Telecommunications Technology Association
Super Micro Computer, Inc.

TPC Express Benchmark™ IoT Full Disclosure Report

Machbase 8.0.1
running on

Supermicro A+ Server 1115SV-WTNR
(with 5x Supermicro A+ Server 1115SV-WTNR Nodes)

with

Red Hat Enterprise Linux Server Release 8.6

TPCx-IoT Version 2.1.0
Report Edition First
Report Submitted Sep 18, 2023
First Edition – September 2023

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Abstract

TTA conducted the TPC Express Benchmark™ IoT (TPCx-IoT) on the 5x Supermicro A+ Server 1115SV-WTNR. The software used included Machbase 8.0.1. This report provides full disclosure of the methodology and results. All testing was conducted in conformance with the requirements of the TPCx-IoT Standard Specification, Revision 2.1.0.

The benchmark results are summarized below.

Configuration Summary

<table>
<thead>
<tr>
<th>Sponsor</th>
<th>Cluster Nodes</th>
<th>Storage Software</th>
<th>Operating System</th>
</tr>
</thead>
<tbody>
<tr>
<td>TTA SuperMicro</td>
<td>Supermicro A+ Server 1115SV-WTNR</td>
<td>Machbase 8.0.1</td>
<td>Red Hat Enterprise Linux Release 8.6</td>
</tr>
</tbody>
</table>

TPC Express Benchmark™ IoT Metrics

<table>
<thead>
<tr>
<th>Total System Cost (USD)</th>
<th>IoTps</th>
<th>USD/kIoTps</th>
<th>Availability Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>$248,443.45</td>
<td>4,529,397.35</td>
<td>$54.85</td>
<td>Sep 18, 2023</td>
</tr>
</tbody>
</table>

Executive Summary

The Executive Summary follows on the next several pages.
## Machbase 8.0.1

<table>
<thead>
<tr>
<th>Total System Cost</th>
<th>TPCx-IoT Performance Metric</th>
<th>Price/Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>$248,443.45 USD</td>
<td>4,529,397.35 IoTps</td>
<td>$54.85 USD/kIoTps</td>
</tr>
</tbody>
</table>

### Servers

<table>
<thead>
<tr>
<th>Operating System</th>
<th>Other Software</th>
<th>Availability Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Hat Enterprise Linux Server Release 8.6</td>
<td>None</td>
<td>Sep 18, 2023</td>
</tr>
</tbody>
</table>

### System Under Test Configuration Overview

- **Total Servers:** 5x Supermicro A+ Server 1115SV-WTNR
- **Total Processors/Cores/Threads:** 5/224/448

**Server Configuration:**
- **Processor:**
  - 2x Master Node
  - 1x AMD EPYC 8534P (2.30GHz, 64-core, 128 MB L3)
  - 384 GB
- **Memory:**
  - 1x 1TB NVMe M.2 PCIe SSD Gen4
- **Storage Device:**
  - 7x 3.8TB NVMe PCIe SSD Gen4
- **Network Controller:**
  - 1x Mellanox CX-7 100GbE
  - 1x Broadcom BCM57416 Dual-Port 10GbE

**Connectivity:**
- NVIDIA MSN2700 100GbE Switch (32 x QSFP28 Ports)

**Total Rack Units:** (5x 1115SV-WTNR) + (1x MSN2700) = (5x1) + (1x1) = 6 RU
## Machbase 8.0.1

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Source</th>
<th>List Price (USD)</th>
<th>Qty</th>
<th>Extended Price (USD)</th>
<th>3 yr. Maint. Price (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Server Hardware</td>
<td>AS - 11155V-WTNRT-O-OTO-10</td>
<td>1</td>
<td>10,456.00</td>
<td>2</td>
<td>20,912.00</td>
<td></td>
</tr>
<tr>
<td>Supermicro A+ Server AS -11155V-WTNRT (OPTIMIZED) [NR]H135V-WT, CSE-1168TS-R000NP, PWS-861A-1R)</td>
<td>AS - 11155V-WTNRT-O-OTO-10</td>
<td>1</td>
<td>3,000.00</td>
<td>3</td>
<td>9,020.00</td>
<td></td>
</tr>
</tbody>
</table>

