

TPC Benchmark™ E and  
TPC Benchmark™ Energy  
Full Disclosure Report for



**PRIMERGY RX300 S7**

**Using**

**Microsoft SQL Server 2012  
Enterprise Edition**

**Using**

**Microsoft Windows Server 2008 R2  
Enterprise Edition SP1**

**TPC-E Version 1.12.0**

**TPC-Energy Version 1.4.2**

**Submitted for Review**

**July 5, 2012**

## First Edition July 2012

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Benchmark results are highly dependent upon workload, specific application requirements, system design and implementation. Relative system performance will vary as a result of these and other factors. Therefore, TPC Benchmark™ E should not be used as a substitute for a specific customer application benchmark when critical capacity planning and/or product evaluation decisions are contemplated.

All performance data contained in this report were obtained in a rigorously controlled environment. Results obtained in other operating environments may vary significantly. We do not warrant or represent that a user can or will achieve similar performance expressed in transactions per second (tpsE) or normalized price/performance (\$/tpsE). No warranty of system performance or price/performance is expressed or implied in this report.

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## Abstract

This report documents the TPC Benchmark™ E results achieved by Fujitsu using Microsoft SQL Server 2012 Enterprise Edition.



The TPC Benchmark™ E tests were run on a PRIMERGY RX300 S7 system using the Microsoft Windows Server 2008 R2 Enterprise Edition SP1 operating system.

The results, summarized below, show the number of TPC Benchmark™ E transactions per second (tpsE), the price per tpsE (\$/tpsE) and the TPC-Energy (Watts/tpsE).

Hardware	Software	Total System Cost	tpsE	\$ USD/tpsE	Availability Date
Fujitsu PRIMERGY RX300 S7	Microsoft SQL Server 2012 Enterprise Edition Microsoft Windows Server 2008 R2 Enterprise Edition SP1	\$ 328,623 USD	1,871.81	\$ 175.57 USD	August 17, 2012

Hardware	TPC-Energy	Average Power of REC	Idle Power of REC
Fujitsu PRIMERGY RX300 S7	0.69 Watts/tpsE	1,288.82 Watts	843.88 Watts

The benchmark implementation and results were audited by Francois Raab for InfoSizing Inc. ([www.sizing.com](http://www.sizing.com)). The auditor's attestation letter is contained in Section 8 of this report.

		<b>PRIMERGY RX300 S7</b>			<b>TPC-E 1.12.0</b> <b>TPC Pricing 1.7.0</b> <b>TPC-Energy 1.4.2</b>
					Report Date July 5, 2012
TPC-E Throughput <b>1,871.81 tpsE</b>	Price/Performance <b>\$ 175.57 USD</b> <b>per tpsE</b>	Availability Date <b>August 17,</b> <b>2012</b>	Total System Cost <b>\$ 328,623</b>	TPC-Energy Metric <b>0.69 Watts/tpsE</b>	
<b>Database Server Configuration</b>					
Operating System <b>Microsoft Windows Server</b> <b>2008 R2 Enterprise Edition</b> <b>SP1</b>		Database Manager <b>Microsoft SQL Server</b> <b>2012 Enterprise</b> <b>Edition</b>		Processors/Cores/Threads <b>2/16/32</b>	Memory <b>512 GB</b>
<b>SUT</b>					
			<b>Tier A</b> PRIMERGY RX200 S7 1x Intel Xeon E5-2660 2.20 GHz 16 GB Memory 1x 250 GB 7.2k rpm SATA Drive 2x onboard LAN 1 Gb/s 1x Dual Port LAN 1 Gb/s		
			<b>Tier B</b> PRIMERGY RX300 S7 2x Intel Xeon E5-2690 2.90 GHz 512 GB Memory 8x 146 GB 15k rpm SAS Drives 2x onboard LAN 1 Gb/s 5x SAS RAID Controller		
<b>Storage</b> 1x PRIMECENTER Rack 4x ETERNUS JX40 60x 200 GB SSD Drives 2x 1 TB 7.2k rpm SATA Drives					
Initial Database Size <b>7,704 GB</b>		Redundancy Level 1 <b>RAID-5 data and RAID-10 log</b>		Storage <b>60 x 200 GB SSD</b> <b>2 x 1 TB 7.2k rpm HDD</b> <b>6 x 146 GB 15k rpm HDD</b>	



# PRIMERGY RX300 S7

**TPC-E 1.12.0**  
**TPC Pricing 1.7.0**  
**TPC-Energy 1.4.2**

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Description	Part Number	Price Source	Unit Price	Qty	Extended Price	3-yr. Maint. Price
<b>Database Server (Tier B) Hardware</b>						
<b>PRIMERGY RX300S7</b>				1	65,198.00	
PY RX300S7 8x2.5" HDD bays	S26361-K1373-V201			1		
Modular PSU 800W platinum hp	S26113-F574-E10			1		
Power Supply Dummy	S26113-F574-E99			1		
Cable powercord rack, 4m, grey	T26139-Y1968-E100			1		
Intel Xeon E5-2690 8C/16T 2.90 GHz	S26361-F3686-E290			2		
32GB(1x32GB) 4Rx4 L DDR3-1333 LR ECC	S26361-F3698-E517			16		
Performance Mode Installation	S26361-F3694-E2			2		
DVD-RW supermulti slimline SATA	S26361-F3269-E2			1		
HD SAS 6G 146GB 15K HOT PL 2.5" EP	S26361-F4482-E514			8		
RAID Ctrl SAS 6G 1GB (D3116)	S26361-F3669-E1			1		
RAID Ctrl SAS 6G 8Port ex 1GB FH/LP LSI	S26361-F3713-L501			4		
Rack-Mount Kit F1-C S7 LV	S26361-F2735-E175			1		
Rack Cable Arm 2U	S26361-F2735-E82			1		
Mounting in symmetrical Racks	S26361-F4530-E10			1		
region kit APAC/America/EMEA/Indien	S26361-F1452-E100			1		
PRIMERGY RX300S7 Installation, normal business hours	PYR300-N038005-0NA		350.00	1		350.00
PYRX300 Series Warranty Uplift, 36 Months, Enhanced Plus Level, 24x7 4hr Onsite, Prepaid billing (PYR300-U004361-0NA)	PYR300-U004361-0NA		931.00	1		931.00
				<b>Subtotal (*)</b>	65,198.00	1,281.00
<b>Storage</b>						
<b>PRIMECENTER RACK</b>				1	2,400.00	
PRIMECENTER M1 Rack 724S 24U-1050x700	S26361-K827-V220			1	2,400.00	
Dummy panel, plastics, 1U + assembly	S26361-F4530-L131			3		
Dummy panel, plastics, 2U + assembly	S26361-F4530-L132			6		
Socket strip 3phase 3x 8 sockets	S26361-F2262-L31		210.00	1	210.00	
PYPRIMECENTER Warranty Uplift, 36 Months, Enhanced Plus Level, 24x7 4hr Onsite, Prepaid billing (PYPCTR-U004361-0NA)	PYPCTR-U004361-0NA		720.00	1		720.00
<b>ETERNUS JX40</b>				1	2,611.00	
ETERNUS JX40	FTS:ETJXS11BG			4	10,444.00	
PRIMERGY Rackinstallation SX/DX ex works	D:FCSX-INPSR			4		
SSD SAS 6G 200 GB MLC NO HP 2.5" EP PERF	S26361-F4581-L200		3,350.00	60	201,000.00	
SAS CABLE 1X SFF 8088-1X SFF 8088 2M	D:KBSAS1S-1S-2M		70.00	4	280.00	
HD SATA 1000 GB 2.5"	S26361-F3601-L100		510.00	2	1,020.00	
PYJX40 Warranty Uplift, 12 Months, Enhanced Plus Level, 24x7x365 Phone Support (Sev1 - Live Transfer), 24x7x365 Onsite and Parts (Sev1 Resp. Time - 4 Hours), Incl. Holidays, Prepaid billing	PYJX40-U004121-0NA		609.00	4		2,436.00
PYJX40 Post Warranty, 24 Months, Enhanced Plus Level, 24x7x365 Phone Support (Sev1 - Live Transfer), 24x7x365 Onsite and Parts (Sev1 Resp. Time - 4 Hours), Incl. Holidays, Prepaid billing	PYJX40-P004241-0NA		1,218.00	4		4,872.00
PYJX40 during normal business hours, Primergy storage installation, One Time billing	PYJX40-N043005-0NA		450.00	4		1,800.00
				<b>Subtotal(*)</b>	215,354.00	9,828.00



# PRIMERGY RX300 S7

**TPC-E 1.12.0**  
**TPC Pricing 1.7.0**  
**TPC-Energy 1.4.2**

Report Date  
 July 5, 2012

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Database Server (Tier B) Software							
SQL Server 2012 Enterprise Edition 2Core License	7JQ-00256	2	13,472.50	8	107,780.00		
Windows Server 2008 R2 Enterprise Edition	P72-04217	2	2,280.00	1	2,280.00		
Microsoft Problem Resolution Services	n/a	2	259.00	1			259.00
				<b>Subtotal</b>	<b>110,060.00</b>		<b>259.00</b>
Application Server (Tier A) Hardware							
<b>Primergy RX200 S7</b>							
PY RX200 S7, 4x2.5	S26361-K1386-V101	1	4,274.00	1	4,274.00		
Modulare SV 450W platin hp	S26113-F575-E10	1		1			
Power Supply Dummy	S26113-F574-E99	1		1			
Intel Xeon E5-2660 8C/16T 2.20 GHz 20MB	S26361-F3691-E220	1		1			
4GB (1x4GB) 2Rx8 L DDR3-1600 U ECC	S26361-F3694-E514	1		4			
Performance Mode Installation	S26361-F3694-E2	1		1			
DVD-RW supermulti slimline SATA	S26361-F3269-E2	1		1			
HD SATA 6G 250GB 7.2K HOT PL 2.5" BC	S26361-F3708-E250	1		1			
Eth Ctrl 2x1Gbit PCIe x4 D2735-2 Cu lp	S26361-F3610-E202	1		1			
Rack Mount Kit F1-C S7 LV	S26361-F2735-E175	1		1			
Rack Cable Arm 1U	S26361-F2735-E81	1		1			
Cable pow ercord rack, 4m, grey	T26139-Y1968-E100	1		1			
Mounting in symmetrical Racks	S26361-F4530-E10	1		1			
region kit APAC/America/EMEA/Indien	S26361-F1452-E100	1		1			
PRIMERGY RX200S7 Installation, normal business hours	PYR200-N038005-ONA	1	200.00	1			200.00
PYRX200 Series Warranty Uplift, 36 Months, Enhanced Plus Level, 24x7 4hr Onsite, Prepaid billing (PYR300-U004361-ONA)	PYR200-U004361-ONA	1	750.00	1			750.00
				<b>Subtotal(*)</b>	<b>4,274.00</b>		<b>950.00</b>
Application Server (Tier A) Software							
Windows Server 2008 R2 Standard x64 Edition	P73-04165	2	711.00	1	711.00		
				<b>Subtotal</b>	<b>711.00</b>		
Miscellaneous							
DISPLAY B20T-6 LED (incl 2spares)	S26361-K1416-V140	1	187.20	3	561.60		
Infrastructure or Connectivity							
KB400 USB grey INT USA (incl 2 spares)	S26381-K550-E102	1	14.00	3	42.00		
Mouse M480 grey (incl 2 spares)	S26381-K431-E101	1	8.00	3	24.00		
LAN-CAT 5 Enhanced, l=3m	T26139-Y2425-M3	1	5.00	2	10.00		
				<b>Subtotal(*)</b>	<b>637.60</b>		<b>0.00</b>
				<b>Total</b>	<b>396,234.60</b>		<b>12,318.00</b>
Dollar Volume Discount (see Notes)		28%	1		79,929.81		
					<b>316,304.79</b>		

Notes:	<b>Three-Year Cost of Ownership USD</b>	\$328,623
Price Source: 1=Fujitsu, 2=Microsoft Corporation	<b>TPC-E Throughput</b>	1,871.81
Discount applies to all subtotal marked with(*) .	<b>\$ USD/tpsE</b>	\$175.57
Pricing is for these or similar quantities. Discounts for similiary sized configurations w ill be similar to what is quoted here, but may vary based on the specific components priced.		

