



Enabling an Idea:

How ClearNAND™ Flash Helped Data Design Create a High-Performance Industrial SSD

A Micron/Data Design Case Study

About Data Design Corporation

Data Design Corporation is a turnkey electronic design and product-manufacturing company that provides custom electronic-design solutions in embedded processing, RF and optical communication, instrumentation, digital signal processing, and power management.

Since getting its start in scientific instrumentation in 1985, the Gaithersburg, Maryland-based contract engineering firm has been expanding its skill set and customer base and now boasts a diverse scope of products in its portfolio, with designs in use from the South Pole, to national laboratories working with high-end physics, to the intelligence community, to aerospace and telecommunications.

“Anything that has electrons moving in it, we’ve probably had a hand in it,” said Richard Baum, Data Design’s Director of Engineering. “A lot of the output of our company is designs. With electronic design engineers at just about every level and discipline, we take the requirements that the customer gives us, and we hand them a design package: ‘Here are working prototypes; here is the documentation you need to make those prototypes.’”

Data Design’s Dilemma— Storage-Technology Shortcomings

Traditional spinning hard drive media (HDD) has not been able to meet ever-increasing demands for higher density and lower power usage. These demands are present in a wide variety of applications, including data processing, search and storage, and extreme terabyte-scale data sets. Data Design develops multiple products that leverage the efficiencies of NAND Flash to meet these needs.

“NAND Flash has the advantage over HDDs in that it’s higher-performance, lower-power, and much more mechanically robust than spinning media,” Baum explains. “It allows our customers to take advantage of the fact that they need less infrastructure as far as cooling and space—the actual square footage in their buildings—to house the amount of data and processing power that they need.”

But NAND Flash is not without challenges of its own. For the past few years, Data Design’s engineers have increasingly struggled with a problem inherent in NAND technology, particularly in multilevel cell (MLC) devices—bit errors. As customers began requesting designs that were focused less on storing non-critical images and audio files and more on storing code data, these bit errors became vitally important. “We were storing FPGA configuration data; if *one bit* is wrong, the *whole thing* just doesn’t work,” explains Baum. Complicating the issue of bit errors was each design’s ability to incorporate the error correction code (ECC) resources needed to deal with them. Data Design’s projects often have small power budgets that limit the size of the NAND controller to as small as 8 bits—not a lot of resources for dealing with ECC problems.

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“We were running into the problem that we were interfacing a NAND device to a different controller on just about every project we had,” Baum elaborates. “So we had to redo how we handled these errors—in a processor or an FPGA or a custom controller—every time a customer came to us with a new requirement. We were constantly dedicating resources to dealing with these errors all over again, every time,” he said. “When you have a number of NAND devices, and you’re receiving data at 5–7 GB/s, the amount of resources required to handle the errors with the data coming in at that rate is extremely expensive.”

How Micron’s ClearNAND Flash Enabled an Otherwise-Impossible Design

Faced with the obstacle of expensive controller resources, it didn’t seem feasible that Data Design would be able to bring to fruition their idea for a truly high-end PCI Express (PCIe) solid state drive (SSD) storage device specialized for the industrial military market. They had pushed their plans aside as simply being too cost-prohibitive to be marketable, when a product-development road map call with Micron product managers changed everything.

When ClearNAND Flash popped up in the course of the discussion, Data Design immediately seized on the potential uses for a high-speed, low-power NAND device with built-in ECC algorithms in a host of its products—including the shelved design for a high-end PCIe SSD.

“Our PCI Express solid state storage device offers twice the density of our immediate competition, in half the space, and it’s orders of magnitude faster and lower-power than the traditional spinning media that this is designed to replace,” Baum said. “This product would not have been possible for us to produce had it not been for a managed NAND technology such as Micron’s ClearNAND. ClearNAND enabled us to achieve the density and power and IOPs that our customers are looking for.”

In hard numbers, Data Design’s SSD achieves a whopping 4TB of data capacity in a single-slot PCIe board and performance of about 1.5 million 2KB IOPs,

all on a stunningly low power budget of about 60W—far less than the 2000W required by the 100 HDDs that would have to be chained together in a complex RAID system to achieve the same performance.

Employing modules constructed with Micron’s Enhanced ClearNAND Flash devices, Data Design’s PCIe SSD delivers a total package of smaller space requirements, lower latency, faster access time, lower power consumption, and reduced controller complexity.