### Supermicro A+ Server AS -11155V-WTNRT (OPTIMIZED) [NR]H135V-WT, CSE-1168TS-R000NP, PWS-861A-1R)

- **Part Number**: AS - 11155V-WTNRT-O-OTO-10
- **Quantity**: 1
- **List Price (USD)**: 3,000.00
- **Extended Price (USD)**: 9,020.00
- **3 yr. Maint. Price (USD)**: 1,908.22

### TPCx-IoT 2.1.0

- **Vendor**: TTA, Supermicro
- **Report Date**: Sep 18, 2023
### Network

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Model Number</th>
<th>Quantity</th>
<th>Unit Price</th>
<th>Total Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>NVIDIA MSN2700-CS2F Spectrum 100GbE 1U Open Ethernet Switch</td>
<td>MSN2700-CS2F</td>
<td>2</td>
<td>$21,568.00</td>
<td>$21,568.00</td>
</tr>
<tr>
<td>Mellanox MCP1600-E002E30 Passive NVIDIA MCP1600-C001E30N Direct Attach Copper</td>
<td>MCP1600-C001E30N</td>
<td>2</td>
<td>$144.00</td>
<td>$720.00</td>
</tr>
<tr>
<td>Cable Ethernet 100GbE QSFP28 1m Black 30AWG CA-N</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mellanox Technical Support and Warranty - Silver 3 Year with 4 Hours On-Site</td>
<td>781-C27N4Z+P2CM83</td>
<td>6</td>
<td>$10,131.00</td>
<td>$10,131.00</td>
</tr>
<tr>
<td>Support for SN2000 Series Switch</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Sub-Total** $22,288.00, $10,131.00

### Software

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Model Number</th>
<th>Quantity</th>
<th>Unit Price</th>
<th>Total Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machbase v8.0.1 Cluster Edition (includes 1y 7x24x4 Technical Support)</td>
<td></td>
<td>-</td>
<td>$170,000.00</td>
<td>$170,000.00</td>
</tr>
<tr>
<td>Machbase v8.0.1 Cluster Edition 7x24x4 Technical Support</td>
<td></td>
<td>-</td>
<td>$25,500.00</td>
<td>$25,500.00</td>
</tr>
</tbody>
</table>

**Sub-Total** $170,000.00, $70,485.00

### Infrastructure

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Model Number</th>
<th>Quantity</th>
<th>Unit Price</th>
<th>Total Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP M27fw FHD Monitor (w/ spares)</td>
<td>2H1A4AAA#ABA</td>
<td>5</td>
<td>$159.00</td>
<td>$795.00</td>
</tr>
<tr>
<td>HP 225 Wired Mouse and Keyboard Combo (w/ spares)</td>
<td>286J4UT#ABA</td>
<td>5</td>
<td>$21.00</td>
<td>$105.00</td>
</tr>
</tbody>
</table>

**Sub-Total** $540.00

### Discounts*

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Model Number</th>
<th>Quantity</th>
<th>Unit Price</th>
<th>Total Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machbase v8.0.1 Cluster Edition (includes 1y 7x24x4 Technical Support)</td>
<td></td>
<td>-</td>
<td></td>
<td>$(59,500.00)</td>
</tr>
<tr>
<td>Machbase v8.0.1 Cluster Edition 7x24x4 Technical Support</td>
<td></td>
<td>-</td>
<td></td>
<td>$(17,850.00)</td>
</tr>
</tbody>
</table>

**Sub-Total** $(59,500.00), $(17,850.00)

**Total** $185,677.45 USD, $62,766.00 USD

### Price Source

1) Super Micro Computer Inc.  2) NVIDIA Inc.  3) Red Hat Inc.  4) Machbase Inc.  5) Hewlett Packard Inc.

