SPC BENCHMARK 1™
FULL DISCLOSURE REPORT

TEXAS MEMORY SYSTEMS, INC.
TEXAS MEMORY SYSTEMS RAMSAN-400

SPC-1 V1.10.1

Submitted for Review: January 28, 2008
Submission Identifier: A00063

First Edition – January 2008

Trademarks

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AUDIT CERTIFICATION

Matt Key
Texas Memory Systems, Inc.
750 Central Expressway M/S 3488
Santa Clara, CA 95050

January 25, 2008

The SPC Benchmark 1™ results listed below for the Texas Memory Systems RamSan-400 were produced in compliance with the SPC Benchmark 1™ V1.10.1 Onsite Audit requirements.

SPC Benchmark 1™ V1.10.1 Results	
Tested Storage Configuration (TSC) Name: Texas Memory Systems RamSan-400	
Metric	**Reported Result**
SPC-1 IOPS™	291,208.58
SPC-1 Price-Performance	$0.67/SPC-1 IOPS™
Total ASU Capacity	137.439 GB
Data Protection Level	Other Data Protection
Total TSC Price (including three-year maintenance)	$194,785

The following SPC Benchmark 1™ Onsite Audit requirements were reviewed and found compliant with V1.10.1 of the SPC Benchmark 1™ specification:

- A Letter of Good Faith, signed by a senior executive.
- The following Data Repository storage items were verified by physical inspection and information supplied by Texas Memory Systems, Inc.:
  - ✓ Physical Storage Capacity and requirements.
  - ✓ Configured Storage Capacity and requirements.
  - ✓ Addressable Storage Capacity and requirements.
  - ✓ Capacity of each Logical Volume and requirements.
  - ✓ Capacity of each Application Storage Unit (ASU) and requirements.
- An appropriate diagram of the Benchmark Configuration (BC)/Tested Storage Configuration (TSC).
- Physical verification of the components to mach the above diagram.

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643 Bair Island Road, Suite 103
Redwood City, CA 94062
AuditService@storageperformance.org
650.556.9384

AUDIT CERTIFICATION *(CONT.)*

- Listings and commands to configure the Benchmark Configuration/Tested Storage Configuration, including customer tunable parameters.
- Commands and parameters used to configure the SPC-1 Workload Generator.
- The following Host System requirements were verified by physical inspection and information supplied by Texas Memory Systems, Inc.:
  - ✓ The type of each Host System including the number of processors and main memory.
  - ✓ The presence and version number of the Workload Generator on each Host System.
  - ✓ The TSC boundary within each Host System.
- The execution of each Test, Test Phase, and Test Run was observed and found compliant with all of the requirements and constraints of Clauses 4 and 5 of the SPC-1 Benchmark Specification.
- The Test Results Files and resultant Summary Results Files received from Texas Memory Systems, Inc. for each of following were authentic, accurate, and compliant with all of the requirements and constraints of Clauses 4 and 5 of the SPC-1 Benchmark Specification:
  - ✓ Data Persistence Test
  - ✓ Sustainability Test Phase
  - ✓ IOPS Test Phase
  - ✓ Response Time Ramp Test Phase
  - ✓ Repeatability Test
- There were no differences between the Tested Storage Configuration (TSC) used for the benchmark and Priced Storage Configuration.
- The submitted pricing information met all of the requirements and constraints of Clause 8 of the SPC-1 Benchmark Specification.
- The Full Disclosure Report (FDR) met all of the requirements in Clause 9 of the SPC-1 Benchmark Specification.

Audit Notes:

There were no audit notes or exceptions.

Respectfully,

Walter E. Baker

Walter E. Baker
SPC Auditor

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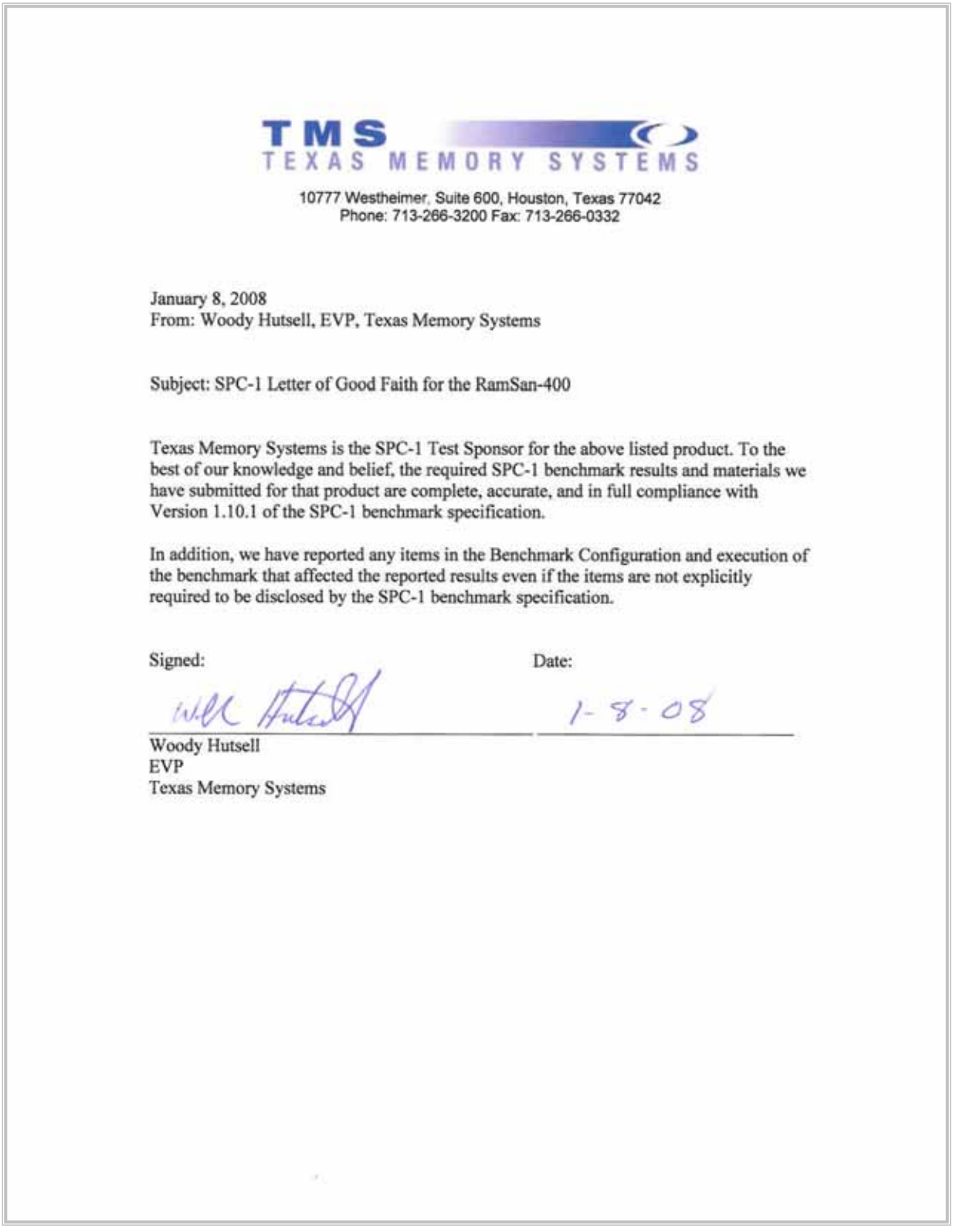
LETTER OF GOOD FAITH



