

# Lightning-Fast, Power-Efficient Analytics

## Micron® 5210 ION SSD Makes Oracle® Database 12c Analytics Thrive

### Overview

The Micron® 5210 ION SSD is a revolutionary approach to solving the data access problem.

When we introduced the Micron 5210 ION SSD — the industry’s first quad-level cell (QLC) SSD<sup>1</sup> — we targeted read-intensive enterprise workloads that would benefit from faster, lower-power data access; workloads that would see major benefit from SSDs; workloads that have struggled with spinning media.

Our QLC NAND technology narrows the affordability gap between performance HDDs and SSDs to enable these workloads like never before.

This technical brief highlights the Oracle 12c Database Business Intelligence / Decision Support Systems (BI/DSS) performance<sup>2</sup> of a Micron 5210 ION-based platform compared to legacy platforms using 10K RPM 2.4TB hybrid HDDs.<sup>3</sup>

We find that compared to a legacy configuration, the Micron 5210 ION delivers:

- 3.8X on average faster complex query processing
- Better energy usage, consuming 73% less power
- 3.8X higher storage throughput

### Fast Facts

**3.8X** Query processing advantage

**73%** Energy efficiency improvement — systems and data centers run cooler

**3.8X** Storage throughput advantage

**Micron** The first SSD manufacturer to bring QLC benefits to enterprise-class SSDs<sup>2</sup>

**Four** Four bits per cell NAND helps you learn more from your growing data, more affordably than ever



1. <http://investors.micron.com/releasedetail.cfm?releaseid=1068052>

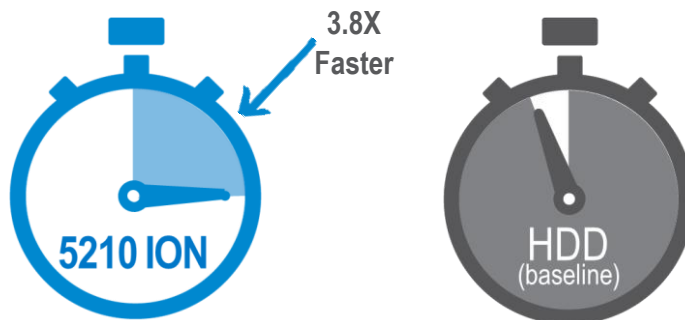
2. We use the term performance to indicate queries per hour (QPH), a common measurement of a BI platform’s ability to deliver results (completed queries per hour). See Configuration Details for system-specific testing information.

3. As of this document’s publication, 2.4TB is the maximum 10K RPM hybrid HDD capacity broadly available from a major HDD vendor. See Configuration Details for system-specific testing information.

## Complete Complex Queries 3.8X Faster

When comparing BI/DSS platforms, the primary metric of interest is time to complete a stream of queries (stream run time). Queries process faster when stream run time is lower, enabling faster answers and enhanced iterative queries (by completing additional queries in the same timeframe).

Figures 1a and 1b show the relative single stream completion time for each configuration. Figure 1a shows the Micron 5210 ION configuration completion time. Figure 1b shows the legacy HDD configuration stream run time as a baseline. In Figures 1a and 1b, lower elapsed time is better.



*Figure 1a: Stream Run Time:  
5210 ION SSD Configuration*

*Figure 1b: Stream Run Time:  
Legacy Configuration*

Figures 1a and 1b show that the Micron 5210 ION provides a significant performance boost over the legacy configuration, completing the test stream 3.8 times faster.

## Realize 73% Higher Energy Efficiency

The Micron 5210 ION drives these impressive results with far greater energy efficiency (where energy efficiency is expressed as the amount of energy consumed to complete the test query set of the Micron 5210 ION and baseline legacy configurations). We used two servers that, aside from storage, were identically configured (hardware and software). We recorded the power each configuration consumed (watts) and the time each took to complete the query set.

Figures 2a and 2b below show the energy consumed to complete the test query set, with Figure 2a showing energy consumed by the QLC configuration and Figure 2b showing energy consumed by the legacy configuration. Both figures show kilowatt hours (KWh), and lower is better.

These figures show that the QLC configuration consumed about 73% less energy to process the same query set.