### Audited by Pre-Publication Board

*All discounts are based on US list prices and for similar quantities and configurations. Discounts for similarly sized configurations will be similar to those quoted here, but may vary based on the components in the configuration.

**Three-Year Cost of Ownership:** $248,443.45 USD

**IoTPs:** 4,529,397.35

**USD/kIoTPs:** $54.85 USD
Prices used in TPC benchmarks must reflect the actual prices a customer would pay for purchase of the components in all regions specified in the result. Individually negotiated discounts are not permitted. Special prices based on assumptions about past or future purchases are not permitted. All discounts reflect standard pricing conventions for the listed components. For complete details, see the pricing section of the TPC benchmark specification. If you find that stated prices are not available according to these terms, please inform the TPC at pricing@tpc.org. Thank you.
## Numerical Quantities

| Scale Factor | 13000000000 |

### Performance Run (Run2)

| Warmup Run Start Time | 2023-08-30 16:26:37.000 |
| Warmup Run End Time | 2023-08-30 17:09:45.000 |
| Warmup Run Elapsed Time | 2,587.186 |
| Measured Run Start Time | 2023-08-30 17:09:46.000 |
| Measured Run End Time | 2023-08-30 17:57:37.000 |
| Measured Run Elapsed Time | 2,870.139 |

**Performance Metric (IoTps)** 4,529,397.35

### Repeatability Run (Run1)

| Warmup Run Start Time | 2023-08-30 17:58:57.000 |
| Warmup Run End Time | 2023-08-30 18:42:27.000 |
| Warmup Run Elapsed Time | 2,610.021 |
| Measured Run Start Time | 2023-08-30 18:42:29.000 |
| Measured Run End Time | 2023-08-30 19:27:46.000 |
| Measured Run Elapsed Time | 2,716.382 |

**Performance Metric (IoTps)** 4,785,777.55
Machbase 8.0.1

TPCx-IoT 2.1.0
TPC Pricing 2.8.0
Report Date Sep. 18, 2023

Performance Run Report (Run2)

TPCx-IoT Performance Metric (IoTps) Report
Test Run2 details : Total Time For Warmup Run In Seconds = 2,587.186
Test Run2 details : Total Time In Seconds = 2,870.139
Total Number of Records = 13,000,000,000

TPCx-IoT Performance Metric (IoTps): 4,529,397.35

Repeatability Run Report (Run1)

TPCx-IoT Performance Metric (IoTps) Report
Test Run1 details : Total Time For Warmup Run In Seconds = 2,610.021
Test Run1 details : Total Time In Seconds = 2,716.382
Total Number of Records = 13,000,000,000

TPCx-IoT Performance Metric (IoTps): 4,785,777.55

Summary details of the run reports are show above. For the complete run reports, see the Supporting Files Archive.
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Clause 0 Preamble

0.1 TPC Express Benchmark™ IoT Overview

TPC Express Benchmark™ IoT (TPCx-IoT) was developed to provide an objective measure of hardware, operating system and commercial NoSQL database software distributions, and to provide the industry with verifiable performance, price-performance and availability metrics. The benchmark models a continuous system availability of 24 hours a day, 7 days a week.

Even though the modeled application is simple, the results are highly relevant to hardware and software dealing with IoT gateway systems in general. TPCx-IoT stresses both hardware and software including database APIs and network connections to the database. This workload can be used to assess a broad range of NoSQL databases. TPCx-IoT can be used to assess a range of NoSQL implementations in a technically rigorous and directly comparable and vendor-neutral manner. The metric effectively represents the total number of records that can be inserted into a NoSQL database per second while running queries against the database.

The TPCx-IoT kit is available from the TPC (See www.tpc.org/tpcx-iot for more information). Users must sign up and agree to the TPCx-IoT User Licensing Agreement (ULA) to download the kit. Redistribution of the kit is prohibited. All related work (such as collaterals, papers, derivatives) must acknowledge the TPC and include TPCx-IoT copyright. The TPCx-IoT Kit includes: the TPCx-IoT Specification document, the TPCx-IoT Users Guide document, shell scripts to set up the benchmark environment and Java code to execute the benchmark load.