TMS
TEXAS MEMORY SYSTEMS

10777 Westheimer, Suite 600, Houston, Texas 77042
Phone: 713-266-3200 Fax: 713-266-0332

January 8, 2008
From: Woody Hutsell, EVP, Texas Memory Systems

Subject: SPC-1 Letter of Good Faith for the RamSan-400

Texas Memory Systems is the SPC-1 Test Sponsor for the above listed product. To the best of our knowledge and belief, the required SPC-1 benchmark results and materials we have submitted for that product are complete, accurate, and in full compliance with Version 1.10.1 of the SPC-1 benchmark specification.

In addition, we have reported any items in the Benchmark Configuration and execution of the benchmark that affected the reported results even if the items are not explicitly required to be disclosed by the SPC-1 benchmark specification.

Signed: Date: 1-8-08

Woody Hutsell
EVP
Texas Memory Systems

EXECUTIVE SUMMARY

Test Sponsor and Contact Information

Test Sponsor and Contact Information	
Test Sponsor Primary Contact	Texas Memory Systems, Inc. – http://www.texmemsys.com/ Dan Scheel – dan.scheel@texmemsys.com 10777 Westheimer Road, Suite 600 Houston, TX 77042 Phone (713) 266-3200 FAX: (713) 266-0332
Test Sponsor Alternate Contact	Texas Memory Systems, Inc. – http://www.texmemsys.com/ Matt Key – matt.k@texmemsys.com 10777 Westheimer Road, Suite 600 Houston, TX 77042 Phone (713) 266-3200 FAX: (713) 266-0332
Auditor	Storage Performance Council – http://www.storageperformance.org Walter E. Baker – AuditService@StoragePerformance.org 643 Bair Island Road, Suite 103 Redwood City, CA 94063 Phone: (650) 556-9384 FAX: (650) 556-9385

Revision Information and Key Dates

Revision Information and Key Dates	
SPC-1 Specification revision number	V1.10.1
SPC-1 Workload Generator revision number	V2.00.04a
Date Results were first used publicly	January 28, 2008
Date the FDR was submitted to the SPC	January 28, 2008
Date the TSC is available for shipment to customers	currently available
Date the TSC completed audit certification	January 25, 2008

Tested Storage Product (TSP) Description

The RamSan-400 is a scalable DDR RAM storage device ideal for storing performance-demanding data and accelerating application performance. It is equipped with up to 8 4Gb Fibre Channel ports or 4 4x InfiniBand ports and is recognized as any other storage device to the network. With a bandwidth of 3GB/s it is capable of over 400,000 IOPS with less than 15 microseconds of latency. With the RamSan-400's intuitive software, up to 1024 LUNs can be partitioned per system.

There is no tradeoff in reliability for all this performance. The RamSan-400 includes hot-swappable redundancies wherever physical wear is a factor, such as power supplies and backup hard disks. It also includes three independent internal UPS systems to ensure that no power loss or power supply failure will stop the RamSan from performing its internal backup procedures. Redundant cooling fans, redundant data ports and ChipKill protected memory are also part of the sophisticated design.

Summary of Results

SPC-1 Results	
Tested Storage Configuration (TSC) Name: Texas Memory Systems RamSan-400	
Metric	**Reported Result**
SPC-1 IOPS™	291,208.58
SPC-1 Price-Performance	$0.67/SPC-1 IOPS™
Total ASU Capacity	137.439 GB
Data Protection Level	Other Data Protection
Total TSC Price (including three-year maintenance)	$194,785

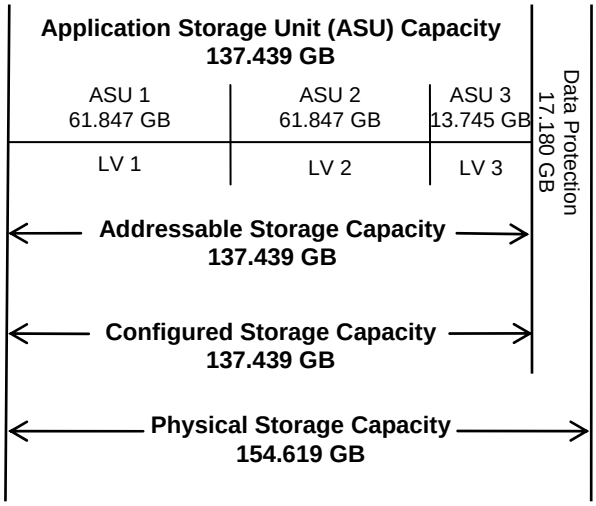
SPC-1 IOPS™ represents the maximum I/O Request Throughput at the 100% load point.