The benchmark results and test methodology were audited by Francois Raab for InfoSizing Inc. (www.sizing.com)

Prices used in TPC benchmarks reflect the actual prices a customer would pay for a one-time purchase of the stated components. 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 components. For complete details, see the pricing section of the TPC benchmark pricing specifications. If you find that the stated prices are not available according to these terms, please inform the TPC at pricing@tpc.org. Thank you.



# PRIMERGY RX300 S7

**TPC-E 1.12.0**  
**TPC Pricing 1.7.0**  
**TPC-Energy 1.4.2**

Report Date  
 July 5, 2012

Availability Date  
 August 17, 2012

## Numerical Quantities Summary

Reported Throughput:	1,871.81 tpsE	Configured Customers:	940,000	
Response Times (in seconds)	Minimum	Average	90th%tile	Maximum
Broker Volume	0.00	0.01	0.03	0.39
Customer Position	0.00	0.01	0.02	0.97
Market Feed	0.00	0.01	0.02	1.01
Market Watch	0.00	0.01	0.02	1.00
Security Detail	0.00	0.01	0.01	0.61
Trade Lookup	0.00	0.07	0.11	1.22
Trade Order	0.00	0.03	0.05	0.96
Trade Result	0.00	0.03	0.05	0.98
Trade Status	0.00	0.01	0.02	0.93
Trade Update	0.01	0.08	0.12	1.22
Data Maintenance	0.00	0.02	N/A	0.05
Transaction Mix	Transaction Count		Mix %	
Broker Volume	6,603,955		4.900%	
Customer Position	17,520,233		13.000%	
Market Feed	1,347,712		1.000%	
Market Watch	24,258,833		18.000%	
Security Detail	18,867,950		14.000%	
Trade Lookup	10,781,456		8.000%	
Trade Order	13,611,846		10.100%	
Trade Result	13,477,103		10.000%	
Trade Status	25,606,833		19.000%	
Trade Update	2,695,416		2.000%	
Data Maintenance	120		N/A	
Test Duration and Timings				
Ramp-up Time (hh:mm:ss)	00:26:15			
Measurement Interval (hh:mm:ss)	02:00:00			
Business Recovery Time (hh:mm:ss)	00:13:29			
Total Number of Transactions Completed	134,771,337			

<b>PRIMERGY RX300 S7</b>	<b>Energy Summary</b>		<b>TPC-E 1.12.0 TPC Pricing 1.7.0 TPC-Energy 1.4.2</b>
			Report Date July 5, 2012
			Availability Date August 17, 2012

TPC-E Throughput <b>1,871.81 tpsE</b>	Price/Performance <b>\$ 175.57 USD</b> per tpsE	Availability Date <b>August 17,</b> <b>2012</b>	Total System Cost <b>\$ 328,623</b>	TPC-Energy Metric <b>0.69 Watts/tpsE</b>
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**Numerical Quantities For Reported Energy Configuration:**

**REC Idle Power: 843.88 Watts**  
**Average Power of REC : 1,288.82 Watts**

**Subsystem Reporting:**

	Secondary Metrics	Additional Numerical Quantities			
	watts/tpsE	Full Load Avg Watts	Full Load % of REC	Idle Avg Watts	Idle % of REC
<b>Database Server *)</b>	0.32	592.41	45.97%	239.56	28.39%
<b>Storage *)</b>	0.31	578.42	44.88%	544.80	64.56%
<b>Application Server *)</b>	0.05	100.99	7.84%	59.12	7.01%
<b>Miscellaneous *)</b>	0.01	17.00	1.32%	0.40	0.05%
<b>Total REC</b>	0.69	1,288.82	100.00%	843.88	100.00%

\*) see pricing for list of components

**Lowest ambient temperature at air inlet: 20.13 Degrees Celsius**

**Items in Priced Configuration not in the Reported Energy Configuration**  
**None**

**Items in the Reported Energy Configuration not in the Measured Energy Configuration**  
**Fujitsu Display B20T-6 LED**



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# Clause 0: Preamble

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## Introduction

TPC Benchmark™ E (TPC-E) is an On-Line Transaction Processing (OLTP) workload. It is a mixture of read-only and update intensive transactions that simulate the activities found in complex OLTP application environments. The database schema, data population, transactions, and implementation rules have been designed to be broadly representative of modern OLTP systems. The benchmark exercises a breadth of system components associated with such environments, which are characterized by:

- The simultaneous execution of multiple transaction types that span a breadth of complexity; Moderate system and application execution time;
- A balanced mixture of disk input/output and processor usage; Transaction integrity (ACID properties);
- A mixture of uniform and non-uniform data access through primary and secondary keys;
- Databases consisting of many tables with a wide variety of sizes, attributes, and relationships with realistic content;
- Contention on data access and update.

The TPC-E operations are modelled as follows: The database is continuously available 24 hours a day, 7 days a week, for data processing from multiple Sessions and data modifications against all tables, except possibly during infrequent (e.g., once a month) maintenance Sessions. Due to the worldwide nature of the application modelled by the TPC-E benchmark, any of the transactions may be executed against the database at anytime, especially in relation to each other.

## Goal of the TPC-E Benchmark

The TPC-E benchmark simulates the OLTP workload of a brokerage firm. The focus of the benchmark is the central database that executes transactions related to the firm's customer accounts. In keeping with the goal of measuring the performance characteristics of the database system, the benchmark does not attempt to measure the complex flow of data between multiple application systems that would exist in a real environment. The mixture and variety of transactions being executed on the benchmark system is designed to capture the characteristic components of a complex system. Different transaction types are defined to simulate the interactions of the firm with its customers as well as its business partners. Different transaction types have varying run-time requirements.

The benchmark defines:

- Two types of transactions to simulate Consumer-to-Business as well as Business-to-Business activities
- Several transactions for each transaction type
- Different execution profiles for each transaction type
- A specific run-time mix for all defined transactions

For example, the database will simultaneously execute transactions generated by systems that interact with customers along with transactions that are generated by systems that interact with financial markets as well as administrative systems. The benchmark system will interact with a set of driver systems that simulate the various sources of transactions without requiring the benchmark to implement the complex environment.

The Performance Metric reported by TPC-E is a "business throughput" measure of the number of completed Trade-Result transactions processed per second (see Clause 6.7.1). Multiple Transactions are used to simulate the business activity of processing a trade, and each Transaction is subject to a Response Time constraint. The Performance Metric for the benchmark is expressed in transactions-per-second-E (tpsE). To be compliant with the TPC-E standard, all references to tpsE Results must include the tpsE rate, the associated price-per-tpsE, and the Availability Date of the Priced Configuration (See Clause 6.7.3 for more detail).

Although this specification defines the implementation in terms of a relational data model, the database may be implemented using any commercially available Database Management System (DBMS), Database Server, file system, or other data repository that provides a functionally equivalent implementation. The terms "table", "row", and "column" are used in this document only as examples of logical data structures.

TPC-E uses terminology and metrics that are similar to other benchmarks, originated by the TPC and others. Such similarity in terminology does not imply that TPC-E Results are comparable to other benchmarks. The only benchmark Results comparable to TPC-E are other TPC-E Results that conform to a comparable version of the TPC-E specification.

## **Restrictions and Limitations**

Despite the fact that this benchmark offers a rich environment that represents many OLTP applications, this benchmark does not reflect the entire range of OLTP requirements. In addition, the extent to which a customer can achieve the Results reported by a vendor is highly dependent on how closely TPC-E approximates the customer application. The relative performance of systems derived from this benchmark does not necessarily hold for other workloads or environments. Extrapolations to any other environment are not recommended.

Benchmark Results are highly dependent upon workload, specific application requirements, and systems design and implementation. Relative system performance will vary because of these and other factors. Therefore, TPC-E should not be used as a substitute for specific customer application benchmarking when critical capacity planning and/or product evaluation decisions are contemplated.

Benchmark Sponsors are permitted various possible implementation designs, insofar as they adhere to the model described and pictorially illustrated in this specification. A Full Disclosure Report (FDR) of the implementation details, as specified in Clause 9.1, must be made available along with the reported Results.

## Clause 1: Overview

---

### **Order and Titles**

*The order and titles of sections in the Report and Supporting Files must correspond with the order and titles of sections from the TPC-E Standard Specification (i.e., this document). The intent is to make it as easy as possible for readers to compare and contrast material in different Reports (9.1.1.1).*

The order and titles in this report correspond to those in the TPC-E specification.

### **Executive Summary Statement**

*The TPC Executive Summary Statement must be included near the beginning of the Report (9.2).*

The Executive summary has been included near the beginning of this FDR.

### **Benchmark Sponsor**

*A statement identifying the benchmark sponsor(s) and other participating companies must be provided (9.3.1.1).*

Fujitsu is the sponsor of this TPC Benchmark™ E result.

## Configuration Diagram

Diagrams of both measured and Priced Configurations must be reported in the Report, accompanied by a description of the differences (9.3.1.2).

The measured and priced configurations are shown in the following figures. There are differences between both configurations at additional storage used for database setup and backup in the measured configuration. This storage is not used during measurement and not required for pricing.

Figure 1-1: Priced Configuration



### Tier A

PRIMERGY RX200 S7  
1x Intel Xeon E5-2660 2.20 GHz  
16 GB Memory  
1x 250 GB 7.2k rpm SATA Drive  
2x onboard LAN 1 Gb/s  
1x Dual Port LAN 1 Gb/s

### Tier B

PRIMERGY RX300 S7  
2x Intel Xeon E5-2690 2.90 GHz  
512 GB Memory  
8x 146 GB 15k rpm SAS Drives  
2x onboard LAN 1 Gb/s  
5x SAS RAID Controller

### Storage

1x PRIMECENTER Rack  
4x ETERNUS JX40  
60x 200 GB SSD Drives  
2x 1 TB 7.2k rpm SATA Drives

Figure 1-2: Measured Configuration



#### **Tier A**

PRIMERGY RX200 S7  
1x Intel Xeon E5-2660 2.20 GHz  
16 GB Memory  
1x 250 GB 7.2k rpm SATA Drive  
2x onboard LAN 1 Gb/s  
1x Dual Port LAN 1 Gb/s

#### **Tier B**

PRIMERGY RX300 S7  
2x Intel Xeon E5-2690 2.90 GHz  
512 GB Memory  
8x 146 GB 15k rpm SAS Drives  
2x onboard LAN 1 Gb/s  
5x SAS RAID Controller

#### **Storage**

1x PRIMECENTER Rack  
4x ETERNUS JX40  
60x 200 GB SSD Drives  
2x 1 TB 7.2k rpm SATA Drives  
14x FibreCat SX40  
120x 146 GB 15k rpm SAS Drives  
48x 73 GB 15k rpm SAS Drives

## **Hardware Configuration**

*A description of the steps taken to configure all the hardware must be reported in the Report (9.3.1.4).*

### **Driver**

The driver system is not part of the System Under Test (SUT) and priced configuration. This system was connected with Tier A system, using onboard LAN with 2 x 1 Gb/s Ethernet. There are two LAN segments for these connections.