The purpose of TPC benchmarks is to provide relevant, objective performance data to industry users. To achieve that purpose, TPC benchmark specifications require that benchmark tests be implemented with systems, products, technologies and pricing that:

- Are generally available to users;
- Are relevant to the market segment that the individual TPC benchmark models or represents (e.g., TPCx-IoT models and represents a NoSQL database mimicking an IoT gateway system);
- Would plausibly be implemented by a significant number of users in the market segment the benchmark models or represents.

The use of new systems, products, technologies (hardware or software) and pricing is encouraged so long as they meet the requirements above. Specifically prohibited are benchmark systems, products, technologies or pricing (hereafter referred to as "implementations") whose primary purpose is performance optimization of TPC benchmark results without any corresponding applicability to real-world applications and environments. In other words, all "benchmark special" implementations that improve benchmark results but not real-world performance or pricing, are prohibited.

The rules for pricing are included in the TPC Pricing Specification. Further information is available at www.tpc.org.
Clause 1 General Items

1.1 Test Sponsor

A statement identifying the benchmark sponsor(s) and other participating companies must be provided.

This benchmark was co-sponsored by Telecommunications Technology Association and Super Micro Computer, Inc.

1.2 Parameter Settings

Settings must be provided for all customer-tunable parameters and options which have been changed from the defaults found in actual products, including by not limited to:

- Configuration parameters and options for server, storage, network and other hardware component incorporated into the pricing structure;
- Configuration parameters and options for operating system and file system component incorporated into the pricing structure;
- Configuration parameters and options for any other software component incorporated into the pricing structure;
- Compiler optimization options.

Comment 1: In the event that some parameters and options are set multiple times, it must be easily discernible by an interested reader when the parameter or option was modified and what new value it received each time.

Comment 2: This requirement can be satisfied by providing a full list of all parameters and options, as long as all those that have been modified from their default values have been clearly identified and these parameters and options are only set once.

The Supporting Files Archive contains the parameters and options used to configure the components involved in this benchmark.

1.3 Configuration Diagrams

Diagrams of both measured and priced configurations must be provided, accompanied by a description of the differences.

This includes, but is not limited to:

- Total number of nodes used
- Total number and type of processors used/total number of cores used/total number of threads used (including sizes of L2 and L3 caches)
- Size of allocated memory, and any specific mapping/partitioning of memory unique to the test
- Number and type of disk units (and controllers, if applicable)
- Number of channels or bus connections to disk units, including their protocol type
- Number of LAN (for example, Ethernet) connections and speed for switches and other hardware components physically used in the test or are incorporated into the pricing structure
- Type and the run-time execution location of software components
1.3.1 Measured Configuration

Figure 1-1 shows the measured configuration.

The measured configuration consisted of:

- **Total Nodes:** 5
- **Total Processors/Cores/Threads:** 5/224/448
- **Total Memory:** 1.92TB
- **Total Number of Storage Devices:** 40
- **Total Storage Capacity:** 29.5TB

**Connectivity:**

- NVIDIA MSN2700 100GbE Switch

**Servers**

- 2x Master Node:
  - 1x AMD EPYC 8534P (2.30GHz, 64-core, 128MB L3)
  - 384GB
- 3x Data Nodes:
  - 1x AMD EPYC 8324P (2.65GHz, 32-core, 128MB L3)
  - 384GB

**Processor Model:**

- 1x AMD EPYC 8534P
- 7x 3.8TB NVMe PCIe SSD Gen4

**Memory:**

- 1x 1TB NVMe M.2 PCIe SSD Gen4
- 7x 3.8TB NVMe PCIe SSD Gen4
- 1x Broadcom BCM57416 Dual-Port 10GbE

**Storage Devices:**

- 1x Broadcom BCM57416 Dual-Port 10GbE

**Network Controller:**

The distribution of software components over server nodes is detailed in section 1.5.
1.3.2 Priced Configuration
There are no differences between the priced configuration and the measured configuration.