Total ASU (Application Storage Unit) **Capacity** represents the total storage capacity read and written in the course of executing the SPC-1 benchmark.

A **Data Protection Level** of Other Protection Level was used. Data protection was accomplished with the use of Error Correction Code (ECC) and Chipkill layout. The ECC hardware stored an additional eight bits of parity data for every 64-bit word while the Chipkill layout allocates each bit to a separate memory chip. During read requests the hardware uses the parity data to detect data corruption. Any failure within a memory chip, or an entire chip failure, is seen as a single-bit error in ECC and is corrected at wire speed. If maintenance is unaddressed, and multiple chip failures occur, then this is seen as a multi-bit ECC error and is uncorrectable. Both levels of ECC events are reported upon occurrence. For more information regarding Chipkill, please see http://www-05.ibm.com/hu/termekismertetok/xseries/dn/chipkill.pdf.

Storage Capacities and Relationships

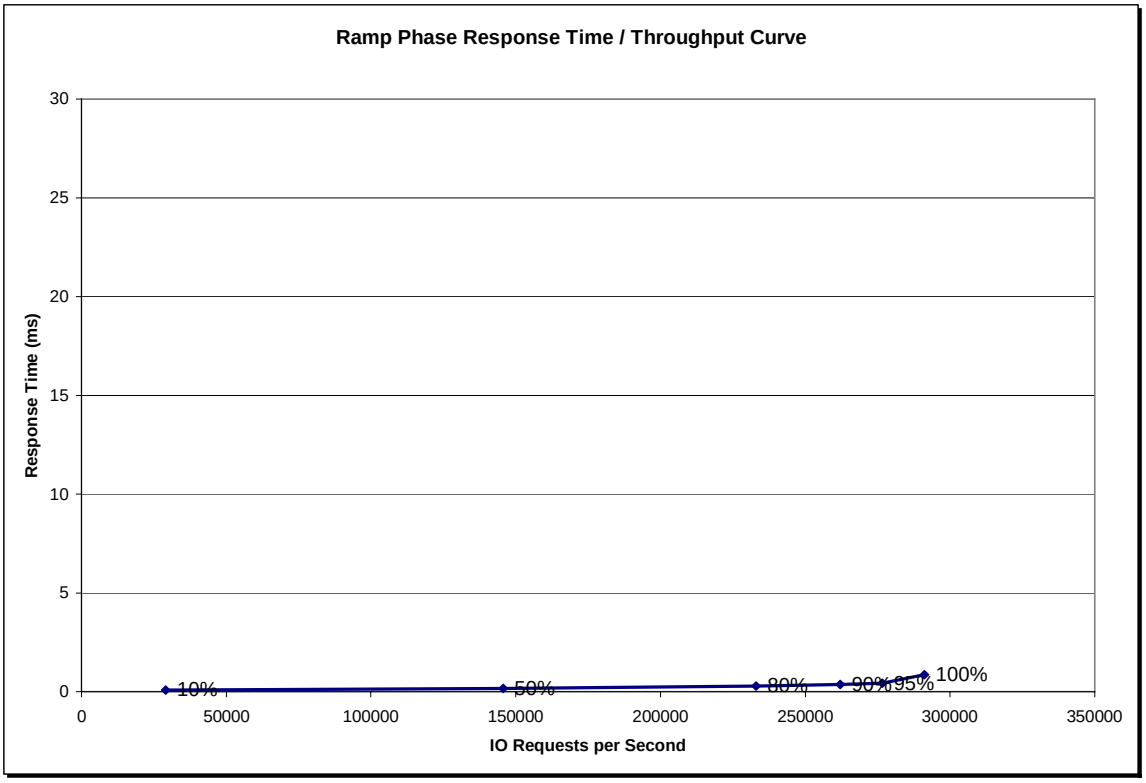
The following diagram documents the various storage capacities, used in this benchmark, and their relationships.



Response Time – Throughput Curve

The Response Time-Throughput Curve illustrates the Average Response Time (milliseconds) and I/O Request Throughput at 100%, 95%, 90%, 80%, 50%, and 10% of the workload level used to generate the SPC-1 IOPS™ metric.

The Average Response Time measured at any of the above load points cannot exceed 30 milliseconds or the benchmark measurement is invalid.