### **Tier A**

The Tier A server is a Fujitsu PRIMERGY RX200 S7 with one Intel Xeon E5-2660 Eight-Core Processor and 16 GB of memory. One SATA 250 GB 7.2k rpm disk drive is connected to the onboard controller. One 1 Gb/s dual port Ethernet LAN card is plugged in the PCI-E slot. Each of the two ports is directly connected with one of the 1 Gb/s Ethernet onboard LAN ports of Tier B using a LAN crossover cable. There are two LAN segments for these connections. The two onboard 1 Gb/s LAN ports are used for driver connection.

## **Tier B**

The Tier B or database server is a Fujitsu PRIMERGY RX300 S7 with two Intel Xeon E5-2690 Eight-Core Processors and 512 GB memory. All of the eight onboard 2.5" disk bays are used with 8x SAS 146 GB 15k rpm disk drives and RAID controller SAS 6G 1GB (D3116). Two drives are configured with RAID1 for OS and database. Six drives are configured with RAID10 for database log. Four RAID controllers SAS 6G 8Port ex 1GB are used to connect the external disk drives to the server. The controller cache of all 5 RAID controllers is configured with Write Through. The two onboard 1 Gb/s Ethernet LAN ports are connected to the Tier A system as described above.

## **Storage**

4 Fujitsu ETERNUS JX40 are used, each with 15x 200GB SSD 2.5" RAID5. One of these Fujitsu ETERNUS JX40 is used with additional 2x SATA 1TB 7.2k rpm HDD 2.5" RAID 1. The enclosures are connected to the controllers SAS 6G 8Port ex 1GB. For details see table 2-2 Disk Configuration. The disk configuration can be done with the ServerView RAID Manager, which is shipped on ServerStart DVD together with the Server.

## **Software Configuration**

*A description of the steps taken to configure all the software must be reported in the Report (9.3.1.5).*

The default installation of the operating system was executed on Tier A and B as well as the installation of the database SW on Tier B and the database client connectivity on Tier A. Information about changes to the software, settings and BenchCraft can be found in the SupportingFiles directory Introduction - Software. SQL Server 2012 has been updated with cumulative update package 1. For details and how to obtain the SW see <http://support.microsoft.com/kb/2679368>.



## Clause 2: Database Design, Scaling and Population

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### Database Creation

*A description of the steps taken to create the database for the Reported Throughput must be reported in the Report (9.3.2).*

*The physical organization of tables and indices, within the database, must be reported in the Report. (9.3.2.1)*

The database has been created for 940,000 customers. The SQL Server scripts and setup command files are included in the SupportingFiles\Clause2 folder. Two file groups are used for the tables and indices. The distribution is shown in table 2-1.

### Partitioning

*While few restrictions are placed upon horizontal or vertical partitioning of tables and rows in the TPC-E benchmark (see Clause 2.3.3), any such partitioning must be reported in the Report.(9.3.2.2)*

There is no partitioning implemented in this configuration.

### Replication and Duplicated Attributes

*Replication of tables, if used, must be reported in the Report (9.3.2.3).*

*Additional and/or duplicated attributes in any table must be reported in the Report along with a statement on the impact on performance (9.3.2.4).*

There is no replication implemented in this configuration.  
No duplications or additional attributes were used.

## Cardinality of Tables

The cardinality (e.g. the number of rows) of each table, as it existed after database load (see Clause 2.6), must be reported in the Report (9.3.2.5).

The database was configured for 940,000 customers. The cardinality of the tables after database load is as shown in the following table 2-1.

Table 2-1: Table Cardinality and File Groups

Table	Cardinality after database load	File Group
ACCOUNT_PERMISSION	6673826	1
ADDRESS	1410004	1
BROKER	9400	1
CASH_TRANSACTION	14943737411	2
CHARGE	15	1
COMMISSION_RATE	240	1
COMPANY	470000	1
COMPANY_COMPETITOR	1410000	1
CUSTOMER	940000	1
CUSTOMER_ACCOUNT	4700000	1
CUSTOMER_TAXRATE	1880000	1
DAILY_MARKET	840289500	1
EXCHANGE	4	1
FINANCIAL	9400000	1
HOLDING	831690350	2
HOLDING_HISTORY	21768468686	2
HOLDING_SUMMARY	46752556	2
INDUSTRY	102	1
LAST_TRADE	643900	1
NEWS_ITEM	940000	1
NEWS_XREF	940000	1
SECTOR	12	1
SECURITY	643900	1
SETTLEMENT	16243200000	2
STATUS_TYPE	5	1
TAXRATE	320	1
TRADE	16243200000	2
TRADE_HISTORY	38983684215	2
TRADE_REQUEST	0	2
TRADE_TYPE	5	1
WATCH_ITEM	94014652	1
WATCH_LIST	940000	1
ZIP_CODE	14741	1

## Distribution of Tables, Partitions and Logs

The distribution of tables, partitions and logs across all media must be explicitly depicted for the measured and Priced Configurations (9.3.2.6).

Table 2-2: Disk Configuration

HBA - Port	Disk	Drives	Partition	Size	Use
Ctrl 0	0 – onboard	2x146GB 15k rpm SAS, RAID1	C:\	136 GB	OS, DB
	1 – onboard	6x146GB 15k rpm SAS, RAID10	L:\	409 GB	DB Log
Ctrl 1 Port 0	2 – JX40	15x200GB SSD, RAID5	C:\jp\tpce011	21.5 GB	Filegroup1
			C:\jp\tpce012	846.4GB	Filegroup2
			C:\jp\tpce021	21.5 GB	Filegroup1
			C:\jp\tpce022	846.4GB	Filegroup2
			C:\jp\tpce031	21.5 GB	Filegroup1
C:\jp\tpce032	846.5GB	Filegroup2			
Ctrl 1 Port 1	3 – SX40	12x146GB, 15k rpm SAS, RAID5	C:\jp\help01	1498 GB	DB setup Backup
	4 – SX40	12x146GB, 15k rpm SAS, RAID5	C:\jp\help02	1498 GB	DB setup Backup
	5 – SX40	12x146GB, 15k rpm SAS, RAID5	C:\jp\help03	1498 GB	DB setup Backup
Ctrl 2 Port 0	6 – JX40	15x200GB SSD, RAID5	C:\jp\tpce041	21.5 GB	Filegroup1
			C:\jp\tpce042	846.4GB	Filegroup2
			C:\jp\tpce051	21.5 GB	Filegroup1
			C:\jp\tpce052	846.4GB	Filegroup2
			C:\jp\tpce061	21.5 GB	Filegroup1
			C:\jp\tpce062	846.5GB	Filegroup2
Ctrl 2 Port 1	7 – SX40	12x146GB, 15k rpm SAS, RAID5	C:\jp\help04	1498 GB	DB setup Backup
	8 – SX40	12x146GB, 15k rpm SAS, RAID5	C:\jp\help05	1498 GB	DB setup Backup
	9 – SX40	24x73GB, 15k rpm SAS, RAID5	C:\jp\help06	1560 GB	DB setup Backup
Ctrl 3 Port 0	10 – JX40	15x200GB SSD, RAID5	C:\jp\tpce071	21.5 GB	Filegroup1
			C:\jp\tpce072	846.4GB	Filegroup2
			C:\jp\tpce081	21.5 GB	Filegroup1
			C:\jp\tpce082	846.4GB	Filegroup2
			C:\jp\tpce091	21.5 GB	Filegroup1
			C:\jp\tpce092	846.5GB	Filegroup2
Ctrl 3 Port 1	11 – SX40	12x146GB, 15k rpm SAS, RAID5	C:\jp\help07	1498 GB	DB setup Backup
	12 – SX40	12x146GB, 15k rpm SAS, RAID5	C:\jp\help08	1498 GB	DB setup Backup
	13 – SX40	12x146GB, 15k rpm SAS, RAID5	C:\jp\help09	1498 GB	DB setup Backup
Ctrl 4 Port 0	14 – JX40	15x200GB SSD, RAID5	C:\jp\tpce101	21.5 GB	Filegroup1
			C:\jp\tpce102	846.4GB	Filegroup2
			C:\jp\tpce111	21.5 GB	Filegroup1
			C:\jp\tpce112	846.4GB	Filegroup2
			C:\jp\tpce121	21.5 GB	Filegroup1
			C:\jp\tpce122	846.5GB	Filegroup2
	C:\jp\addon	931.0GB	DB addon		
18 – SX40	2x1TB 7.2k rpm SATA, RAID1				
Ctrl 4 Port 1	15 – SX40	12x146GB, 15k rpm SAS, RAID5	C:\jp\help10	1498 GB	DB setup Backup
	16 – SX40	12x146GB, 15k rpm SAS, RAID5	C:\jp\help11	1498 GB	DB setup Backup
	17 – SX40	24x73GB, 15k rpm SAS, RAID5	C:\jp\help12	1560 GB	DB setup Backup

## **Database Interface, Data Model and Load Methodology**

*A statement must be provided in the Report that describes:*

*The Database Interface (e.g., embedded, call level) and access language (e.g., SQL, COBOL read/write) used to implement the TPC-E Transactions. If more than one interface / access language is used to implement TPC-E, each interface / access language must be described and a list of which interface /access language is used with which Transaction type must be reported.*

*The data model implemented by the DBMS (e.g., relational, network, hierarchical) (9.3.2.7).*

*The methodology used to load the database must be reported in the Report (9.3.2.8).*

Microsoft SQL Server 2012 Enterprise Edition is a relational database. The interface used was Microsoft SQL Server stored procedures accessed with Remote Procedure Calls embedded in C++ code using the Microsoft ODBC interface.

The methodology used to load the database is described in Clause2 of the SupportingFiles directory.

## Clause 3: Transactions

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### Vendor-Supplied Code

*A statement that vendor-supplied code is functionally equivalent to Pseudo-code in the specification (see Clause 3.2.1.6) must be reported in the Report (9.3.3.1).*

The vendor supplied code is functionally equivalent to the pseudo-code.

### Database Footprint Requirements

*A statement that the database footprint requirements (as described in Clause 3.3) were met must be reported in the Report (9.3.3.2).*

Database footprint requirements were met as described in the specification.

## Clause 4: SUT, Driver and Network

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### Network Configuration

*The Network configurations of both the measured and Priced Configurations must be described and reported in the Report. This includes the mandatory Network between the Driver and Tier A (see Clause 4.2.2) and any optional Database Server interface networks (9.3.4.2):*

Figures 1-1 and 1-2 show the configuration of the measured and priced configurations. Both are identical in case of the network configuration. Tier B system PRIMERGY RX300 S7 has an onboard Ethernet controller with two 1Gb/s ports. Tier A system PRIMERGY RX200 S7 has an onboard Ethernet controller with two 1Gb/s ports used for driver system connection. Tier A system was extended with one dual-port 1Gb/s Ethernet controller card. These two ports were directly connected with the two onboard ports of Tier B using different LAN segments.

## Clause 5: EGen

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### **EGen Version**

*The version of EGen used in the benchmark must be reported (9.3.5.1).*

The EGen version used was 1.12.0.

### **EGen Code**

*A statement that all required TPC-provided EGen code was used in the benchmark must be reported (9.3.5.2).*

All the required TPC-provided code was used in the benchmark.

### **EGen Modifications**

*If the Test Sponsor modified EGen, a statement EGen has been modified must be reported in the Report. All formal waivers from the TPC documenting the allowed changes to EGen must also be reported in the Report (see Clause 5.3.7.1). If any of the changes to EGen do not have a formal waiver that must also be reported (9.3.5.3). If the Test Sponsor extended EGenLoader (as described in Appendix A.6), the use of the extended EGenLoader and the audit of the extension code by an Auditor must be reported (9.3.5.4).*

There were no modifications to the EGen. EGenLoader was not extended for this benchmark.

