty systems can be complicated. In addition to its GAP PAD solutions, Henkel's most recent thermal innovation for 5G is a novel thermal gel designed to accommodate the

environmental and location realities of next-generation infrastructure components. The new TIMs are thermally conductive, dispensable, pre-cured gels that offer stable viscosity in storage and in use. The materials, available in standard and high gap (2.0 mm) formulations, offer high-volume production simplicity as the pre-cured formulation requires no mixing or refrigeration. Once applied, the 3.8 W/m-K and soon-to-be-released 6 W/m-K TIM gels maintain their form and position, which is critical for telecom devices that may be placed vertically in outdoor environments with limited active cooling.

Reliable 5G networks will clearly require a host of solutions – at the printed circuit board level all the way up to the final system enclosure – to deliver on the huge expectations. Keeping all systems go also means keeping all systems cool, making thermal management one of the most critical pieces of the 5G solution.

Learn more about Henkel's complete 5G telecom infrastructure portfolio of electronic materials:
BERGQUIST® GAP PAD® TGP 7000ULM
BERGQUIST® GAP PAD® TGP 6000ULM
Telecom and Datacom Infrastructure Solutions