TPC Express Benchmark™ IoT Full Disclosure Report

Machbase 5.7.3

running on

KTNF KR580S1 Servers

with

CentOS Linux 7.6.1810

TPCx-IoT Version 1.0.4
Report Edition First
Report Submitted November 11, 2019
First Edition - November 2019

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Abstract

TTA conducted the TPC Express Benchmark™ IoT (TPCx-IoT) on the KTNF KR580S1. The software used included Machbase 5.7.3. 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 1.0.4.

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</td>
<td>1x KR580S1 (Master)</td>
<td>Machbase 5.7.3</td>
<td>CentOS Linux 7.6.1810</td>
</tr>
<tr>
<td></td>
<td>2x KR580S1 (Data)</td>
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### TPC Express Benchmark™ IoT Metrics

<table>
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<tr>
<th>Metric</th>
<th>Value</th>
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<tr>
<td>Total System Cost (USD)</td>
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</tr>
<tr>
<td>IoTps</td>
<td>1,043,276.60</td>
</tr>
<tr>
<td>USD/IoTps</td>
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</tr>
<tr>
<td>Availability Date</td>
<td>Currently Available</td>
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</tbody>
</table>

### Executive Summary

The Executive Summary follows on the next several pages.
# EXECUTIVE SUMMARY

**Machbase 5.7.3**

<table>
<thead>
<tr>
<th>Total System Cost</th>
<th>TPCx-IoT Performance Metric</th>
<th>Price/Performance</th>
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<tr>
<td>$344,548 USD</td>
<td>1,043,276.60 IoTps</td>
<td>$0.34 USD/IoTps</td>
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</table>

<table>
<thead>
<tr>
<th>Servers</th>
<th>Operating System</th>
<th>Other Software</th>
<th>Availability Date</th>
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<tr>
<td>KTNF KR580S1</td>
<td>CentOS Linux 7.6.1810</td>
<td>None</td>
<td>Currently Available</td>
</tr>
</tbody>
</table>

**System Under Test Configuration Overview**

![25/100Gb Ethernet Switch](image)

**Master Node**

1 x KTNF KR580S1
- 2 x Intel Xeon Gold 6140 2.30GHz
- 12 x 64GB (768GB) Memory
- 2 x 600GB SAS HDD
- 1 x 25Gb 2-Port Ethernet Adaptor

**Data Node**

2 x KTNF KR580S1
- 2 x Intel Xeon Gold 6140 2.30GHz
- 4 x 64GB (256GB) Memory
- 2 x 600GB SAS HDD
- 2 x 1.6TB NVMe SSD
- 1 x 25Gb 2-Port Ethernet Adaptor

<table>
<thead>
<tr>
<th>Total Servers:</th>
<th>3x KR580S1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Processors/Cores/Threads:</td>
<td>6/108/216</td>
</tr>
</tbody>
</table>

**Server Configuration:**
- Processor: 1x KR580S1 (Master); 2x Intel® Xeon® Gold 6140 (2.30GHz, 18-core, 24.75 MB L3)
- Memory: 768 GB
- Storage Controller: Broadcom MEGARAID SAS 9361-8i
- Storage Device: 2x 600 GB 10.5K RPM SAS HDD
- Network Controller: Mellanox MCX4121A-ACAT 25G
- Connectivity: Mellanox MSN2010-CB2F 10/25GbE and 100GbE Switch
- Total Rack Units: (3x KTNF KR580S1) + (1x MSN201-CB2F) = (3x2) + (1x1) = 7 RU

**TPCx-IoT 1.0.4**
**TTA**

Full Disclosure Report Machbase 5.7.3

**Report Date**

November 11, 2019
## Machbase 5.7.3

### Executive Summary

**TPCx-IoT 1.0.4**

**TPC Pricing 2.4.0**

**Report Date**

Nov. 11, 2019

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**Machbase 5.7.3**

**TPCx-IoT 1.0.4**

**Report Date**

Nov. 11, 2019

---

### Pricing:

1 = KTNF Co. Ltd.; 2 = Mellanox Technologies, Ltd.; 3 = Rockplace Inc.; 4 = Machbase Inc.

* Discount applies to all line items where Source = 4.