1.4 Dataset Distribution
The distribution of dataset across all media must be explicitly described.

Table 1-1 describes the distribution of the dataset across all storage media in the system.

<table>
<thead>
<tr>
<th>Server</th>
<th>Storage</th>
<th>Disk Drive</th>
<th>Description of Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3</td>
<td>M.2 PCIe Gen4 PCIe Gen4</td>
<td>1 x 1TB NVMe SSD 7 x 3.8TB NVMe SSD</td>
<td>Operating System, Root, Swap, Machbase Coordinator, Machbase Data</td>
</tr>
<tr>
<td>4-5</td>
<td>M.2 PCIe Gen4 PCIe Gen4</td>
<td>1 x 1TB NVMe SSD 7 x 3.8TB NVMe SSD</td>
<td>Operating System, Root, Swap, Machbase Broker, Machbase Data</td>
</tr>
</tbody>
</table>

*Table 1-1 Dataset Distribution Across Storage Media*

1.5 Software Component Distribution
The distribution of various software components across the system must be explicitly described.

Table describes the distribution of the software components across the system.

<table>
<thead>
<tr>
<th>Server</th>
<th>Broker</th>
<th>Coordinator</th>
<th>Warehouse</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>4</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>5</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

*Table 1-2 Software Component Distribution Across Nodes*

The storage system software used was Machbase 8.0.1.
Clause 2 Workload Related Items

2.1 Hardware and Software Tunable Parameters

Script or text used to set all hardware and software tunable parameters must be reported.

The Supporting Files Archive contains all configuration scripts.

2.2 Run Report

The run report generated by the TPCx-IoT Kit for Performance Run and Repeatability Run must be reported.

The Supporting Files Archive contains the full run report. The following excerpts from the run report summarize the Performance Run and the Repeatability Run.

Run Report for Run 1 (Repeatability Run)

TPCx-IoT Performance Metric (IoTps) Report
Test Run 1 details: Total Time For Warmup Run In Seconds = 2,587.186
Test Run 1 details: Total Time In Seconds = 2,870.139
Total Number of Records = 13,000,000,000

TPCx-IoT Performance Metric (IoTps): 4,529,397.35

Run Report for Run 2 (Performance Run)

TPCx-IoT Performance Metric (IoTps) Report
Test Run 2 details: Total Time For Warmup Run In Seconds = 2,610.021
Test Run 2 details: Total Time In Seconds = 2,716.382
Total Number of Records = 13,000,000,000

TPCx-IoT Performance Metric (IoTps): 4,785,777.55
2.1 Benchmark Kit Identification
The version of the TPCx-IoT kit and checksums for key files are listed below.

<table>
<thead>
<tr>
<th>File</th>
<th>MD5</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPCx-IoT-master.sh</td>
<td>cc24620cfdee08290d771c5471a8d1ee</td>
</tr>
<tr>
<td>tpcx-iot/machbase-binding/lib/core-0.13.0-SNAPSHOT.jar</td>
<td>a03b7d2a9fe20ade6e223a639ae2b8f5</td>
</tr>
<tr>
<td>IoT_cluster_validate_suite.sh</td>
<td>b2342754095f973ce27f43c28d3ca0ae</td>
</tr>
</tbody>
</table>

2.2 Benchmark Kit Changes
No modifications were made to TPC-provided kit.
Clause 3 System Under Test and Benchmark Driver
See files in directory clause3 of supporting files

Clause 4 Scale Factor and Metrics

4.1 Scale Factor, Performance, Price-Performance
The metrics for Run 1 and Run 2 are summarized below.

<table>
<thead>
<tr>
<th></th>
<th>Run 1</th>
<th>Run 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scale Factor</td>
<td>130000000000</td>
<td>130000000000</td>
</tr>
<tr>
<td>Measured Run Time (seconds)</td>
<td>2,870.139</td>
<td>2,716.382</td>
</tr>
<tr>
<td>IoTps</td>
<td>4,529,397.35</td>
<td>4,785,777.55</td>
</tr>
</tbody>
</table>

Run2 Price-Performance: 54.85 $/kIoTps
# Third-Party Price Quotes

NVIDIA Inc.