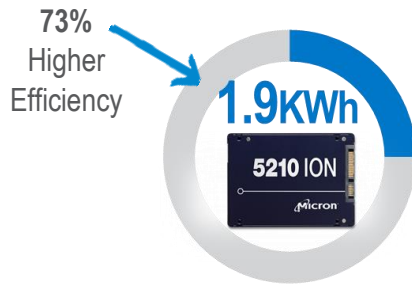


Figure 2a: 5210 ION Configuration

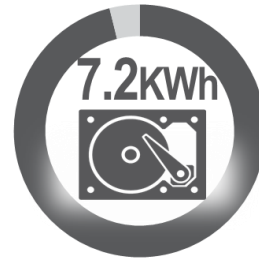


Figure 2b: Legacy Configuration

## Summary

We compared two BI/DSS platforms — one with a Micron 5210 ION SSD and the other with a 10K RPM HDD — by measuring how long it took to complete a single stream of 22 queries and the resulting energy efficiency. The queries were executed with DoP = 96. We found the Micron 5210 ION configuration completed the query set 3.8 times faster while consuming 73% less energy.

Micron's 5210 ION QLC SSD offers both extreme performance and power efficiency. It packs four bits in every storage cell, storing 33% more than the prior generation triple-level cell (TLC) technology. As a worldwide leader in flash technology, Micron is the first SSD manufacturer to bring QLC benefits to enterprise-class SSDs.

For mostly read workloads like BI/DSS, the Micron 5210 ION helps you manage the growing demand for more detailed analytics along with increasing pressure for energy efficiency — and do it more affordably than ever before.



Learn more

- Micron's [5210 ION SSD](#)
- [See](#) what this new [QLC NAND](#) SSD can do for you
- [Compare SSD and HDD endurance in the age of QLC](#)
- Keep up to date with the latest in Micron storage news; follow us on Twitter [@Micron Storage](#)

## How We Tested

We used the TPC-H benchmark tools for all query performance tests.<sup>4</sup> It uses a series of 22 business-oriented, ad-hoc queries and concurrent data modifications to gauge platform capability. We tested each configuration with one stream and Max DoP = 96.<sup>5</sup>

## Configuration Details

Table 1 summarizes the hardware and software configurations. Note that the total database size exceeds available memory to ensure a storage-centric workload.

| Item        | Configuration Details       | Item     | Configuration Details                                     |
|-------------|-----------------------------|----------|---|
| RAID        | RAID 5                      | CPU      | Intel® Xeon® Platinum 8168 (x2)                           |
| Controller  | PERC Dell H740P             | DRAM     | 384GB, DDR4   |
| HDD Storage | 10K RPM 2.4 TB HDD (x8)     | Database | Oracle Database 12c Enterprise Edition Release 12.2.0.1.0 |
| SSD Storage | Micron 5210 1.92TB SSD (x8) | OS       | Oracle Linux 7.5-4.1.12-124.16.4.el7uek.x86_64            |

Table 1: Hardware and Software Configuration

## Storage Throughput Drives Results

To better understand the results, we compared each configuration’s storage throughput. Figure 3 shows that the Micron 5210 ION configuration demonstrated about 3.8X higher storage throughput in testing (relative to the baseline HDD configuration).

Our test showed that the legacy HDD configuration (the test baseline) attained much lower total disk throughput than the Micron 5210 ION SSD configuration. Storage throughput is a major contributing factor in read-centric application workloads.

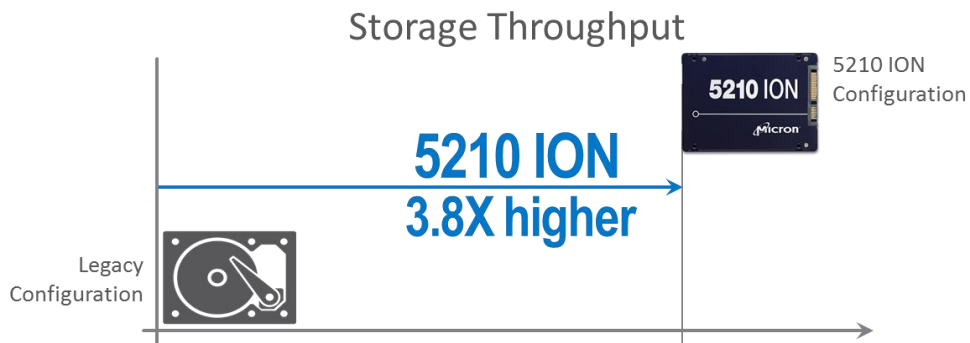


Figure 3: Micro 5210 ION, Legacy Throughput

4. For additional details on the TPC-H benchmark see: [http://www.tpc.org/tpc\\_documents\\_current\\_versions/pdf/tpc-h\\_v2.17.3.pdf](http://www.tpc.org/tpc_documents_current_versions/pdf/tpc-h_v2.17.3.pdf).

5. Maximum degree of parallelism (Max DoP) is an adjustable parameter that tells the database Server Planner how many parallel operations it can use for a given query. Different deployments may use different values for Max DoP. Single stream used as HDDs did not support additional streams.

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