

» Whitepaper «



Maintaining High Performance and Reliability: Innovative Vibration Suppression Technology for Communication Rack Mount Servers

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Maximizing uptime, performance and reliability of networked systems is a mandate for server technology. Additional requirements challenge OEMs and equipment providers to find server solutions for installations in space-constrained environments with system longevity of up to five years and even longer for certain applications or vertical markets. It is also of the utmost importance that crucial servers for the telecommunications market meet strict NEBS (Network Equipment Building Systems) or ETSI (European Telecommunications Standards Institute) requirements that specify stringent Carrier-Class features to guarantee operation under the environmental extremes found in a central office.

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To stay competitive, it is crucial that server designs meet or exceed these tough requirements. As standard building blocks used in a variety of telecom and IP network applications, Kontron communication rack mount servers have consistently demonstrated long life reliability under harsh conditions and within the limited space of telecom central office and data center environments. However, telecom and IP networking are not the only applications to benefit from these ruggedized servers. There is also growing demand for rugged server solutions in a broad range of military, aerospace, government, medical and energy market applications.

Kontron offers two types of communication rack mount servers: Carrier Grade Servers and IP Network Servers. Carrier Grade Servers are NEBS-3 and ETSI-compliant and are deployed in Telco applications such as unified messaging, Service over IP (SoIP), video on demand (VoD), media and signaling gateways, operational system support, mobile location service and media servers. Likewise, IP Network Servers are used in a broad range of data network applications that have large I/O requirements. These servers offer the long life, ruggedness and reliability required for network security and other enterprise-based applications.

Testing and Analysis Ensure Higher Levels of Reliability

As mentioned previously, one of the most important considerations in selecting a Telco server solution is whether it meets the requirements for NEBS (Network Equipment Building Systems) certification standards from Telcordia for equipment used in Telco central offices. But standards alone do not necessarily drive higher levels of reliability for all market applications. Even if equipment is not designed for the central office, next generation system requirements frequently specify a ruggedized chassis design. Many systems now require enhanced ruggedness and reliability to prevent equipment damage or failure from environmental issues such as temperature and humidity, vibration and airborne contaminants, plus be fire resistant and the ability to withstand an earthquake shock. Important, too, are server designs that enable improved space planning and simplified equipment installation.

With its extensive knowledge and 10-year successful history in the server market, the Communication Rack Mount Server (CRMS) division at Kontron has an ongoing practice of analyzing potential issues that could jeopardize how its servers adhere to NEBS requirements or the overall quality and reliability of the system itself. The experts at Kontron are committed to testing and reviewing all components to make sure each is up to the company's high standards. As part of this continual analysis process, the design team has revealed some significant concerns associated with system vibration that needs to be given serious consideration when choosing a reliable server.

Vibration Threatens System Reliability and Performance

During the initial validation prior to a release of a new Kontron line of servers, the company's engineers identified an issue that can significantly affect system reliability and performance. Systems were experiencing an unexpected performance loss when subjected to extreme temperatures. After comprehensive testing, the cause was narrowed down to the operation of the hard drives, which were experiencing excessive re-syncs of the drive's heads due to the added vibration caused by the system's fan speed increase in response to the temperature changes. Kontron engineers immediately embarked on an extensive investigation into the effects vibration has on hard drives, the sources of vibration and the solutions to reducing vibration's negative impact on performance.

The Cause

The primary source of internally-generated vibration is system fans. Because today's higher-power systems require increased thermal management that typically involves greater airflow, fans have had to greatly increase their rotational speeds, with some fans now spinning at over 18,000 RPM. This has resulted in both increased amplitude and frequency of system vibration to keep the system cooled to its specifications.

The system performance problem has arisen due to hard disk drives that are more sensitive than ever to vibration. Rotational speeds and bit densities for hard drives continue to increase making them more susceptible and vulnerable to shock and vibration due to their inherent mechanical structure. This fact, coupled with higher speed thermal management system fans, has led to an underlying problem that can have serious consequences.