## Clause 6: Performance Metrics and Response time

### EGen Driver

The number of EGenDriverMEE and EGenDriverCE instances used in the benchmark must be reported in the Report (see Clause 6.2.5) (9.3.1.1).

One Tier A system was used and configured to drive 16 EGenDriverMEE and 16 EGenDriverCE instances.

### Measured Throughput

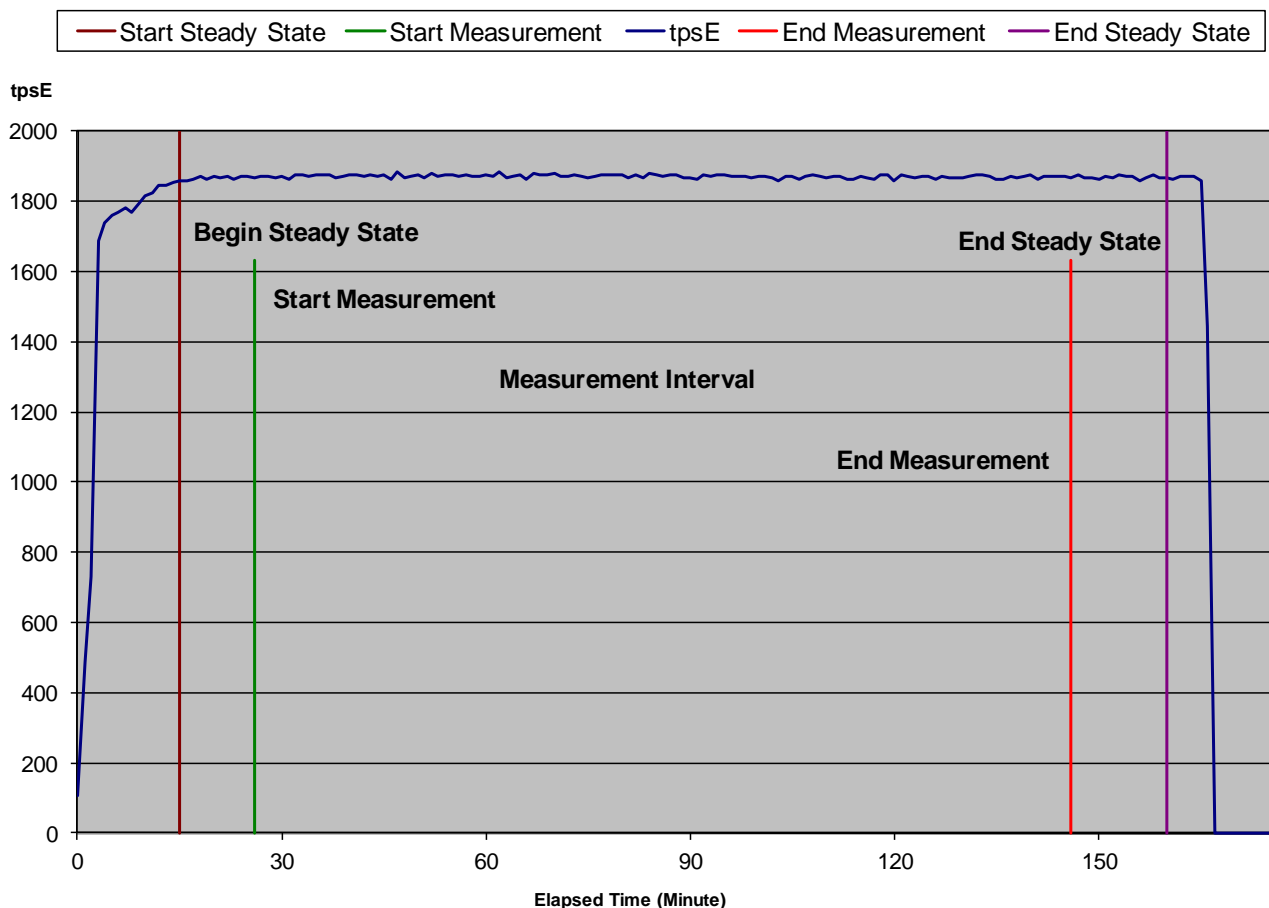
The Measured Throughput must be reported in the Report (see Clause 6.7.1.2) (9.3.6.2).

The measured throughput was 1,871.81 tpsE.

### Test Run Graph

A Test Run Graph of throughput versus elapsed wall clock time must be reported in the Report for the Trade-Result Transaction (see Clause 6.7.2) (9.3.6.3).

Figure 6-1: Test Run Graph





## Steady State

*The method used to determine that the SUT had reached a Steady State prior to commencing the Measurement Interval must be reported in the Report (9.3.6.4).*

During the run the tpsE throughput was observed to determine steady state. After the run steady state was confirmed by:

1. Looked at the Test Run Graph and verified that tpsE was steady prior to commencing the Measurement Interval.
2. Calculated 60 minute average tpsE during the Steady State moving the time window 10 minutes each time. Then confirmed that the minimum 60 minute average tpsE was not less than 98% of the Reported Throughput, and that the maximum 60 minute average tpsE was not greater than 102% of the Reported Throughput.
3. Calculated 10 minute average tpsE during the Steady State moving the window 1 minute each time. Then confirmed that the minimum 10 minute average tpsE was not less than 80% of the Reported Throughput, and that the maximum 10 minute average tpsE was not greater than 120% of the Reported Throughput.
4. Two completed full checkpoints.

## Work Performed During Steady State

*A description of how the work normally performed during a Test Run, actually occurred during the Measurement Interval must be reported in the Report (for example checkpointing, writing Undo/Redo Log records, etc.) (9.3.6.5).*

The Microsoft SQL Server recovery interval parameter was set to the maximum allowable value to perform checkpoint at specific intervals. Checkpoints were automatically issued at specified intervals (448 seconds) and specified duration (435 seconds). SQL Server was started with trace flag 3502, which caused it to log the occurrence of the checkpoints. This information was used to verify that the checkpoints occurred at the appropriate times and duration during steady state.

## Transaction Input Parameter Averages

The recorded averages over the Measurement Interval for each of the Transaction input parameters specified by clause 6.4.1 must be reported (9.3.6.6).

Table 6-2: Transaction Input Parameter Averages.

Transaction	Parameter	Range Min	Range Max	Value	Check
Customer Position	By Tax ID	48.00%	52.00%	50.03%	Ok
	Get History	48.00%	52.00%	50.00%	Ok
	Overall				Ok
Market Watch	By Watch List	57.00%	63.00%	60.01%	Ok
	By Customer Account	33.00%	37.00%	34.99%	Ok
	By Industry	4.50%	5.50%	5.01%	Ok
	Overall				Ok
Security Detail	Access LOB	0.90%	1.10%	1.00%	Ok
	Overall				Ok
Trade Lookup	Frame 1	28.50%	31.50%	29.99%	Ok
	Frame 2	28.50%	31.50%	30.01%	Ok
	Frame 3	28.50%	31.50%	30.00%	Ok
	Frame 4	9.50%	10.50%	10.00%	Ok
	Overall				Ok
Trade Update	Frame 1	31.00%	35.00%	32.98%	Ok
	Frame 2	31.00%	35.00%	33.00%	Ok
	Frame 3	32.00%	36.00%	34.02%	Ok
	Overall				Ok
Trade Order	By Non-Owner	9.50%	10.50%	9.99%	Ok
	By Company Name	38.00%	42.00%	39.99%	Ok
	Buy On Margin	7.50%	8.50%	8.01%	Ok
	Rollback	0.94%	1.04%	0.99%	Ok
	LIFO	33.00%	37.00%	34.97%	Ok
	Trade Qty 100	24.00%	26.00%	25.01%	Ok
	Trade Qty 200	24.00%	26.00%	24.99%	Ok
	Trade Qty 400	24.00%	26.00%	25.00%	Ok
	Trade Qty 800	24.00%	26.00%	25.01%	Ok
	Market Buy	29.70%	30.30%	30.00%	Ok
	Market Sell	29.70%	30.30%	30.02%	Ok
	Limit Buy	19.80%	20.20%	20.00%	Ok
	Limit Sell	9.90%	10.10%	9.99%	Ok
	Stop Loss	9.90%	10.10%	9.98%	Ok
Overall				Ok	

## Clause 7: Transaction and System Properties

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### ACID Tests

*The results of the ACID tests must be reported in the Report along with a description of how the ACID requirements were met, and how the ACID tests were run (9.3.7.1).*

The TPC Benchmark™ E Standard Specification defines a set of transaction processing system properties that a system under test (SUT) must support during the execution of the benchmark. Those properties are Atomicity, Consistency, Isolation and Durability (ACID). This section quotes the specification definition of each of those properties and describes the tests done as specified and monitored by the auditor, to demonstrate compliance. See also file MSTPCE ACID Procedures.pdf in the SupportingFiles directory.

### Redundancy Level and Data Accessibility

*The Test Sponsor must report in the Report the Redundancy Level (see Clause 7.5.7.1) and describe the Data Accessibility test(s) used to demonstrate compliance (9.3.7.2).*

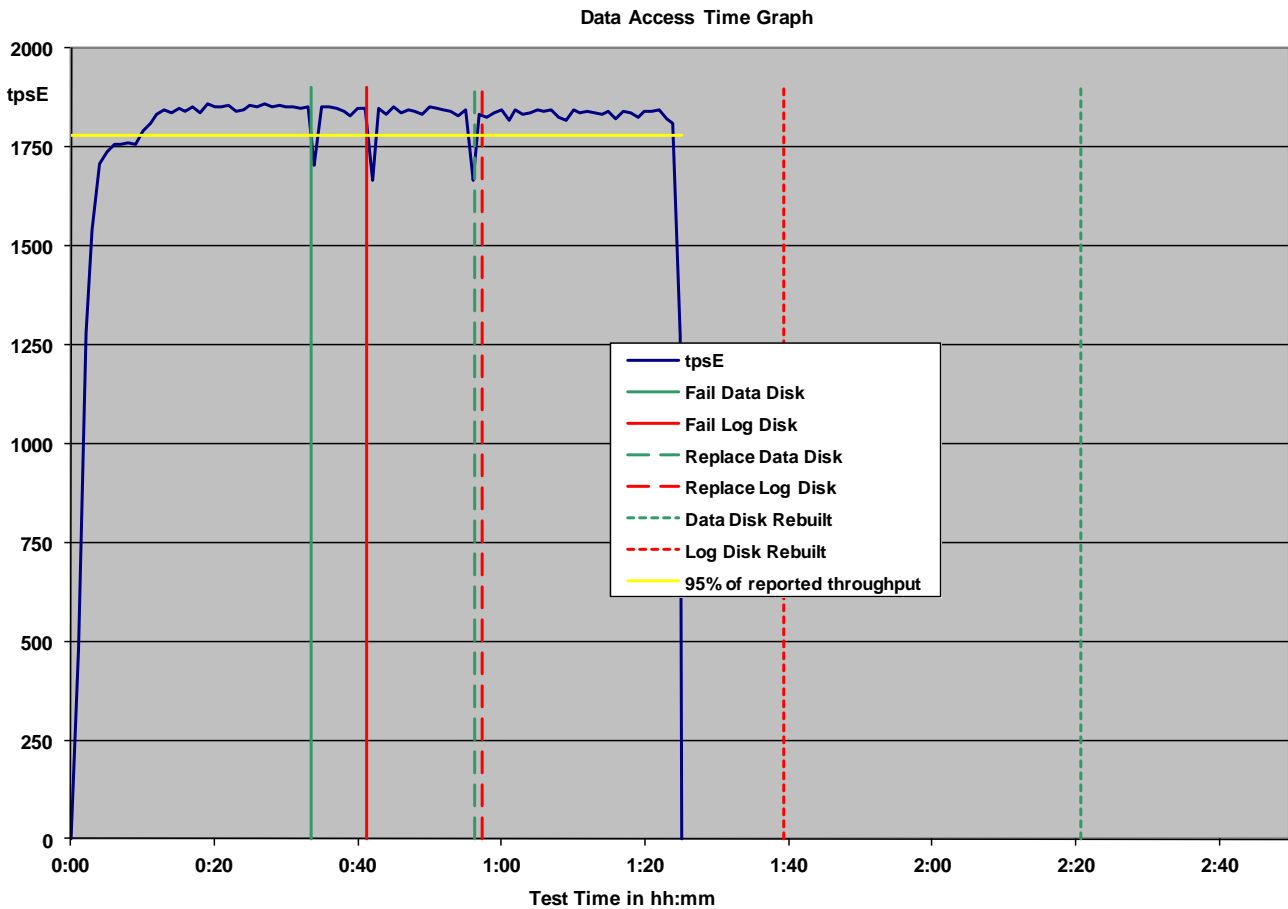
*A Data Accessibility Graph for each run demonstrating a Redundancy Level must be reported in the Report (see Clause 7.5.7.2) (9.3.7.3).*

Redundancy Level 1 was used for the storage system. To prove Redundancy Level 1, the following steps were successfully performed on a database data and log disk. The test for Redundancy Level 1 is the test for Permanent Irrecoverable Failure of any single Durable Medium. The different steps and the various states of the two disks are reported by ServerView RAID and written to the system event (see SupportingFiles).