Response Time – Throughput Data

	10% Load	50% Load	80% Load	90% Load	95% Load	100% Load
I/O Request Throughput	29,108.36	145,605.79	232,991.56	262,089.32	276,655.51	291,208.58
Average Response Time (ms):						
All ASUs	0.09	0.16	0.29	0.37	0.43	0.86
ASU-1	0.08	0.15	0.28	0.36	0.41	0.90
ASU-2	0.09	0.16	0.27	0.35	0.42	0.74
ASU-3	0.11	0.20	0.33	0.41	0.49	0.83
Reads	0.08	0.15	0.28	0.35	0.40	0.87
Writes	0.10	0.18	0.31	0.39	0.45	0.86

Tested Storage Configuration Pricing *(Priced Storage Configuration)*

TMS TEXAS MEMORY SYSTEMS

Quote

10777 Westheimer Road, Suite 600, Houston, TX 77042
Phone: 713-266-3200 | Fax: 713-266-0332 | sales@superssd.com

Quote #: JB080109 A
Date 1/9/2008

Quote to: **Contact:**

Ln #	Qty	Part	Description	Unit Price	Ext. Price
HARDWARE					
1	1	U-RamSan-400/128GB	128-GB RamSan-400 Includes: 128-GB DDR RAM Storage (Upgradeable to 128-GB), One dual ported 4-Gb fibre Channel controller (FC-400) or 1 single ported 4x InfiniBand controller (IB-900). Hot swappable hard disk drives and power supplies. Redundant battery and fans.	$ 81,200	$ 81,200
2	3	U-FC-400	Additional dual 4-Gb fibre Channel link	$ 3,000	$ 9,000
3	1	U-Active Backup	Firmware feature that constantly writes data from memory to disk drives.	$ 4,000	$ 4,000
HARDWARE SUB-TOTAL					**$ 94,200**
SUPPORT					
4	1	U-Critical-Year1	Advanced Parts Replacement with 7x24x4 onsite service for one year, which must run concurrent with first year of warranty. If this SKU is ordered, [24x7-Phone-Support] and [SparesKit-3U] must be ordered per site. Customer is responsible for shipping. Price and availability may vary based on location.	$4000/unit	$ 4,000
5	1	U-Critical-AddYr	Advanced Parts Replacement with 7x24x4 onsite service for one year. [24x7-Phone-Support] must be ordered per site. Customer is responsible for shipping. Price and availability may vary based on location. Maximum of two additional years of on-site service can be ordered. [$4000/unit + 5% of hardware list price]	$4000/unit + 5% of hardware list price	$ 8,710
6	1	U-Critical-AddYr	Advanced Parts Replacement with 7x24x4 onsite service for one year. [24x7-Phone-Support] must be ordered per site. Customer is responsible for shipping. Price and availability may vary based on location. Maximum of two additional years of on-site service can be ordered. [$4000/unit + 5% of hardware list price]	$4000/unit + 5% of hardware list price	$ 8,710
7	3	U-24x7-Phone-Support	One-year 24x7 technical support by phone per site.	$ 1,000	$ 3,000
8	1	U-SparesKit-3U	Includes 1 Power Supply, 1 Disk Drive, 1 Fan Bank.	$ 1,150	$ 1,150
SUPPORT SUB-TOTAL					**$ 25,570**
ADDITIONAL ITEMS					
9	16	U-QLE2462-CK	QLogic 4 Gbit PCI-X HBA, Dual Ported	$ 2,795	$ 44,720
10	3	U-SB5600-20A-E	Qlogic fibre Channel Switch (16) 4Gb & (4) 10Gb Ports, (16) SFP's, (1) power supply.	$ 9,325	$ 27,975
11	40	U-LC/LC-Dupl-50/125-Riser-5M	5M fibre Channel Cables	$ 53	$ 2,120
ADDITIONAL ITEMS SUB-TOTAL					**$ 74,815**
12	1	Shipping	Overnight courier service	$200	$ 200

TOTAL PURCHASE PRICE **$ 194,785**

Quote is valid until 02/08/2008
Delivery is within 30 days after order is placed.
Payment terms: Net 30 (1.5% penalty per month late)

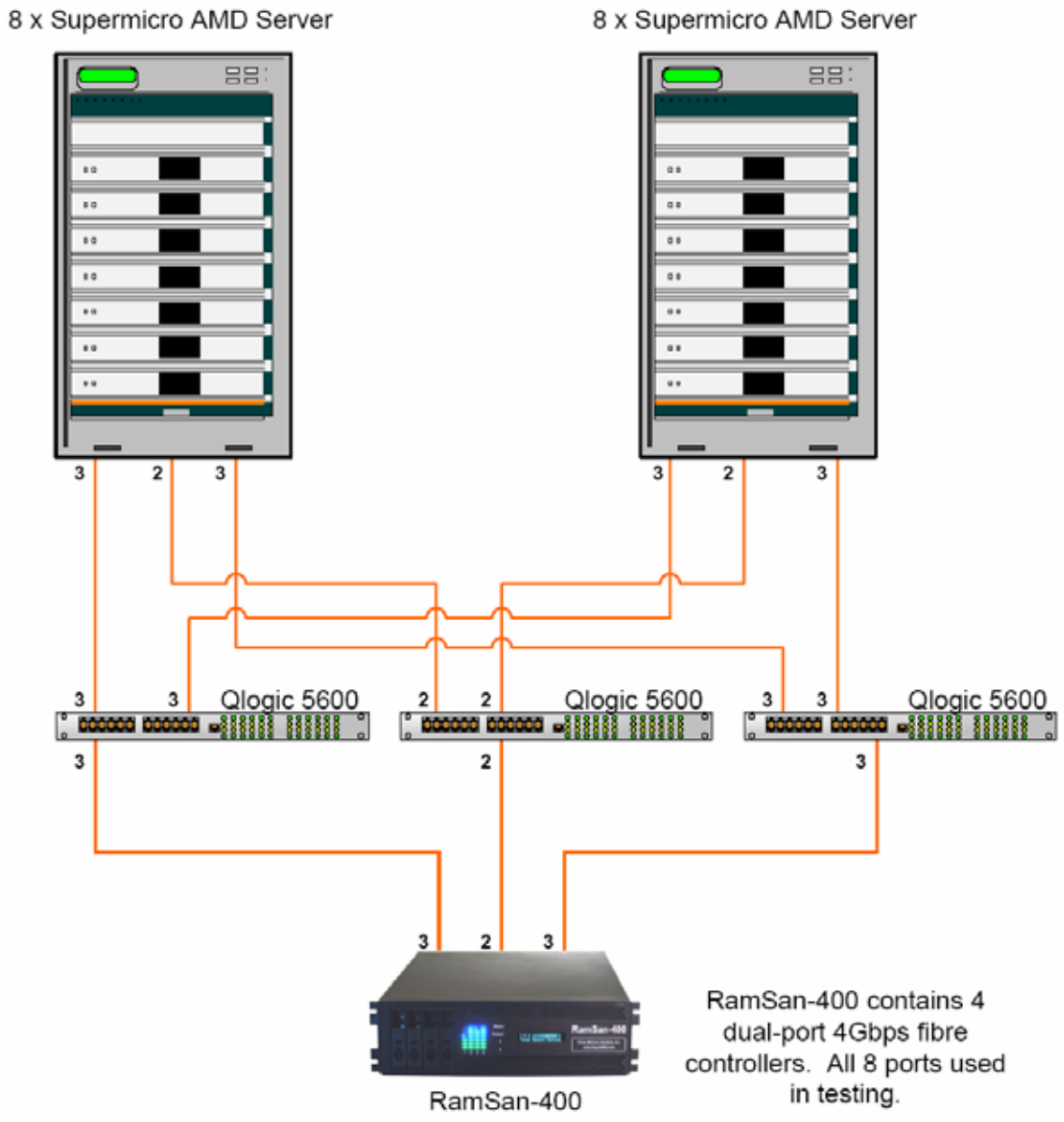
Texas Memory Systems Quote - Page 1 of 1