**Three-Year Cost of Ownership:** $344,548

**IoTps:** 1,043,276.60

**USD/IoTps:** $0.34

---

**Prices used in TPC benchmarks reflect the actual prices a customer would pay for a one-time purchase of the stated Line Items. Individually negotiated discounts are not permitted. Special prices based on assumptions about past or future purchases are not permitted. All discounts reflect standard pricing policies for the listed Line Items. For complete details, see the pricing section of the TPC Benchmark Standard. If you find that the stated prices are not available according to these terms, please inform the TPC at pricing@tpc.org. Thank you.**

---

### Description

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
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<th>List Price</th>
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**Audited by Doug Johnson, InfoSizing**
<table>
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<th>Numerical Quantities</th>
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<td>Scale Factor</td>
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<table>
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<th>Performance Run (Run2)</th>
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</tr>
<tr>
<td>Warmup Run End Time</td>
</tr>
<tr>
<td>Warmup Run Elapsed Time</td>
</tr>
<tr>
<td>Measured Run Start Time</td>
</tr>
<tr>
<td>Measured Run End Time</td>
</tr>
<tr>
<td>Measured Run Elapsed Time</td>
</tr>
<tr>
<td>Performance Metric (IoTps)</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Repeatability Run (Run1)</th>
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<tbody>
<tr>
<td>Warmup Run Start Time</td>
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<td>Warmup Run End Time</td>
</tr>
<tr>
<td>Warmup Run Elapsed Time</td>
</tr>
<tr>
<td>Measured Run Start Time</td>
</tr>
<tr>
<td>Measured Run End Time</td>
</tr>
<tr>
<td>Measured Run Elapsed Time</td>
</tr>
<tr>
<td>Performance Metric (IoTps)</td>
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</table>
Performance Run Report (Run2)

===============================================
TPCx-IoT Performance Metric (IoTps) Report
Test Run2 details : Total Time For Warmup Run In Seconds = 2,059.186
Test Run2 details : Total Time In Seconds = 2,012.889
                   Total Number of Records = 210000000

TPCx-IoT Performance Metric (IoTps): 1043276.6039

===============================================

Repeatability Run Report (Run1)

===============================================
TPCx-IoT Performance Metric (IoTps) Report
Test Run1 details : Total Time For Warmup Run In Seconds = 2,017.764
Test Run1 details : Total Time In Seconds = 1,982.044
                   Total Number of Records = 210000000

TPCx-IoT Performance Metric (IoTps): 1059512.3014

===============================================

Summary details of the run reports are show above. For the complete run reports, see the Supporting Files Archive.
Revised History

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<th>Date</th>
<th>Edition</th>
<th>Description</th>
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<tr>
<td>November 11, 2019</td>
<td>First</td>
<td>Initial Publication</td>
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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 sponsored by Telecommunications Technology Association.

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:** 3
- **Total Processors/Cores/Threads:** 6/108/216
- **Total Memory:** 1.37
- **Total Number of Storage Devices:** 10
- **Total Storage Capacity:** 10.00

**Connectivity:** Mellanox MSN2010-CB2F 10/25GbE and 100GbE Switch

**Server Configurations:**

- **1 x KTNF KR580S1**
  - 2 x Intel Xeon Gold 6140 2.30GHz
  - 12 x 64GB (768GB) Memory
  - 2 x 600GB SAS HDD
  - 1 x 25Gb 2-Port Ethernet Adaptor

- **2 x KTNF KR580S1**
  - 2 x Intel Xeon Gold 6140 2.30GHz
  - 4 x 64GB (256GB) Memory
  - 2 x 600GB SAS HDD
  - 2 x 1.6TB NVMe SSD
  - 1 x 25Gb 2-Port Ethernet Adaptor

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>Controller</th>
<th>Disk Drive</th>
<th>Description of Content</th>
</tr>
</thead>
<tbody>
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<td>Megaraid SAS-3 3108</td>
<td>2 x SAS 600GB HDD</td>
<td>Machbase Broker, Operating System, Root, Swap</td>
</tr>
<tr>
<td>2, 3</td>
<td>Megaraid SAS-3 3108</td>
<td>2 x SAS 600GB HDD</td>
<td>Operating System, Root, Swap</td>
</tr>
<tr>
<td></td>
<td>U.2 PCIe Gen3</td>
<td>2 x 1.6TB NVMe SSD</td>
<td>Machbase Data, coordinator</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>
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<td>1</td>
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<td>3</td>
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<td>X</td>
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Table 1-2 Software Component Distribution Across Nodes