The Detrimental Results

Performance issues resulting from increased vibration may not be immediately obvious as the cause of the system sluggishness could be attributed to any number of other hardware or software problems. One clue that the problem is related to vibration is if the degradation occurs during a time when the fans are running at high speeds, such as happens when the system responds to increased ambient temperatures. The user may note that as the ambient temperatures rise, the system performance falls. They may further note that at certain limits, the system can degrade to a point where a drive goes "offline" or worse, the system crashes. This is certainly not an acceptable response for a mission-critical system.

New Vibration Suppression Technologies from Kontron

Attacking the issue head-on, Kontron has integrated innovative vibration suppression technologies into its communication rack mount servers. Using its considerable

server expertise, Kontron's CRMS design team has developed new methods of reducing the affects of vibration within the chassis. These new techniques benefit customers by allowing denser systems to operate at higher temperatures thus enabling the customer to deploy their solutions in environments not previously possible. In addition, they benefit from being able to use a greater variety of hard disk types and sizes instead of being limited to a few "extra rugged" devices. It is expected that the next generation hard drives will likely be even more sensitive to vibration given the increase in areal bit density and reduction in overall drive mass. By employing these vibration suppression technologies, Kontron's CRMS products have greater "headroom" to accommodate these new drives.

The proprietary vibration suppression technologies in Kontron's communication rack mount servers are designed to significantly reduce the amount of vibration by isolating both vibration-generating devices and vibration-sensitive devices. The company's 1U and 2U Carrier Grade and IP Network servers utilize a unique vibration-absorbing material allowing its designers to isolate both the fans and hard drives from direct contact with the system's metal infrastructure so they literally "float" inside the chassis. This approach requires that the initial system design includes vibration suppression as a key requirement. For example, the typical enterprise server hard drive "cage" is integrated tightly with the main chassis walls and/or floors. While this is efficient from a design point-of-view, it allows vibration to be transmitted directly to the hard drives. And while the drives can be, and should be, isolated from the cage, Kontron has found that creating a self-contained drive cage and isolating the entire cage from the chassis greatly reduces vibration-induced performance loss of the drives over drive isolation alone.



The Kontron CG2100 is a NEBS-3 and ETSI-compliant 2U rack mount server that features the company's proprietary vibration suppression technologies.

Holistic Approach to Higher Reliability

More than the sum of its components, system reliability is a dynamic equation that can change under varying operational circumstances. Simply putting off-the-shelf rubber

grommets everywhere will not guarantee an optimal solution. The size, shape, number, location and most importantly the selection of elastic material all affect the quantity of the vibration reduction. In reality, the challenge is not so much to reduce the total amount of vibration in the system but to attenuate certain frequencies that hard drives are particularly sensitive to. Given that these frequencies vary from drive to drive and that no simulation technique exists that would accurately model a system's vibration patterns, Kontron developed a proprietary software package that accurately and precisely measures hard drive performance as a function of drive type, fan speed and system configuration. This allows the team to quickly analyze various isolation solutions that include the following components:

- » Hard disk drive assembly and best way to isolate the drives
- » Multiple system fans running at different speeds
- » Comparing chassis materials and alternative designs

Using this analysis method, Kontron determined that by implementing these vibration reduction techniques, not only is vibration reduced from the system fans but it also reduces the effects of vibration from the spinning hard drives on themselves and on neighboring drives. Furthermore, vibration from sources external to the system such as other systems sharing the same rack or from HVAC and other building machinery is also greatly reduced.

Analyzing Other Components

Solving the issues associated with vibration does not stop at isolating the problematic components. In fact, Kontron found that to maintain optimal performance, isolation may not always be the best solution. Kontron engineers have found that changing the mass of a structure will often provide better attenuation of vibration than isolation will. It is important not to "over-isolate" the design by creating many smaller, lighter independent structures that actually may be more sensitive to vibration. To find the right balance of mass versus isolation, the engineers at Kontron rely on their experience in solving past problems and then evaluating each option carefully using Kontron's proprietary performance analysis tool.