Quote provided by: Jamon Bowen
jamon.b@ramsan.com
Purchase orders can be faxed to: 713-266-0332

Differences between the Tested Storage Configuration (TSC) and Priced Storage Configuration

There were no differences between the Tested Storage Configuration and the Priced Storage Configuration.

Benchmark Configuration/Tested Storage Configuration Diagram



Benchmark Configuration/Tested Storage Configuration Components

Host System:	Tested Storage Configuration (TSC):
16 – Supermicro AMD Opteron Servers, each with:	16 – Qlogic QLE2462 4Gb dual-port PCIe HBAs
2 – AMD Opteron Model 275 dual core 2.2 GHz CPUs	3 – Qlogic 5600 Switches
2 x 1024 KB L2 cache per CPU	**Texas Memory Systems RamSan-400**
4 GB main memory	4 – dual port 4Gbps fibre controllers
Windows Server 2003 Enterprise Edition with SP2	8 – 4Gb FC ports
PCIe	4 – hot swappable RAID-3 backup disks
WG	

In each of the following sections of this document, the appropriate Full Disclosure Report requirement, from the SPC-1 benchmark specification, is stated in italics followed by the information to fulfill the stated requirement.

CONFIGURATION INFORMATION

Benchmark Configuration (BC)/Tested Storage Configuration (TSC) Diagram

Clause 9.2.4.4.1

A one page Benchmark Configuration (BC)/Tested Storage Configuration (TSC) diagram shall be included in the Executive Summary…

The Benchmark Configuration (BC)/Tested Storage Configuration (TSC) is illustrated on page 14 *(Benchmark Configuration/Tested Storage Configuration Diagram).*

Storage Network Configuration

Clause 9.2.4.4.1

…

5. *If the TSC contains network storage, the diagram will include the network configuration. If a single diagram is not sufficient to illustrate both the Benchmark Configuration and network configuration in sufficient detail, the Benchmark Configuration diagram will include a high-level network illustration as shown in Figure 9-8. In that case, a separate, detailed network configuration diagram will also be included as described in Clause 9.2.4.4.2.*

Clause 9.2.4.4.2

If a storage network was configured as a part of the Tested Storage Configuration and the Benchmark Configuration diagram described in Clause 9.2.4.4.1 contains a high-level illustration of the network configuration, the Executive Summary will contain a one page topology diagram of the storage network as illustrated in Figure 9-9.

The Benchmark Configuration (BC)/Tested Storage Configuration (TSC) was configured with local storage and, as such, did not employ a storage network.

Host System Configuration

Clause 9.2.4.4.3

The FDR shall minimally contain, for each Host System running the Workload Generator, a listing of the following:

1. *Number and type of CPUs.*
2. *Main memory capacity.*
3. *Cache memory capacity.*
4. *Number and type of disk controllers or Host Bus Adapters.*

The details of the Host System configuration may be found on page 14 *(Benchmark Configuration/Tested Storage Configuration Diagram).*

Customer Tunable Parameters and Options

Clause 9.2.4.5.1

All Benchmark Configuration (BC) components with customer tunable parameter and options that have been altered from their default values must be listed in the FDR. The FDR entry for each of those components must include both the name of the component and the altered value of the parameter or option. If the parameter name is not self-explanatory to a knowledgeable practitioner, a brief description of the parameter's use must also be included in the FDR entry.

"Appendix B: Customer Tunable Parameters and Options" on page 59 contains the customer tunable parameters and options that have been altered from their default values for this benchmark.

Tested Storage Configuration (TSC) Description

Clause 9.2.4.5.2

The FDR must include sufficient information to recreate the logical representation of the TSC. In addition to customer tunable parameters and options (Clause 4.2.4.5.3), that information must include, at a minimum:

- *A diagram and/or description of the following:*
  - *All physical components that comprise the TSC. Those components are also illustrated in the BC Configuration Diagram in Clause 9.2.4.4.1 and/or the Storage Network Configuration Diagram in Clause 9.2.4.4.2.*
  - *The logical representation of the TSC, configured from the above components that will be presented to the Workload Generator.*
- *Listings of scripts used to create the logical representation of the TSC.*
- *If scripts were not used, a description of the process used with sufficient detail to recreate the logical representation of the TSC.*

"Appendix C: Tested Storage Configuration (TSC) Creation" on page 60 contains the detailed information that describes how to create and configure the logical TSC.