The storage system software used was Machbase 5.7.3.
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 = 2,017.764
Test Run 1 details :  Total Time In Seconds = 1,982.044
                      Total Number of Records = 2100000000

TPCx-IoT Performance Metric (IoTps): 1059512.3014
```

Run Report for Run 2 (Performance Run)

```
TPCx-IoT Performance Metric (IoTps) Report
Test Run 2 details :  Total Time For Warmup Run In Seconds = 2,059.186
Test Run 2 details :  Total Time In Seconds = 2,012.889
                      Total Number of Records = 2100000000

TPCx-IoT Performance Metric (IoTps): 1043276.6039
```
2.3 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>TPC-IoT-master.sh</td>
<td>1dbe4d963fa7321e3df244913b3ef4ae</td>
</tr>
<tr>
<td>tpcx-iot/lib/core-0.13.0-SNAPSHOT.jar</td>
<td>7b8c3de667e60b96bd7611de0525ee65</td>
</tr>
<tr>
<td>IoT_cluster_validate_suite.sh</td>
<td>1d85705de67fb3c767d7a1fe8775275f</td>
</tr>
</tbody>
</table>

2.4 Benchmark Kit Changes
No modifications were made to TPC-provided kit.
Clause 3 Scale Factor and Metrics

3.1 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>2100000000</td>
<td>2100000000</td>
</tr>
<tr>
<td>Measured Run Time (seconds)</td>
<td>1,982.044</td>
<td>2,012.889</td>
</tr>
<tr>
<td>IoTps</td>
<td>1,059,512.30</td>
<td>1,043,276.60</td>
</tr>
</tbody>
</table>

Run2 Price-Performance: 0.34 $/IoTps.
Letter of Attestation

The auditor’s agency name, address, phone number, and Attestation letter must be included in the full disclosure report. A statement should be included specifying who to contact in order to obtain further information regarding the audit process.

This benchmark was audited by Doug Johnson, InfoSizing.

www.sizing.com
63 Lourdes Drive
Leominster, MA 10453
978-343-6562

This benchmark’s Full Disclosure Report (FDR) can be downloaded from www.tpc.org.

A copy of the auditor’s Letter of Attestation follows.
Kihan Choi
Research Engineer
Telecommunications Technology Association (TTA)
Bundang-ro 47, Bundang-gu, Seongnam-city
Gyeonggi-do, 13591, Republic of Korea

October 31, 2019

I verified the TPC Express Benchmark™ IoT v1.0.4 performance of the following configuration:

Platform: KTNF KR58051 (3x KR58051)
Operating System: CentOS Linux 7.6.1810
Storage Software: Machbase 5.7.3

The results were:

**Performance Metric** 1,043,276.60 IoTps
**Run Elapsed Time** 2,012.889 Seconds

**Cluster** 3x KTNF KR58051, each with:
- CPUs: 2x Intel® Xeon® Gold 6140 (2.30 GHz, 18-core, 24.75 MB L3)
- Memory: 768 GB (Master node)
  - 256 GB (Data nodes)
- Storage
  - Qty | Size | Type
  - 2   | 600GB| 10.5K RPM SAS HDD (All nodes)
  - 2   | 1.6TB| NVMe SSD (Data nodes)

In my opinion, these performance results were produced in compliance with the TPC requirements for the benchmark.

The following verification items were given special attention:

- All TPC-provided components were verified to be v1.0.4
- No modifications were made to any of the Java code
- Any and all modifications to shell scripts were reviewed for compliance
- All checksums were validated for compliance
- The generated dataset was properly scaled to 2100000000 rows
- The dataset was protected with a minimum of two-way replication
- The elapsed times for all phases and runs were correctly measured and reported
- The system pricing was verified for major components and maintenance
- The major pages from the FDR were verified for accuracy

Additional Audit Notes:

None.

Respectfully Yours,

[Signature]

Doug Johnson, Certified TPC Auditor
# Third-Party Price Quotes

**KTNF Co., Ltd**

## Contents

1. **General**