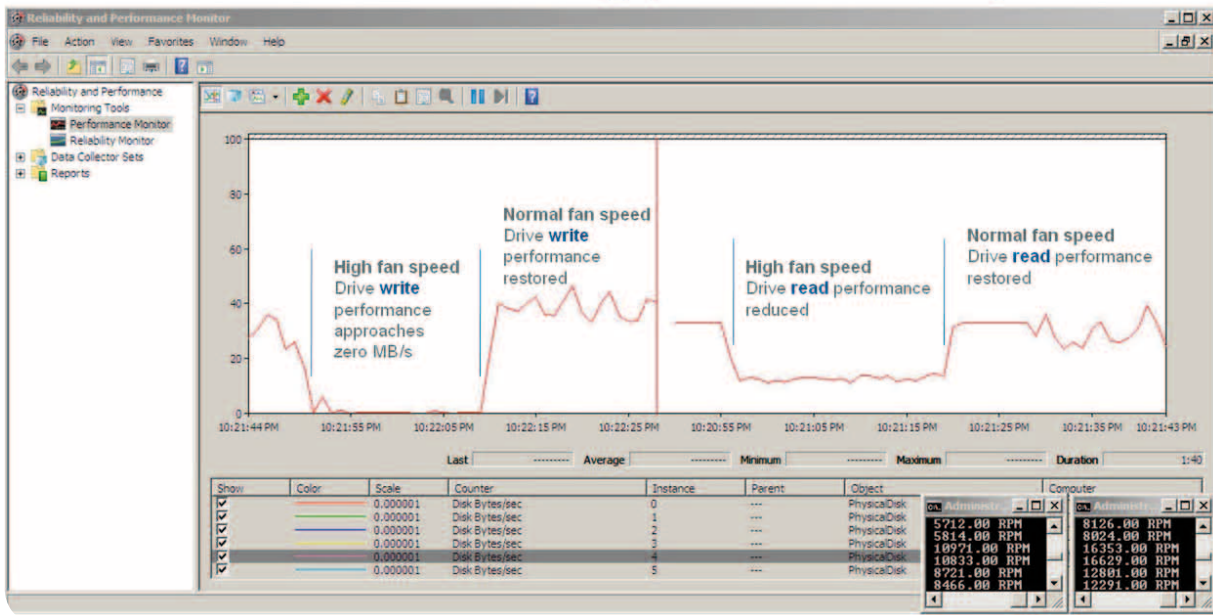
Kontron's new communication rack mount servers also employ high-quality fans with carefully balanced blades and high-quality bearings that are guaranteed and tested to meet specific vibration limits. As systems become more powerful, it is important that there be a continual evaluation process of new fan and disk drive products in the industry to assure that systems continue to deliver the best performance and reliability possible.

Furthermore, Kontron recommends that enterprise-class drives be tested to meet specific vibration-tolerant requirements, and is continually requalifying drives to meet its server and vibration specifications.

Testing the Affects of System Vibration

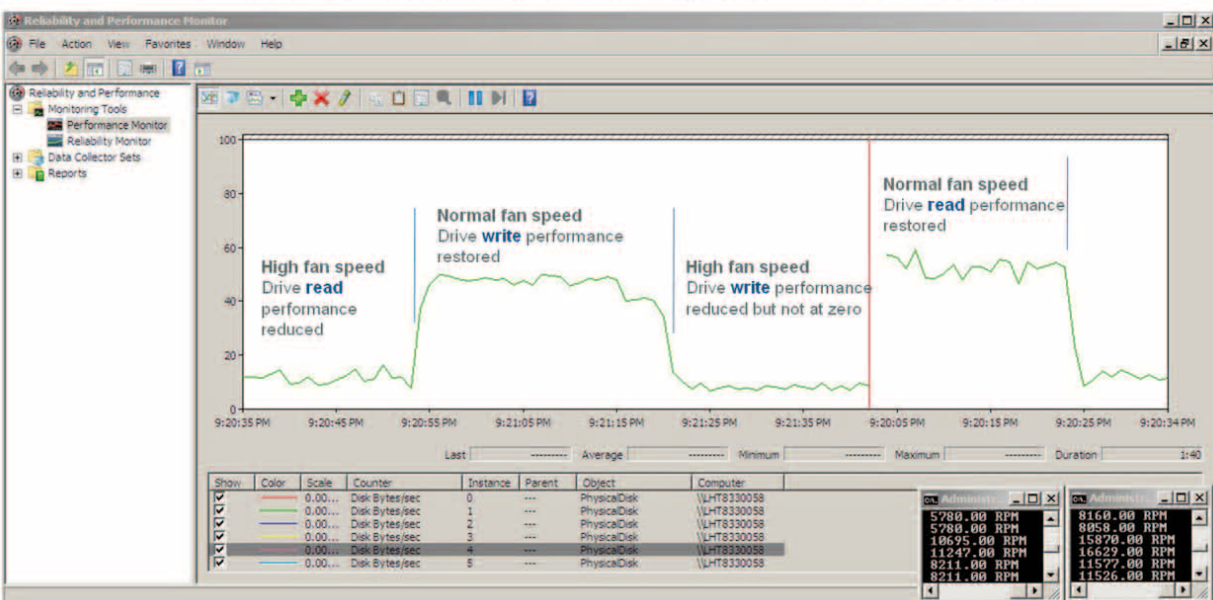
The diagrams below show the test results of system vibration from a server before and after vibration suppression technology has been integrated into its design.