SPC-1 Workload Generator Storage Configuration

Clause 9.2.4.5.3

The FDR must include all SPC-1 Workload Generator storage configuration commands and parameters.

The SPC-1 Workload Generator storage configuration commands and parameters for this measurement appear in "Appendix D: SPC-1 Workload Generator Storage Commands and Parameters" on page 62.

SPC-1 DATA REPOSITORY

This portion of the Full Disclosure Report presents the detailed information that fully documents the various SPC-1 storage capacities and mappings used in the Tested Storage Configuration. "SPC-1 Data Repository Definitions" on page 55 contains definitions of terms specific to the SPC-1 Data Repository.

Storage Capacities and Relationships

Clause 9.2.4.6.1

Two tables and an illustration documenting the storage capacities and relationships of the SPC-1 Storage Hierarchy (Clause 2.1) shall be included in the FDR.

SPC-1 Storage Capacities

SPC-1 Storage Capacities		
Storage Hierarchy Component	**Units**	**Capacity**
Total ASU Capacity	Gigabytes (GB)	137.439
Addressable Storage Capacity	Gigabytes (GB)	137.439
Configured Storage Capacity	Gigabytes (GB)	137.439
Physical Storage Capacity	Gigabytes (GB)	154.619
Data Protection *(Other Data Protection)*	Gigabytes (GB)	17.180
Required Storage	Gigabytes (GB)	0.000
Global Storage Overhead	Gigabytes (GB)	0.000
Total Unused Storage	Gigabytes (GB)	0.000

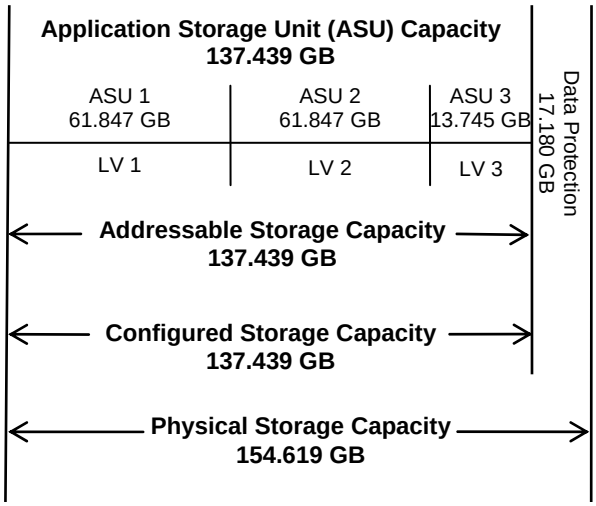
SPC-1 Storage Hierarchy Ratios

	Addressable Storage Capacity	**Configured Storage Capacity**	**Physical Storage Capacity**
Total ASU Capacity	100.00%	100.00%	88.89%
Required for Data Protection (Other)		12.50%	11.11%
Addressable Storage Capacity		100.00%	88.89%
Required Storage		0.00%	0.00%
Configured Storage Capacity			88.89%
Global Storage Overhead			0.00%
Unused Storage:			
Addressable	0.00%		
Configured		0.00%	
Physical			0.00%

The Physical Storage Capacity consisted of 154.619 GB of solid state storage, which consisted of 137.439 GB of available capacity plus 17.180 GB for data protection (ECC/Chipkill). There was 0.000 GB (0.00%) of Unused Storage within the Physical Storage Capacity. Global Storage Overhead consisted of 0.000 GB (0.00%) of Physical Storage Capacity. There was 0.000 GB (0.00%) of Unused Storage within the Configured Storage Capacity. The Total ASU Capacity utilized 100.00% of the Addressable Storage Capacity resulting in 0.000 GB (0.00%) of Unused Storage within the Addressable Storage Capacity.

SPC-1 Storage Capacities and Relationships Illustration

The various storage capacities configured in the benchmark result are illustrated below (not to scale).



Logical Volume Capacity and ASU Mapping

Clause 9.2.4.6.2

A table illustrating the capacity of each ASU and the mapping of Logical Volumes to ASUs shall be provided in the FDR. … Logical Volumes shall be sequenced in the table from top to bottom per its position in the contiguous address space of each ASU. The capacity of each Logical Volume shall be stated. … In conjunction with this table, the Test Sponsor shall provide a complete description of the type of data protection (see Clause 2.4.5) used on each Logical Volume.

Logical Volume Capacity and Mapping		
ASU-1 (61.847 GB)	**ASU-2 (61.847 GB)**	**ASU-3 (13.745 GB)**
1 Logical Volume 61.847 GB per Logical Volume (61.847 GB used per Logical Volume)	1 Logical Volume 61.847 GB per Logical Volume (61.847 GB used per Logical Volume)	1 Logical Volume 13.745 GB per Logical Volume (13.745 GB used per Logical Volume)

The Data Protection Level used for all Logical Volumes was Other Data Protection as described on page 11. See "ASU Configuration" in the **IOPS Test Results File** for more detailed configuration information.

SPC-1 BENCHMARK EXECUTION RESULTS

This portion of the Full Disclosure Report documents the results of the various SPC-1 Tests, Test Phases, and Test Runs. "SPC-1 Test Execution Definitions" on page 56 contains definitions of terms specific to the SPC-1 Tests, Test Phases, and Test Runs.