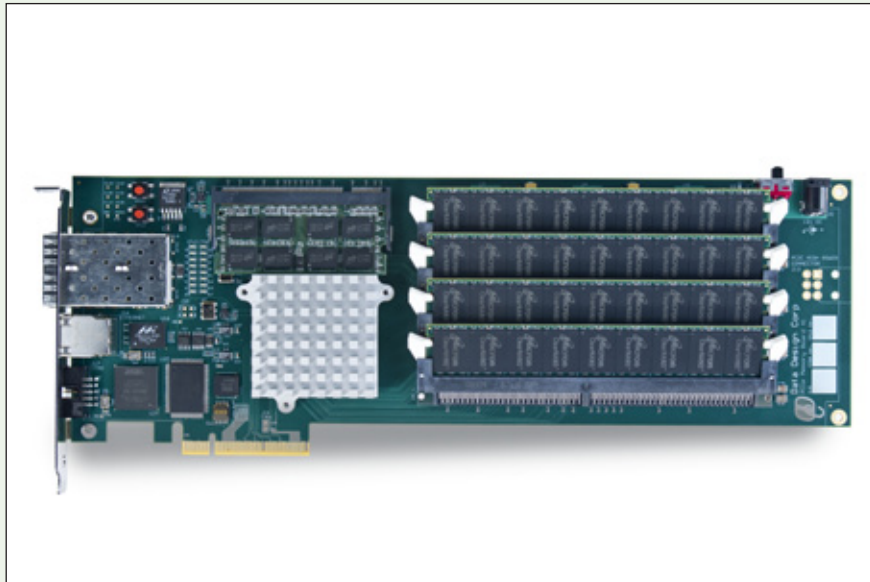
Micron’s Comprehensive Solution, Beyond the Part

But Micron supplied more than just a leading-edge device that erased 70% of Data Design’s controller needs. Micron also provided expert support to integrate the part into the SSD design.

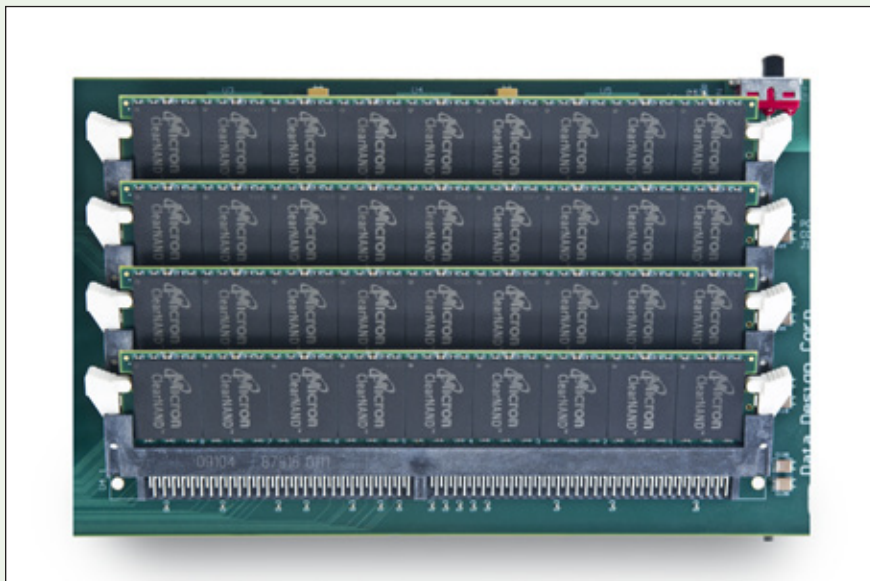
Successful Integration Has Put ClearNAND Flash on Data Design’s Road Map, Too

Data Design plans to continue using ClearNAND Flash to ensure that the types of products they want to produce are marketable, cost-effective designs.

“We’re going to continue to use Micron’s ClearNAND devices in our future products because as the density of the NAND devices gets higher, and the process in producing those parts gets smaller, the number of errors and the resources and IP needed to be developed to handle those errors is going to get extremely expensive,” Baum says. “It really is nice to have the value-added feature ECC built right into the part, and you don’t have to think about it. Micron came in at a very fortunate stage in our design of this product and introduced us to the ClearNAND product.”



Using modules constructed with Micron's Enhanced ClearNAND Flash devices, Data Design's "industrial-strength" PCIe SSD delivers a total package of smaller space requirements, lower latency, faster access time, lower power consumption, and reduced controller complexity.



Micron's ClearNAND Flash devices helped Data Design deliver a single-slot PCIe board with a massive 4TB of storage in replaceable modules.

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