1. Determine the current number of completed trades in the database by counting the rows in SETTLEMENT.
2. Start submitting Transactions and ramp up to the Durability Throughput Requirements (as defined in Clause 7.5.3) and satisfy those requirements for at least 5 minutes.
3. Induce the failure described for the redundancy level being demonstrated. In this case fail a disk in a database data array. Since RAID5 is used, the transactions continue for at least 5 minutes.
4. Induce the failure described for the redundancy level being demonstrated. In this case fail a disk in the database log array. Since RAID10 is used, the transactions continue for at least 5 minutes.
5. Begin the necessary recovery process, by replacing the failed drives in the database data array and start the rebuild process.
6. Begin the necessary recovery process, by replacing the failed drives in the database log array and start the rebuild.
7. Continue running the Driver for at least 20 minutes with throughput above 95% of reported throughput.
8. Terminate the run gracefully from the Driver.
9. Wait until rebuild process has finished.
10. Determine the current number of completed trades in the database by counting the rows in SETTLEMENT.
11. Run the evaluation of Trade-Result Transactions executed and compare it with the difference of the SETTLEMENT rows counted.

The Graph in Figure 7-1 show the measured throughput versus time and the different test stated.

Figure 7-1: Redundancy Level and Data Accessibility Graph



## Business Recovery

The Test Sponsor must describe in the Report the test(s) used to demonstrate Business Recovery (9.3.4.7). The Business Recovery Time must be reported on the Executive Summary Statement and in the Report. If the failures described in Clauses 7.5.2.2, 7.5.2.3 and 7.5.2.4 were not combined into one Durability test (usually powering off the Database Server during the run), then the Business Recovery Time for the failure described for instantaneous interruption is the Business Recovery Time that must be reported in the Executive Summary Statement. All the Business Recovery Times for each test requiring Business Recovery must be reported in the Report (9.3.7.6).

9.3.7.6 The Business Recovery Time Graph (see Clause 7.5.7.4) must be reported in the Report for all Business Recovery tests (9.3.7.7).

The tests for “Instantaneous interrupt,” “Failure of all or part of memory,” and “Loss of external power to the SUT” were combined by power off Tier A and B.

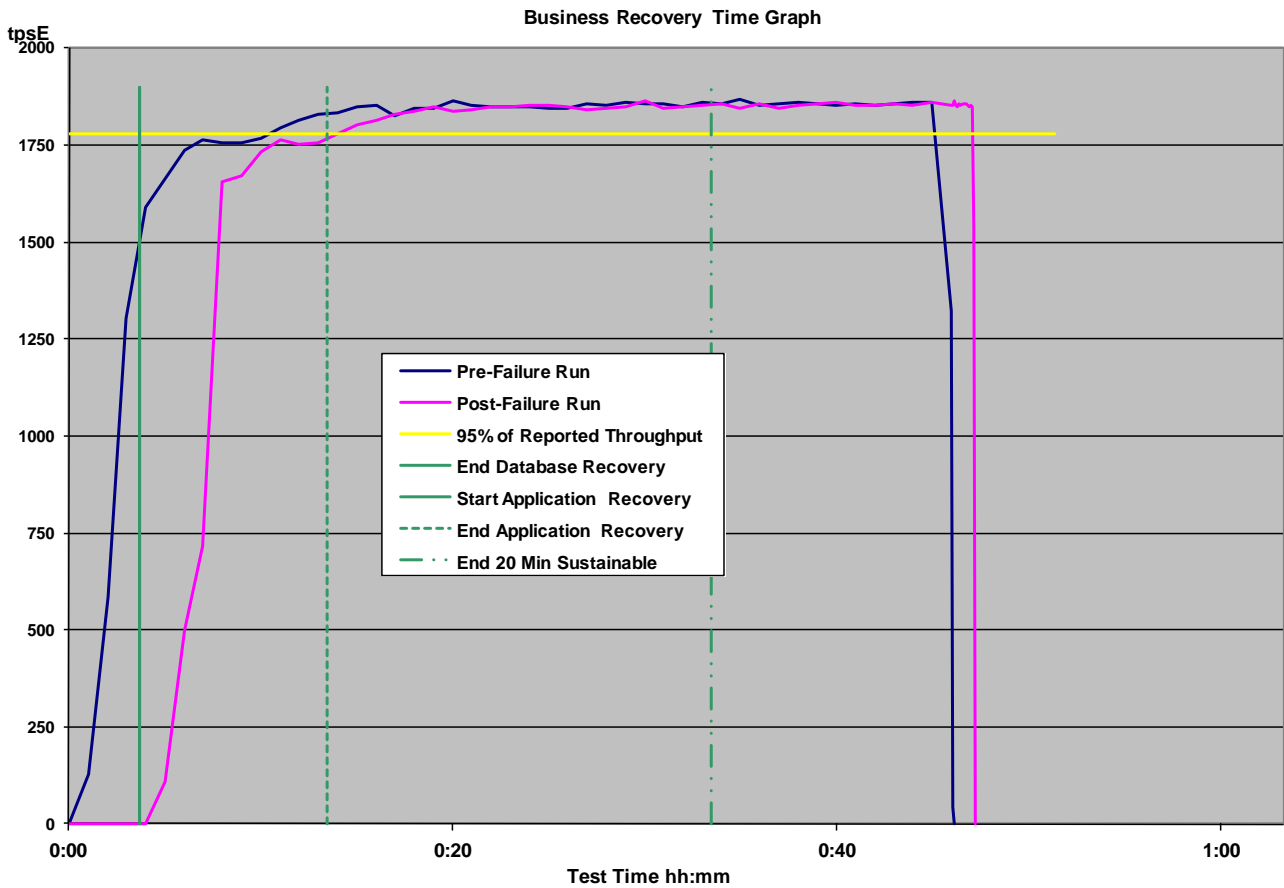
1. Determine the current number of completed trades in the database by counting the rows in SETTLEMENT.
2. Start submitting transactions and ramp up to the Durability Throughput Requirements (as defined in Clause 7.5.3) and satisfy those requirements for at least 20 minutes.
3. Induce the failures by power off Tier B.
4. On the driver side the number of MEE connections is captured and after transaction failures is noted by the drivers, terminate the run and collect the data for Pre-Failure Run.
5. Re-power and restart Tier B.
6. When restarting the database on Tier B, it automatically starts the recovery and records timestamps. The Database Recovery Time was 00:03:41 (hh:mm:ss).

7. After recovery has completed Trade-Cleanup has been executed. A new run started again submitting transactions and ramp up to the Durability Throughput Requirements (as defined in Clause 7.5.3) and satisfy those requirements for at least 20 minutes. The Application Recovery Time was 00:09:48 (hh:mm:ss).
8. Terminate the run gracefully from the Driver and collect the data for Post-Failure Run.
9. Verify that there are no errors in the Post-Failure run and check the consistency of the database as specified in Clause 7.3.1.1.
10. Determine the current number of completed trades in the database by counting the rows in SETTLEMENT.
11. Run the evaluation of Trade-Result Transactions executed in both runs and compare it with the difference of the SETTLEMENT rows counted. The difference must be less than or equal to the maximum number of Transactions which can be simultaneously in-flight from the Driver to the SUT.

The Business Recovery Time (per Clause 7.5.7 Step15) was 00:13:29 (hh:mm:ss).

The Graph in Figure 7-2 shows the measured throughput versus time and the Business Recovery.

Figure 7-2: Business Recovery Graph



## Clause 8: Pricing Related Items

### 60-Day Space

Details of the 60-Day Space computations along with proof that the database is configured to sustain a Business Day of growth must be reported (9.3.8.1).

Table 8-1: Space Requirements

		TPC-E Disk Space Requirements							
Customers Used	940,000	Performance		1,871.81 TpsE	settlements after 8 hours (Business Day)		53,908,128		
Table	Initial Rows	Data (KB)	Index size (KB)	Extra 5% (KB)	initial size Total + 5% (KB)	grow size After run (KB)	Growth (KB)		
ACCOUNT_PERMISSION	6673826	367472	2344	18491	388307	369888	72		
ADDRESS	1410004	81336	624	4098	86058	81984	24		
BROKER	9400	688	936	81	1705	1624	0		
CASH_TRANSACTION	14944061103	1542170856	3255472	77271316	1622697644	1548633584	3207256		
CHARGE	15	8	8	1	17	16	0		
COMMISSION_RATE	240	16	16	2	34	32	0		
COMPANY	470000	99912	30472	6519	136903	130392	8		
COMPANY_COMPETITOR	1410000	37824	34784	3630	76238	72608	0		
CUSTOMER	940000	154040	46312	10018	210370	200384	32		
CUSTOMER_ACCOUNT	4700000	425904	105064			530968	0		
CUSTOMER_TAXRATE	1880000	39208	624	1992	41824	39944	112		
DAILY_MARKET	840289500	39235224	114136	1967468	41316828	39350544	1184		
EXCHANGE	4	8	8	1	17	16	0		
FINANCIAL	9400000	1059264	3376	53132	1115772	1062888	248		
HOLDING	831699467	55454864	37835384	4664512	97954760	94382680	1092432		
HOLDING_HISTORY	21768942726	791597560	528842832	66022020	1386462412	1324131688	3691296		
HOLDING_SUMMARY	46752539	2037552	7968	102276	2147796	2045520	0		
INDUSTRY	102	8	24	2	34	32	0		
LAST_TRADE	643900	39984	624	2030	42638	40608	0		
NEWS_ITEM	940000	101913232	1608			101914944	104		
NEWS_XREF	940000	23424	624	1202	25250	24048	0		
SECTOR	12	8	24	2	34	32	0		
SECURITY	643900	88648	25160	5690	119498	113816	8		
SETTLEMENT	16243551789	774577248	1633496	38810537	815021281	778004520	1793776		
STATUS_TYPE	5	8	8	1	17	16	0		
TAXRATE	320	24	16	2	42	56	16		
TRADE	16243616122	1937887832	1080820088	150935396	3169643316	3024447416	5739496		
TRADE_HISTORY	38984682856	1172514192	3058232	58778621	1234351045	1178777176	3204752		
TRADE_REQUEST	0	0	0	0	0	285112	285112		
TRADE_TYPE	5	8	1032	52	1092	1040	0		
WATCH_ITEM	94014652	2620504	9904	131520	2761928	2630624	216		
WATCH_LIST	940000	23408	21816	2261	47485	45224	0		
ZIP_CODE	14741	488	96	29	613	584	0		
		<b>Initial Database Size</b>				Settlements		18,414,845	
		7,888,969 (MB)				<b>Grown Database Size</b>			
		7,704 (GB)				7,907,539 (MB)			
DB filegroups	partition size (MB)	file size (MB)	alloc total (MB)	loaded (MB)	loaded +5% (MB)	after run (MB)	Business Day (MB)		
	4	2,663,360	10,602,000	10,653,440	7,888,969	8,283,417	7,907,539	7,943,332	
		Number of disks	60						
		Disk Capacity (MB)	190,240						
		RAID5 Overhead	7%						
Initial Growing Space (MB)	7,745,795	Total Space (MB)	10,653,440						
Final Growing Space (MB)	7,764,363	Number of disks	2		Initial Log Size (MB)	25,259	Log units	1	
Delta (MB)	18,568	Disk Capacity (MB)	953,344		Final Log Size (MB)	145,835	Disks per unit	6	
Data Space per Trade (MB)	0.001008	RAID1 Overhead	50%		Log Growth (MB)	120,576	Disk Capacity (MB)	139,488	
1 Day Data Growth (MB)	54,358	Total Space (MB)	953,344		Log Space per Trade	0.006548	RAID10 Overhead	50.0%	
60 Day Space (MB)	11,150,441	Total Space (MB)	11,606,784		1 Day Log Space (MB)	352,976	Log Space (MB)	418,464	

## Attestation Letter

The Auditor's Attestation Letter, which indicates compliance, must be included in the Report (9.3.8.2).