<table>
<thead>
<tr>
<th>Qty</th>
<th>MoQ</th>
<th>Part Number</th>
<th>Reference Part Number</th>
<th>Description</th>
<th>Term (Year)</th>
<th>Unit Price</th>
<th>Discount (%)</th>
<th>Sale Price</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6</td>
<td>520-N9101-00F7-0C1</td>
<td>M5N2700-C52FC</td>
<td>NVIDIA Spectrum based 100GbE 1U Open Ethernet Switch with Cumulus Linux, 32 QSFP28 ports, 2 Power Supplies (AC), x86 CPU, standard depth, PCIe airflow, Rail Kit</td>
<td></td>
<td>$21,568.00</td>
<td>0.00</td>
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**Net Total** $31,699.00

**NOTES**

- All pricing is in USD and subject to change. Pricing does not include currency conversion fees, taxes or VAT, and other considerations that may affect the final price that you pay.
- Purchase Order Receipt Date AND Customer Request Date (CRD) must be earlier than Quote expiration date.
- Distributor Purchase Order to NVIDIA:
  - Quote number listed in this document must be included and can only be used for one unique order and may not be used in any other orders.
  - All products, quantities, pricing, reseller and end customer information must align with those on the referenced, valid quote.
  - Reseller, Reseller Contact, End Customer information
  - Must include full company name with no acronyms or abbreviations, address, first and last name of the product end customer contact, and a valid email address with a domain that matches the company name.
- Please reference your NVIDIA Price List for all ordering rules.
- This document serves as a pricing information to the Distributor.
- This quotation is subject to the terms and conditions specified in the applicable signed agreement between NVIDIA and Partner. In the absence of such signed agreement, NVIDIA’s Standard Terms & Conditions will apply.
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**Order summary**

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Subtotal: $19,485.00

Continue shopping

Continue to checkout
**Quotation**

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**Total**

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**Remark:**

- Here is a quote for applying a Machbase time series database for TTA.
- Quotation: Machbase Cluster Edition Run-Time License 5 nodes (1Set) and 3 years Maintenance (1 Year for free).
- Maintenance: Free maintenance for one year after the contract, 15% of maintenance rate applied afterwards.
- Payment terms: Cash payment terms. (Within 30 days of issue of tax invoice)
- Server installation condition: It is recommended to separate DB server and Storage server.
- Installation: Cluster Edition - 7 Days, DB Table Guide is separately guided with DB Professional Service.
- Quotation validity period: 120 days from the date of quotation.

Machbase Inc.
Hewlett Packard Inc.

HP M27fw FHD Monitor

- 27" FHD (1920x1080)
- 1080p
- 60Hz
- 3-year Limited Warranty

Can’t find what you’re looking for? See similar products

Price:
$199.99

ADD TO CART

Protect your device with an HP Care Pack

- 1-Year Standard Warranty
- HP 2-Year Next Day Exchange Service for Consumer Monitors
- HP 3-Year Next Day Exchange Service for Consumer Monitors

HP 225 Wired Mouse and Keyboard Combo

- Adjustable keyboard feet
- Three-zone layout
- Ergonomically designed
- Made with recycled materials

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Price:
$21.00

ADD TO CART

In stock. Ships in 1 business day

Add to compare

---

TPCx-IoT 2.1.0
Full Disclosure Report

TTA, Supermicro
Machbase 8.0.1

Report Date
Sep 18, 2023
## Supporting File Index

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<th>Clause</th>
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<td>Clause 3</td>
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