SATA HDD Read/Write Throughput Without RV Designs



As this test screen shows, without vibration suppression technology reading performance is reduced but writing performance is reduced to zero when fan speed is toggled between normal and high speeds. The user sees an hourglass or error message that indicates the hard disk drive is not available when performance is at zero MB/s throughput. If this is an OS drive, it could cause a blue screen.

SATA HDD Read/Write Throughput with RV Designs



Integrating vibration suppression technologies shows in this test that reading/writing performance is improved and writing is no longer at zero when the fan speed is toggled between normal and high speeds. The result – hard disk drives are always available and with the expected performance.

Continuous Enhancements in Server Design

Fan and general system vibration can be the cause of under-performing systems that affect the throughput and reliability of sensitive hard disk drives. The good news is that Kontron has developed innovative vibration suppression technologies that it has tested and designed from a ground up system perspective for the company's Carrier-Grade and IP Network communication rack mount servers. Integrating these technologies, Kontron can satisfy the demanding and rugged environmental requirements of the telecom central office, data center and other embedded market applications while alleviating vibration-induced performance and reliability issues.

And what about the future? Given that hard drive suppliers will continue to push to higher densities, and that the cost per usable gigabyte of rotational drives compared to solid state drives is expected to remain lower for the foreseeable future, Kontron is already working on new technologies for the reduction of vibration-induced hard drive performance degradation. Some of these include working with fan vendors on lower-vibrating designs, working with drive manufacturers to reduce the sensitivity of the drives and investigating new materials used for both isolation and for the actual support structures themselves. With these technologies in place, Kontron will continue to be a leading supplier of highly-reliable carrier-grade and IP network servers well into the coming decade.

About Kontron

Kontron designs and manufactures standards-based and custom embedded and communications solutions for OEMs, systems integrators, and application providers in a variety of markets. Kontron engineering and manufacturing facilities, located throughout Europe, Americas, and Asia-Pacific, work together with streamlined global sales and support services to help customers reduce their time-to-market and gain a competitive advantage. Kontron's diverse product portfolio includes: boards and mezzanines, Computer-on-Modules, HMIs and displays, systems, and custom capabilities.

Kontron is a Premier member of the Intel® Embedded and Communications Alliance.

For half-a-decade now, Kontron has been named a VDC *Platinum Embedded Board Vendor*. Based entirely on user feedback, industry professionals evaluate vendors on over 45 non-product related criteria. Kontron is only one of two companies to receive the Platinum award 5-years running.

Kontron is listed on the German TecDAX stock exchange under the symbol „KBC“.

For more information, please visit: www.kontron.com

CORPORATE OFFICES

Europe, Middle East & Africa

Oskar-von-Miller-Str. 1
85386 Eching/Munich
Germany
Tel.: +49 (0)8165/ 77 777
Fax: +49 (0)8165/ 77 219
info@kontron.com

North America

14118 Stowe Drive
Poway, CA 92064-7147
USA
Tel.: +1 888 294 4558
Fax: +1 858 677 0898
info@us.kontron.com

Asia Pacific

17 Building,Block #1,ABP.
188 Southern West 4th Ring Road
Beijing 100070, P.R.China
Tel.: + 86 10 63751188
Fax: + 86 10 83682438
info@kontron.cn