Benchmark Sponsors: Detlev Seidel  
Primary TPC Representative  
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33106 Paderborn, Germany

July 4, 2012

I verified the TPC Benchmark™ E performance and the TPC-Energy measurement of the following configuration:

Platform: PRIMERGY RX300 S7  
Operating system: Microsoft Windows Server 2008 R2 Enterprise Edition SP1  
Database Manager: Microsoft SQL Server 2012 Enterprise Edition

The TPC-E results were:

CPU's Speed	Memory	Disks	Trade-Result 90% Response Time	tpsE
<b>Tier B: PRIMERGY RX300 S7</b>				
2 x Intel Xeon E5-2690 (2.90 GHz)	512 GB	60 x 200 GB SSD 2 x 1 TB 7.2Krpm SATA 8 x 146 GB 15Krpm SAS (int.)	0.05 Seconds	<b>1,871.81</b>
<b>Tier A: PRIMERGY RX200 S7</b>				
1 x Intel Xeon E5-2660 (2.20 GHz)	16 GB	1 x 250 GB 7.2Krpm SATA (int.)	n/a	n/a

In my opinion, these performance results were produced in compliance with the TPC-E benchmark requirements and the following verification items were given special attention:

- All EGen components were verified to be v1.12.0
- The transactions were correctly implemented.
- The database was properly scaled and populated for 940,000 Customers.
- The mandatory network between the driver and the SUT was configured.
- The ACID properties were met.
- Input data was generated according to the specified percentages.
- The reported response times were correctly measured.

- All 90% response times were under the specified maximums.
- The measurement interval was representative of steady state conditions.
- The reported measurement interval was 120 minutes.
- The implementation used Redundancy Level 1.
- The Business Recovery Time of 00:13:29 was correctly measured.
- The 60 day storage requirement was correctly computed and configured.
- The system pricing was verified for major components and maintenance.

The TPC-Energy measurements were:

TPC-Energy Metric	REC Idle Power	Average REC Power	Temperature
0.69 Watts/tpsE	843.88 Watts	1,288.82 Watts	20.13 C

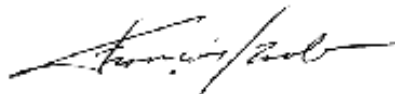
In my opinion, these energy measurements were produced in compliance with the TPC-Energy benchmark requirements and the following verification items were given special attention:

- The power analyzers used met the benchmark requirements and were correctly calibrated.
- The primary metric, secondary metrics and the idle power were calculated correctly.
- Version 1.4.2 of the EMS software package was used.

Additional Audit Notes:

None.

Respectfully Yours,



François Raab, President



## Clause 9: Supporting Files

### Supporting Files Index table

An index for all files required by Clause 9.4 Supporting Files must be provided in the Report. The Supporting Files index is presented in a tabular format where the columns specify the following:

- The first column denotes the clause in the TPC Specification
- The second column provides a short description of the file contents
- The third column contains the path name for the file starting at the SupportingFiles directory.

If there are no Supporting Files provided then the description column must indicate that there is no supporting file and the path name column must be left blank (9.3.9.1).

Clause	Description	Path	Filename
	overview	SupportingFiles	SupportingFiles.doc
Introduction	System Configuration	SupportingFiles/Introduction/	SysInfo_TierA.txt SysInfo_TierB.txt
	Disk Configuration	SupportingFiles/Introduction/Hardware/	DiskConfiguration.doc flatfilelocations.txt makehelpdirff.cmd Readme.txt tempdb12.sql
	Parameter OS Tunables Database Setup	SupportingFiles/Introduction/Software/	CountOperations.reg MemoryManagement.reg MSTPCE Database Setup Reference.doc SQL_IP.reg SQL_LargePages.req SQL_Nodes.reg SQL_Server_Configuration.ver TierA_SQL2012_client_connection_all.reg TierA_W32Time.reg
	Startup Scripts Tier A	SupportingFiles/Introduction/Software/	start_all_RX300.cmd start_CE1_RX300S7.cmd ... start_CE16_RX300S7.cmd start_MEE1_RX300S7.cmd ... start_MEE16_RX300S2.cmd
	Startup Scripts Tier B	SupportingFiles/Introduction/Software/	SqlstartSQL2012.cmd
Clause 2	Create Database	SupportingFiles/Clause2	Backup_Database.sql Check_tempdb.sql Checkpoint_TPCE_Database.SQL Count_Customers.sql Create_Database.sql Create_DM_Audit_Table.sql Create_TID_Ranges_Table.sql Create_Timer_Table.sql Create_TL_TU_Warnings_Table.sql Create_TPCE_VERSIONS_Table.sql Database_Options_1.sql Database_Options_2.sql Drop_and_Create_TPCE_INFO.sql End_Load_Timer.sql Get_Next_T_ID.sql Install_Load_Timer_Proc.sql Load_TPCE_Info.sql Output_TPCE_VERSIONS_Table.SQL Remove_Database.sql Restore_Database.sql SQL_Server_Configuration.sql tempdb12.sql TPCE_Setup.cmd Trade_Cleanup.cmd Trade_Cleanup.sql Version.sql
	Create Database output	SupportingFiles/Clause2/DB_setup	940000Customers_Load_Timer.log Backup_Database.log

			BrokerVolume.log Build_Steps1.log Build_Steps2.log BulkInsert_1.out ... BulkInsert_32.out Check_Constraints_Fixed.log Check_Constraints_Growing.log Check_Constraints_Scaling.log Convert_NI_ITEM_Data.log Create_DB_Audit_Tables.log Create_DM_Audit_Tables.log Create_Indexes_Fixed_Tables.log Create_Indexes_Growing_Tables.log Create_Indexes_Scaling_Tables.log Create_TID_Ranges_Table.log Create_TL_TU_Warnings_Table.log Create_TPCE_VERSIONS_Table.log CreateDB.log CustomerPosition.log Database_Options_1.log Database_Options_2.log DataMaintenance.log DB_Check.log DB_FK_Constraints.log DB_Primary_Key_Check.log DB_RI_Check.log DB_Tables.log Drop_DB_Audit_Tables.log Drop_Fixed_Tables.log Drop_FK_Constraints.log Drop_Growing_Tables.log Drop_Scaling_Tables.log EGenLoaderFrom1To29000.log EGenLoaderFrom29001To59000.log .... EGenLoaderFrom911001To940000.log ERRORLOG FK_Constraints.log Get_Next_T_ID.log Insert_Duplicates_Tests.log Load_Timer.log Load_Timer_Proc.log Load_TPCE_Info.log MarketFeed.log MarketWatch.log Referential_Integrity_Tests.log Remove_Addon_Files.sql RemoveDB.log SecurityDetail.log spfiles.ver spfiles_setup.ver splog.ver spused.ver spused_setup.ver SQL_Server_Configuration.log Tables_Fixed.log Tables_Growing.log Tables_Scaling.log TPCE_VERSIONS.log TradeLookup.log TradeOrder.log TradeResult.log TradeStatus.log TradeUpdate.log Version.log
	Index Creation Scripts	SupportingFiles/Clause2/DDL	BulkInsert_<1..32>.sql Convert_NI_ITEM_Data.SQL Create_Check_Constraints_Fixed.sql Create_Check_Constraints_Growing.sql Create_Check_Constraints_Scaling.sql Create_FK_Constraints.sql Create_Indexes_Fixed.sql Create_Indexes_Growing.sql Create_Indexes_Scaling.sql

			Create_Tables_Fixed.sql Create_Tables_Growing.sql Create_Tables_Scaling.sql Create_Tables_Scaling_Flat.sql Create_TPCE_Types.sql Drop_FK_Constraints.sql Drop_Tables_Fixed.sql Drop_Tables_Growing.sql Drop_Tables_Scaling.sql
	Database Audit Scripts	SupportingFiles/Clause2/Audit_Scripts/Database	Create_DB_Audit_Tables.SQL DB_Check.sql DB_FK_Constraints.sql DB_Primary_Key_Check.SQL DB_Tables.sql Drop_DB_Audit_Tables.SQL Insert_Duplicates_Tests.sql Referential_Integrity_Tests.sql
	Database Space Scripts	SupportingFiles/Clause2/Audit_Scripts/Space	SPFiles.sql SPLog.sql SPUsed.sql
Clause3	Transaction Frames	SupportingFiles/Clause3	BrokerVolume.sql CustomerPosition.sql DataMaintenance.sql MarketFeed.sql MarketWatch.sql SecurityDetail.sql TradeLookup.sql TradeOrder.sql TradeResult.sql TradeStatus.sql TradeUpdate.sql
	BaseServer	SupportingFiles/Clause3/BaseServer	BaseServer.cpp BaseServer.h BaseServer.vcproj BaseServer.vcxproj stdafx.cpp stdafx.h SUTServersLocals.h
	SUT_CE_Server	SupportingFiles/Clause3/SUT_CE_Server	Release\SUT_CE_Server.exe CEServer.cpp CEServer.h CEServerMain.cpp PortDefinitions.h stdafx.cpp stdafx.h SUT_CE_Server.vcproj SUT_CE_Server.vcxproj SUTServer.sln SUTStructs.h
	SUT_MEE_Server	SupportingFiles/Clause3/SUT_MEE_Server	Release\SUT_MEE_Server.exe MEEServer.cpp MEEServer.h MEEServerMain.cpp stdafx.cpp stdafx.h SUT_MEE_Server.vcproj SUT_MEE_Server.vcxproj
	TransactionsSP	SupportingFiles/Clause3/TransactionsSP	BrokerVolumeDB_SP.cpp BrokerVolumeDB_SP.h CheckpointDB_SP.cpp CheckpointDB_SP.h CustomerPositionDB_SP.cpp CustomerPositionDB_SP.h DataMaintenanceDB_SP.cpp DataMaintenanceDB_SP.h MarketFeedDB_SP.cpp MarketFeedDB_SP.h MarketWatchDB_SP.cpp MarketWatchDB_SP.h SecurityDetailDB_SP.cpp SecurityDetailDB_SP.h stdafx.cpp stdafx.h TradeLookupDB_SP.cpp