   - Overview

2. **Specifications**
   - Product Details

## General

- **Company Name**: KTNF Co., Ltd
- **Location**: [Address]
- **Contact**: [Contact Person] (Mobile: [Phone Number])

## Specifications

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
<th>Quantity</th>
<th>Unit Price</th>
<th>Total Price</th>
</tr>
</thead>
<tbody>
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</tr>
</tbody>
</table>

**Notes**

1. Detailed explanation of each product feature and its importance.
2. Additional notes on product specifications.

---

**TPCx-IoT 1.0.4**

**Report Date**: November 11, 2019

**Machbase 5.7.3**
# Rockplace Inc.

---

**Third Party Price Quotes**

**Full Disclosure Report**

**TPCx-IoT 1.0.4**

**Rockplace, Inc.**

**Machbase 5.7.3**

**Report Date**

**November 11, 2019**

---

### boutique place

135-120 Seoul S. Gangnam-gu Sinseondae-dong 634-10 동랑방동 3층 Tel:02/6251.7788 Fax:02/6251.6677

3F, Yundang bldg, 634-10, Shinsa-dong, Gangnam-gu,Seoul, Korea Tel: 02/6251-7788 Fax: 02/6251-6677

---

**견 적 서**

---

**ITEM DESCRIPTION**

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<th>Part No.</th>
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<td>RSC-LSF3</td>
<td>rockPLACE Support Carepack - Linux Standard (3면) per Server - 3 Year 24x7 4hr response - 기술지원 대상: Cent OS - 이용버전: 패치, 방해점, 정상점검 서비스 - Problem tracking/Emergency assistance - Update, Patch, 작업 지원 - 서비스, 시스템 관리, 네트워크 관리 설정 변경 지원 - 안호 변경, 당능 시험, 비상 복구 관련 지원 - MRG Realtime 기술지원 포함</td>
<td>3</td>
<td>4,614</td>
<td>13,842</td>
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</table>

**소 개 금 액 (Sub Total)**

| | 4,614 |

**합 계**

| | 4,614 |

| 부가세(VAT) | 461 |

**합 계(부가세 포함 with VAT)**

| | 5,075 |

---

### Remarks

1. Cent OS의 경우 벤처가 없는 커뮤니티 Linux로 U1,2 레벨의 기술지원만 가능하며, 벤처(L3 레벨) 기술지원은 불가 있습니다.
2. 벤처 시에는 반드시 고객정보(엔도우 yüksel, 업그레이드, 업프로젝트, Email)가 있어야 합니다.
3. OnSite 방문지원이 필요하실 경우에는 관리자에게 구매하시면 됩니다.

---

TPCx-IoT 1.0.4

Full Disclosure Report

Machbase 5.7.3

Report Date

November 11, 2019
### Quotation

**Doc. No.:** MACH-SALES-20191023-01  
**Date:** 2019-10-25  
**To:** TTA  
**CC:** Mr. KI Han Choi  
**Charge:** Director. Kwang Hoon Shim  
(+82-10-9910-8080)

**Company:** Machbase Inc.  
**Address:** Rn. 304, 273 Digital-ro, Guro-gu Seoul, Korea  
**Tel.:** T: 02-2109-5607  
**F.:** 02-2038-4607

<table>
<thead>
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<th>No.</th>
<th>Content</th>
<th>List Price (USD/Node)</th>
<th>Unit Price (USD/Node)</th>
<th>Quantity</th>
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<th>Tax, Incl. (USD)</th>
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<table>
<thead>
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<td>Guide for Server &amp; Node Configuration</td>
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</table>

**Total:** 248,430  
**273,273**

<< REMARK >>

- Here is a quote for applying a Machbase time series database for TTA.
- Quotation: Machbase Cluster Edition Run-Time License 3 Nodes 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: 90 days from the date of quotation.
## Supporting File Index

<table>
<thead>
<tr>
<th>Clause</th>
<th>Description</th>
<th>Archive Pathname</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clause 1</td>
<td>Parameters and options used to configure and tune the SUT</td>
<td>/Clause1</td>
</tr>
<tr>
<td>Clause 2</td>
<td>Configuration scripts and Run Report</td>
<td>/Clause2</td>
</tr>
<tr>
<td>Clause 3</td>
<td>System configuration details</td>
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</tbody>
</table>