			TradeLookupDB_SP.h TradeOrderDB_SP.cpp TradeOrderDB_SP.h TradeResultDB_SP.cpp TradeResultDB_SP.h TradeStatusDB_SP.cpp TradeStatusDB_SP.h TradeUpdateDB_SP.cpp TradeUpdateDB_SP.h TransactionsSP.vcxproj TransactionsSP.vcxproj TxnHarnessDBBase.cpp TxnHarnessDBBase.h TxnHarnessDBConn.cpp TxnHarnessDBConn.h
	TxnHarness	SupportingFiles/Clause3/TxnHarnes	TxnHarness.vcxproj TxnHarness.vcxproj TxnHarness_stdafx.cpp TxnHarness_stdafx.h TxnHarnessSendToMarket.cpp TxnHarnessSendToMarket.h
Clause4			
Clause5	EGen Driver Configuration	SupportingFiles/Clause5	RX300S7_940KCus_16x19p_spiderc_RTE01.xml
	EGenLoader Parameter	SupportingFiles/Clause5	BuildSteps1.log BuildSteps2.log EGenLoaderFrom1To29000.log EGenLoaderFrom29001To59000.log .... EGenLoaderFrom911001To940000.log
	EGenLogger Output	SupportingFiles/Clause5	TxnReportE-MI.xls
Clause6	EGenValidate	SupportingFiles/Clause6	EGenValidate.txt
Clause7	ACID	SupportingFiles/Clause7	MSTPCE ACID Procedures.docx
	ACID Procedures	SupportingFiles/Clause7/AcidProcs	AcidProc.cmd AcidProc.out Remove_AcidProcs.cmd
	ACID Scripts	SupportingFiles/Clause7/AcidProcs/Scripts	AcidProc.vbs CustomerPosition_Iso3.sql CustomerPosition_Iso4.sql Remove_AcidProcs.vbs TradeOrder_C.sql TradeOrder_Iso1_1.sql TradeOrder_Iso1_2.sql TradeOrder_Iso2.sql TradeOrder_Iso3.sql TradeOrder_Iso4.sql TradeOrder_RB.sql TradeResult_Iso1_1.sql TradeResult_Iso1_2.sql TradeResult_Iso2_1.sql TradeResult_Iso2_2.sql TradeResult_Iso3.sql TradeResult_Iso4.sql
	Atomicity	SupportingFiles/Clause7/Atomicity	Atomicity.cmd Atomicity_C.out Atomicity_RB.out
		SupportingFiles/Clause7/Atomicity/Scripts	atom.vbs Atomicity_C.sql Atomicity_RB.sql
	Consistency	SupportingFiles/Clause7/Consistency	Consistency.cmd Consistency.out
SupportingFiles/Clause7/Consistency/Scripts		Consistency.sql Consistency.vbs	
Durability Business Recovery	SupportingFiles/Clause7/Durability/BusinessRecovery	BR_BenchCraft_Config.xml BR_Consistency.out BR_Count_Settlement1.ver BR_Count_Settlement2.ver BR_ERRORLOG1.txt BR_ERRORLOG2a.txt BR_ERRORLOG2b.txt BR_SystemEvents_TierB.txt	

			BusinessRecov_Part1_step60.xlt BusinessRecov_Part1_TxnReportE_20.xls BusinessRecov_Part1_TxnReportE_all.xls BusinessRecov_Part2_step60.xlt BusinessRecov_Part2_TxnReportE_20.xls BusinessRecov_Part2_TxnReportE_all.xls BusinessRecov_TimeGraph.xls
	Durability Data Accessibility	SupportingFiles/Clause7/Durability/Data Accessibility	DA_BenchCraft_Config.xml DA_Count_Settlement1.ver DA_Count_Settlement2.ver DA_ERRORLOG.txt DataAccess_TimeGraph.xls DataAccess_TxnReportE_5min1.xls DataAccess_TxnReportE_5min2.xls DataAccess_TxnReportE_20min.xls DataAccess_TxnReportE_all.xls SystemEvents_Application.txt
	Isolation	SupportingFiles/Clause7/Isolation	Isolation1_S1.rpt Isolation1_S2.rpt Isolation1_S3.rpt Isolation1_S4.rpt Isolation2_S1.rpt Isolation2_S2.rpt Isolation2_S3.rpt Isolation2_S4.rpt Isolation3_S1.rpt Isolation3_S2.rpt Isolation3_S3.rpt Isolation4_S1.rpt Isolation4_S2.rpt Isolation4_S3.rpt
		SupportingFiles/Clause7/Isolation/Scripts	Isolation1_S1.sql Isolation1_S2.sql Isolation1_S3.sql Isolation1_S4.sql Isolation2_S1.sql Isolation2_S2.sql Isolation2_S3.sql Isolation2_S4.sql Isolation3_S1.sql Isolation3_S2.sql Isolation3_S3.sql Isolation4_S1.sql Isolation4_S2.sql Isolation4_S3.sql
Clause8	60-Day Space Calculations	SupportingFiles/Clause8	tpce_space.xls

## Appendix: Third Party Price Quotations

Microsoft Corporation  
One Microsoft Way  
Redmond, WA 98052-6399

Tel 425 882 8080  
Fax 425 936 7329  
<http://www.microsoft.com/>

**Microsoft**

June 20, 2012

Fujitsu  
Detlev Seidel  
Heinz-Nixdorf-Ring 1  
Paderborn, Germany 33106

Here is the information you requested regarding pricing for several Microsoft products to be used in conjunction with your TPC-E benchmark testing.

All pricing shown is in US Dollars (\$).

Part Number	Description	Unit Price	Quantity	Price
7JQ-00256	<b>SQL Server 2012 Enterprise Edition</b> <i>2 Core License</i>	\$ 13,472.50	8	\$ 107,780.00
P72-04217	<b>Windows Server 2008 R2 Enterprise Edition</b> <i>Server License with 25 CALs</i> <i>Open Program - Level C</i> <i>Unit Price reflects a 43% discount from the retail unit price of \$3,999.</i>	\$ 2,280	1	\$ 2,280
P73-04165	<b>Windows Server 2008 Standard Edition</b> <i>Server License with 5 CALs</i> <i>Open Program - Level C</i> <i>Unit Price reflects a 29% discount from the retail unit price of \$999.</i>	\$ 711.00	1	\$ 711.00
N/A	<b>Microsoft Problem Resolution Services</b> <i>Professional Support</i> <i>(1 Incident).</i>	\$ 259.00	1	\$ 259.00

SQL Server 2012 Enterprise Edition, Windows Server 2008 R2 Enterprise Edition, and Windows Server 2008 R2 Standard Edition are currently orderable and available through Microsoft's normal distribution channels. A list of Microsoft's resellers can be found in the Microsoft Product Information Center at <http://pinpoint.microsoft.com/en-US/home>.

Defect support is included in the purchase price. Additional support is available from Microsoft PSS on an incident by incident basis at \$259.00 call.

This quote is valid for the next 90 days.

Reference ID: TPCE\_qhtplyIDTLKTVUKfhjjJhiJiniHjif85757.DOC.

## Appendix B: TPC-Energy Disclosure Report

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### TPC-Energy Clause 2-related items (Methodology)

*The minimum ambient temperature must be disclosed. (7.3.2.1)*

The Minimum Temperature reported by EMS : 20.13 Degrees Celsius

*The characteristics of the external electric power source must be disclosed. In particular, the voltage, frequency in Hertz, and phase information must be reported. (7.3.2.2)*

The external electric power source has the following characteristics: 230V, 50Hz, single phase

*A statement is required that assures that nothing was done to alter the air-pressure in the measurement environment. (7.3.2.3)*

Nothing was done to alter the air-pressure in the measurement environment

*A description of where the temperature was measured and how it was determined that this was representative of the lowest ambient temperature is required. (7.3.2.4)*

The temperature was measured for several air inlets located on different components of SUT and the lowest temperature is reported.

*If a method of cooling other than circulation of ambient air is employed in the REC, a statement describing this method must be included. (7.3.2.5)*

No other method of cooling was used

*7.3.2.6 To be compliant with licenses associated with EMS, the following statement must be included in every FDR which contains a TPC-Energy Metric: (7.3.2.6)*

*The power and temperature characteristics of the MEC were measured using TPC's Energy Measurement Software (EMS). This includes the EMS-PTD, a modified version of the SPEC PTDaemon, which is provided under license from the Standard Performance Evaluation Corporation (SPEC).*

### TPC-Energy Clause 3-related items (Metrics)

*Primary Metric. (7.3.3.1)*

- 1) The normalized work derived from the Performance Metric (as described in Clause 3.2.1) must be disclosed*
- 2) The computation for total energy used (REC Energy Consumption) for each measurement segment that contributes to a Performance Metric must be disclosed. If the energy of the entire Priced Configuration is not derived from direct measurements, the methods for deriving the energy for components which were not measured must be disclosed (See Clause 7.3.3.4)*
- 3) The duration of each measurement that produces a Performance Metric must be disclosed.*
- 4) The average power requirement for each measurement that produces one of these metrics*
- 5) The TPC-Energy Primary Metric must be disclosed, including the calculation that is used to derive it.*

PMU-1 = Tier B (Database Server)			Device: HIOKI 3334		Calibrated: 10-May-12		
Measurement Interval		Meter		Delta		PMU Energy	
Average (watt)	591.23	% of Reading	0.20%	Reading Delta	1.1825	Accuracy Factor	0.20%
Total (watt-sec)	4,256,862.46	% of Range	0.00%	Range Delta	0.0000	Adjusted (watt-sec)	4,265,376.18
Duration (sec)	7,200	Range (watt)	900.00	Total Delta	1.1825	Avg Power (watt)	592.41

PMU-2 = Tier A (Application Server)			Device: HIOKI 3334		Calibrated: 10-May-12		
Measurement Interval		Meter		Delta		PMU Energy	
Average (watt)	100.59	% of Reading	0.10%	Reading Delta	0.10	Accuracy Factor	0.40%
Total (watt-sec)	724,275.39	% of Range	0.10%	Range Delta	0.30	Adjusted (watt-sec)	727,159.75
Duration (sec)	7,200	Range (watt)	300.00	Total Delta	0.40	Avg Power (watt)	100.99

PMU-3 = Storage			Device: HIOKI 3334		Calibrated: 10-May-12		
Measurement Interval		Meter		Delta		PMU Energy	
Average (watt)	577.26	% of Reading	0.20%	Reading Delta	1.15	Accuracy Factor	0.20%
Total (watt-sec)	4,156,285.59	% of Range	0.00%	Range Delta	0.00	Adjusted (watt-sec)	4,164,598.16
Duration (sec)	7,200	Range (watt)	900.00	Total Delta	1.15	Avg Power (watt)	578.42

PMU-4 = Monitor (Nameplate) (Misc)	
PMU Energy	
Average (watt)	17.00
Duration (sec)	7,200.00
Total Energy (watt-sec)	122,400.00

Avg REC Energy (watt)	1,288.82
Total REC Energy (watt-sec)	9,279,534
Run Duration (sec)	7,200
Reported tpsE	1,871.81
Total Transactions	13,477,032.00
<b>Energy (watts/tpsE)</b>	<b>0.69</b>

Total REC Energy Consumption = 9,279,534 watt-seconds

SUT Total Work = Run Duration \* Reported tpsE

SUT Total Work = 13,477,032 transactions

9,279,534 watt-seconds / 13,477,032 transactions = 0.69 watts/tpsE

### Secondary Metrics At Reported Performance. (7.3.3.2)

If the TPC-Energy Secondary Metrics are reported, the components of the REC which are included in each subsystem must be identified. This can be achieved with separate lists to be included in the FDR or with a specific designation in the price spreadsheet. Every component in the REC that consumes energy must be included in exactly one subsystem.

For each defined subsystem, the calculations defined for the TPC-Energy Secondary Metrics in Clause 3.3 must be reported, using the Performance Metric of the entire SUT and the energy consumption for each REC subsystem.

	Secondary Metrics	Additional Numerical Quantities			
		Full Load Avg Watts	Full Load % of REC	Idle Avg Watts	Idle % of REC
Database Server *)	0.32	592.41	45.97%	239.56	28.39%
Storage *)	0.31	578.42	44.88%	544.80	64.56%
Application Server *)	0.05	100.99	7.84%	59.12	7.01%
Miscellaneous *)	0.01	17.00	1.32%	0.40	0.05%
<b>Total REC</b>	<b>0.69</b>	<b>1,288.82</b>	<b>100.00%</b>	<b>843.88</b>	<b>100.00%</b>

\*)See pricing for list of components



<b>Database Server</b>	4,265,376.18 watt-seconds/	13,477,032 transactions =	0.32 watts/tpsE
<b>Storage</b>	4,164,598.16 watt-seconds/	13,477,032 transactions =	0.31 watts/tpsE
<b>Application Server</b>	727,159.75 watt-seconds/	13,477,032 transactions =	0.05 watts/tpsE
<b>Miscellaneous</b>	122,400.00 watt-seconds/	13,477,032 transactions =	0.01 watts/tpsE

*Idle Power reporting. (7.3.3.3)*

- 1) The Idle Power measurement/calculation for the REC must be reported as numerical quantities.
- 2) If TPC-Energy Secondary Metrics are reported, then the Idle Power measurement/calculation for each subsystem must also be reported as numerical quantities.
- 3) The length of time between the conclusion of the performance measurement and the start of the idle measurement must be reported.
- 4) The duration of the idle measurement must be reported
- 5) A statement is required that assures that the system is in a state that is ready to run the Application(s) of the benchmark for the duration of the idle measurement.

PMU-1 = Tier B (Database Server)		Device: HIOKI 3334		Calibrated: 10-May-12			
Idle Interval		Meter		Delta		PMU Energy	
Average (watt)	238.42	% of Reading	0.10%	Reading Delta	0.2384	Accuracy Factor	0.48%
Total (watt-sec)	143,059.19	% of Range	0.10%	Range Delta	0.9000	Adjusted (watt-sec)	143,742.28
Duration (sec)	600	Range (watt)	900.00	Total Delta	1.1384	Avg Power (watt)	239.56

PMU-2 = Tier A (Application Server)		Device: HIOKI 3334		Calibrated: 10-May-12			
Idle Interval		Meter		Delta		PMU Energy	
Average (watt)	58.76	% of Reading	0.10%	Reading Delta	0.06	Accuracy Factor	0.61%
Total (watt-sec)	35,257.16	% of Range	0.10%	Range Delta	0.30	Adjusted (watt-sec)	35,472.42
Duration (sec)	600	Range (watt)	300.00	Total Delta	0.36	Avg Power (watt)	59.12

PMU-3 = Storage		Device: HIOKI 3334		Calibrated: 10-May-12			
Idle Interval		Meter		Delta		PMU Energy	
Average (watt)	543.71	% of Reading	0.20%	Reading Delta	1.09	Accuracy Factor	0.20%
Total (watt-sec)	326,220.78	% of Range	0.00%	Range Delta	0.00	Adjusted (watt-sec)	326,873.22
Duration (sec)	600	Range (watt)	900.00	Total Delta	1.09	Avg Power (watt)	544.80

PMU-4 = Monitor (Nameplate) (Misc)	
PMU Energy	
Average (watt)	0.40

<b>Idle Power (watt)</b>	<b>843.88</b>
--------------------------	---------------

Idle power measurement for REC = 843.88 Watts  
The Idle measurement was started 7 minutes after all data processing was completed.  
Idle measurement duration was 600 seconds  
The system was in a state that was ready to run the applications of the benchmark for the duration of the idle measurement. This was verified by executing one transaction after the idle measurement interval was completed. The transaction time was compared to the allowed 90<sup>th</sup> percentile and found to meet the required specification.

*Disclosure requirements when only part of the REC is measured for power. (7.3.3.4)*

The monitor power consumption in the PMU-4 was calculated using the Nameplate

*Disclosure requirements when component substitution is used. (7.3.3.5)*

The Priced Configuration was identical to the Measured Configuration

## TPC-Energy Clause 4-related items (Drivers/Controller)

*A statement indicating the version of EMS used must be included in the FDR, including a statement that no alterations of this code were made for the benchmark, except as specified by Clause 7.3.4.3. This includes levels for the EMS-PTD Manager, EMS-PTD, EMS Report Generator, and EMS-controller. (7.3.4.1)*

The TPC Energy Management System V1.4.2 was used

*Input parameters for the EMS software must be disclosed. (7.3.4.2)*

See supporting files

*Any changes in the EMS components must be documented. Documentation must include a description of the issue, the reason the change was necessary for disclosure of the Result, and the changes made to resolve it. Any change to TPC-Provided Code must be included with the submission as a Supporting File. (7.3.4.3)*

No changes to EMS components were made

## TPC-Energy Clause 6-related items (Instrumentation)

*For each separate energy measurement (each subset measurement for each distinct measurement period), the following must be reported:*

- 1) Analyzer used (make, model)
- 2) Date of certification of the analyzer (NIST or equivalent)
- 3) Range settings for Amperage, Voltage, and other settings for the measurement period
- 4) Specifications of any additional probes used in the energy measurement
- 5) The accuracy percentages used in the calculations and the source of those percentages. (7.3.6.1)

Power Analyzer Specifications and Settings										
	Make	Model	Serial Number	Calibration date	Range Settings Current [A]	Range Settings Voltage[V]	Full Load		Idle	
							% of reading	% of range	% of reading	% of range
PMU1 - Database Server	HIOKI	3334	90604934	10-May-12	3	300	0.20%	0.00%	0.10%	0.10%
PMU2 - Application Server	HIOKI	3334	90604933	10-May-12	1	300	0.10%	0.10%	0.10%	0.10%
PMU3 - Storage	HIOKI	3334	90604932	10-May-12	3	300	0.20%	0.00%	0.20%	0.00%

Accuracy percentages are taken from the HIOKI Instruction Manual 3334 3334-01 AC/DC POWER HiTESTER

*The make and model of the temperature sensor and/or probe must be disclosed. (7.3.6.2)*

Digi WatchportH

*The accuracy percentage for the temperature sensor and/or probe and the source of this information must be disclosed. (7.3.6.3)*

Temperature accuracy from Manufacturer's Datasheet:  
+/- 0.5° C at -10° C to 85° C

## TPC-Energy Clause 8-related items



Benchmark Sponsors: Detlev Seidel  
Primary TPC Representative  
Fujitsu Technology Solutions  
Heinz-Nixdorf-Ring 1  
33106 Paderborn, Germany

July 4, 2012

I verified the TPC Benchmark™ E performance and the TPC-Energy measurement of the following configuration:

Platform: PRIMERGY RX300 S7  
Operating system: Microsoft Windows Server 2008 R2 Enterprise Edition SP1  
Database Manager: Microsoft SQL Server 2012 Enterprise Edition

The TPC-E results were:

CPU's Speed	Memory	Disks	Trade-Result 90% Response Time	tpsE
<b>Tier B: PRIMERGY RX300 S7</b>				
2 x Intel Xeon E5-2690 (2.90 GHz)	512 GB	60 x 200 GB SSD 2 x 1 TB 7.2Krpm SATA 8 x 146 GB 15Krpm SAS (int.)	0.05 Seconds	<b>1,871.81</b>
<b>Tier A: PRIMERGY RX200 S7</b>				
1 x Intel Xeon E5-2660 (2.20 GHz)	16 GB	1 x 250 GB 7.2Krpm SATA (int.)	n/a	n/a

In my opinion, these performance results were produced in compliance with the TPC-E benchmark requirements and the following verification items were given special attention:

- All EGen components were verified to be v1.12.0
- The transactions were correctly implemented.
- The database was properly scaled and populated for 940,000 Customers.
- The mandatory network between the driver and the SUT was configured.
- The ACID properties were met.
- Input data was generated according to the specified percentages.
- The reported response times were correctly measured.

- All 90% response times were under the specified maximums.
- The measurement interval was representative of steady state conditions.
- The reported measurement interval was 120 minutes.
- The implementation used Redundancy Level 1.
- The Business Recovery Time of 00:13:29 was correctly measured.
- The 60 day storage requirement was correctly computed and configured.
- The system pricing was verified for major components and maintenance.

The TPC-Energy measurements were:

TPC-Energy Metric	REC Idle Power	Average REC Power	Temperature
0.69 Watts/tpsE	843.88 Watts	1,288.82 Watts	20.13 C

In my opinion, these energy measurements were produced in compliance with the TPC-Energy benchmark requirements and the following verification items were given special attention:

- The power analyzers used met the benchmark requirements and were correctly calibrated.
- The primary metric, secondary metrics and the idle power were calculated correctly.
- Version 1.4.2 of the EMS software package was used.

Additional Audit Notes:

None.

Respectfully Yours,



François Raab, President

Supporting Files Index (7.4.4)

Clause	Description	Path
7.4.1	Energy Measurement Logfiles	Clause7.4.1\ptdmanager-logs\A-Power-logresults-001.xml Clause7.4.1\ptdmanager-logs\B-Power-logresults-001.xml Clause7.4.1\ptdmanager-logs\S-Power-logresults-001.xml Clause7.4.1\ptdmanager-logs\A-Temperature-logresults-001.xml Clause7.4.1\ptdmanager-logs\B-Temperature-logresults-001.xml Clause7.4.1\ptdmanager-logs\S-Temperature-logresults-001.xml Clause7.4.1\RUN-REPORTS\rngen-A-Power.txt Clause7.4.1\RUN-REPORTS\rngen-B-Power.txt Clause7.4.1\RUN-REPORTS\rngen-S-Power.txt Clause7.4.1\RUN-REPORTS\rngen-A-Temperature.txt Clause7.4.1\RUN-REPORTS\rngen-B-Temperature.txt Clause7.4.1\RUN-REPORTS\rngen-S-Temperature.txt Clause7.4.1\IDLE-REPORTS\rngen-A-Power.txt Clause7.4.1\IDLE-REPORTS\rngen-B-Power.txt Clause7.4.1\IDLE-REPORTS\rngen-S-Power.txt Clause7.4.1\IDLE-REPORTS\rngen-A-Temperature.txt Clause7.4.1\IDLE-REPORTS\rngen-B-Temperature.txt Clause7.4.1\IDLE-REPORTS\rngen-S-Temperature.txt Clause7.4.1\RX300S7_TPC-E-Energy-Calculation.xlsx
7.4.2	Energy Measurement Controller Files	Clause7.4.2\emsc.log Clause7.4.2\emsc_commands.ems
7.4.3	Energy Measurement Configuration Files	Clause7.4.3\A-Power-ptd.cmd Clause7.4.3\B-Power-ptd.cmd Clause7.4.3\S-Power-ptd.cmd Clause7.4.3\A-Temperature-ptd.cmd Clause7.4.3\B-Temperature-ptd.cmd Clause7.4.3\S-Temperature-ptd.cmd Clause7.4.3\A-Power-ptdm.cmd Clause7.4.3\B-Power-ptdm.cmd Clause7.4.3\S-Power-ptdm.cmd Clause7.4.3\A-Temperature-ptdm.cmd Clause7.4.3\B-Temperature-ptdm.cmd Clause7.4.3\S-Temperature-ptdm.cmd