Clause 5.4.3

The Tests must be executed in the following sequence: Primary Metrics, Repeatability, and Data Persistence. That required sequence must be uninterrupted from the start of Primary Metrics to the completion of Persistence Test Run 1. Uninterrupted means the Benchmark Configuration shall not be power cycled, restarted, disturbed, altered, or adjusted during the above measurement sequence. If the required sequence is interrupted other than for the Host System/TSC power cycle between the two Persistence Test Runs, the measurement is invalid.

SPC-1 Tests, Test Phases, and Test Runs

The SPC-1 benchmark consists of the following Tests, Test Phases, and Test Runs:

- **Primary Metrics Test**
  - Sustainability Test Phase and Test Run
  - IOPS Test Phase and Test Run
  - Response Time Ramp Test Phase
    - 95% of IOPS Test Run
    - 90% of IOPS Test Run
    - 80% of IOPS Test Run
    - 50% of IOPS Test Run
    - 10% of IOPS Test Run (LRT)
- **Repeatability Test**
  - Repeatability Test Phase 1
    - 10% of IOPS Test Run (LRT)
    - IOPS Test Run
  - Repeatability Test Phase 2
    - 10% of IOPS Test Run (LRT)
    - IOPS Test Run
- **Data Persistence Test**
  - Data Persistence Test Run 1
  - Data Persistence Test Run 2

Each Test is an atomic unit that must be executed from start to finish before any other Test, Test Phase, or Test Run may be executed.

The results from each Test, Test Phase, and Test Run are listed below along with a more detailed explanation of each component.

Primary Metrics Test – Sustainability Test Phase

Clause 5.4.4.1.1

The Sustainability Test Phase has exactly one Test Run and shall demonstrate the maximum sustainable I/O Request Throughput within at least a continuous three (3) hour Measurement Interval. This Test Phase also serves to insure that the TSC has reached Steady State prior to reporting the final maximum I/O Request Throughput result (SPC-1 IOPS™).

Clause 5.4.4.1.2

The computed I/O Request Throughput of the Sustainability Test must be within 5% of the reported SPC-1 IOPS™ result.

Clause 5.4.4.1.4

The Average Response Time, as defined in Clause 5.1.1, will be computed and reported for the Sustainability Test Run and cannot exceed 30 milliseconds. If the Average Response time exceeds that 30-milliseconds constraint, the measurement is invalid.

Clause 9.2.4.7.1

For the Sustainability Test Phase the FDR shall contain:

1. *A Data Rate Distribution graph and data table.*
2. *I/O Request Throughput Distribution graph and data table.*
3. *A Response Time Frequency Distribution graph and table.*
4. *An Average Response Time Distribution graph and table.*
5. *The human readable Test Run Results File produced by the Workload Generator (may be included in an appendix).*
6. *A listing or screen image of all input parameters supplied to the Workload Generator (may be included in an appendix).*
7. *The Measured Intensity Multiplier for each I/O stream.*
8. *The variability of the Measured Intensity Multiplier, as defined in Clause 5.3.13.3.*

SPC-1 Workload Generator Input Parameters

The SPC-1 Workload Generator input parameters for the Sustainability, IOPS, Response Time Ramp, Repeatability, and Persistence Test Runs are documented in "Appendix E: SPC-1 Workload Generator Input Parameters" on Page 63.

Sustainability Test Results File

A link to the test results file generated from the Sustainability Test Run is listed below.

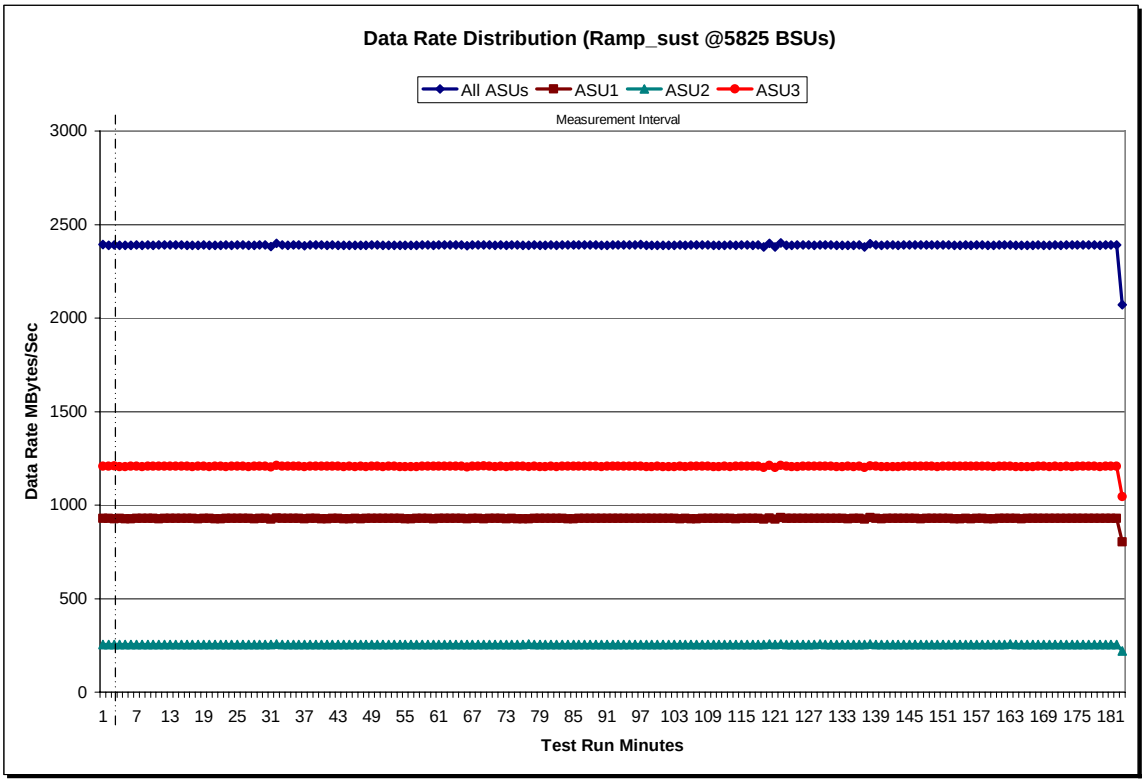
Sustainability Test Results File

Sustainability – Data Rate Distribution Data *(MB / second)*

	Start	Stop	Interval	Duration
Ramp-Up/Start-Up	7:30:27	7:33:27	0-2	0:03:00
Measurement Interval	7:33:27	10:33:27	3-182	3:00:00

Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3
0	2,392.58	929.49	255.38	1,207.71	63	2,390.59	927.83	255.13	1,207.63	126	2,390.99	928.68	255.08	1,207.23
1	2,389.77	927.78	255.21	1,206.77	64	2,390.32	928.40	255.02	1,206.90	127	2,389.52	927.74	254.58	1,207.20
2	2,391.10	927.51	255.14	1,208.45	65	2,385.60	926.55	255.14	1,203.91	128	2,391.98	928.75	256.09	1,207.14
3	2,389.46	928.23	255.17	1,206.06	66	2,390.90	928.65	255.39	1,206.87	129	2,391.18	927.68	255.38	1,208.12
4	2,388.94	927.42	255.47	1,206.06	67	2,390.80	928.05	255.36	1,207.39	130	2,391.16	928.76	255.59	1,206.81
5	2,389.09	927.53	254.80	1,206.76	68	2,390.49	927.18	254.87	1,208.44	131	2,389.09	928.03	254.84	1,206.21
6	2,390.22	927.84	255.69	1,206.69	69	2,391.61	928.29	255.32	1,208.00	132	2,389.17	928.21	254.90	1,206.06
7	2,389.40	928.71	255.02	1,205.67	70	2,389.13	928.39	254.71	1,206.02	133	2,388.88	927.34	255.12	1,206.42
8	2,390.09	928.28	254.88	1,206.93	71	2,391.28	929.09	255.73	1,206.47	134	2,388.41	928.13	254.99	1,205.28
9	2,389.53	928.12	255.14	1,206.27	72	2,388.64	927.10	255.36	1,206.18	135	2,391.30	927.68	255.85	1,207.77
10	2,389.89	927.60	255.14	1,207.15	73	2,390.71	928.37	255.50	1,206.85	136	2,380.09	924.25	254.00	1,201.84
11	2,390.20	927.82	255.25	1,207.14	74	2,390.09	927.58	255.36	1,207.16	137	2,398.19	932.20	256.02	1,209.96
12	2,390.09	928.17	255.27	1,206.66	75	2,389.58	927.12	255.50	1,206.97	138	2,390.54	928.04	255.27	1,207.23
13	2,390.09	928.05	255.74	1,206.30	76	2,389.61	927.41	256.07	1,206.13	139	2,388.54	927.56	254.75	1,206.22
14	2,390.51	928.58	255.17	1,206.77	77	2,390.78	928.94	255.46	1,206.38	140	2,390.09	929.02	255.12	1,205.95
15	2,389.56	928.33	254.92	1,206.31	78	2,388.97	927.93	254.82	1,206.22	141	2,390.03	928.85	255.36	1,205.82
16	2,389.38	927.76	255.85	1,205.77	79	2,388.90	928.05	255.14	1,205.71	142	2,389.20	928.39	254.76	1,206.04
17	2,389.45	927.39	255.55	1,206.52	80	2,391.37	928.89	255.31	1,207.17	143	2,391.08	928.27	255.37	1,207.44
18	2,389.90	927.77	255.78	1,206.35	81	2,389.64	928.37	255.50	1,205.77	144	2,389.91	927.66	254.84	1,207.41
19	2,389.24	928.68	255.23	1,205.33	82	2,390.74	928.42	255.31	1,207.01	145	2,390.85	928.15	255.60	1,207.10
20	2,389.75	927.55	254.79	1,207.41	83	2,390.44	927.34	255.02	1,208.08	146	2,390.23	927.45	255.25	1,207.53
21	2,389.85	927.22	255.20	1,207.43	84	2,390.93	927.38	255.65	1,207.90	147	2,390.53	928.30	254.92	1,207.31
22	2,390.03	928.30	255.55	1,206.18	85	2,390.26	927.97	254.91	1,207.38	148	2,389.96	927.83	255.22	1,206.92
23	2,389.70	927.72	255.21	1,206.77	86	2,390.24	928.05	255.33	1,206.86	149	2,390.06	928.58	255.40	1,206.09
24	2,390.64	928.07	255.01	1,207.55	87	2,391.85	929.01	255.65	1,207.19	150	2,390.06	928.33	255.16	1,206.57
25	2,391.36	928.58	255.78	1,207.00	88	2,391.45	928.45	255.24	1,207.76	151	2,390.87	929.00	255.28	1,206.59
26	2,388.11	927.66	255.25	1,205.20	89	2,389.34	928.39	255.75	1,205.20	152	2,389.54	927.43	255.48	1,206.62
27	2,389.47	927.34	255.10	1,207.04	90	2,389.54	927.92	254.99	1,206.63	153	2,388.67	927.23	254.95	1,206.49
28	2,390.80	927.73	254.96	1,208.11	91	2,389.95	927.81	255.48	1,206.65	154	2,391.26	928.19	255.88	1,207.20
29	2,390.22	928.03	255.24	1,206.94	92	2,391.43	928.19	255.71	1,207.53	155	2,389.55	927.48	255.58	1,206.49
30	2,381.86	924.32	254.67	1,202.87	93	2,391.17	928.24	255.44	1,207.50	156	2,390.22	928.01	255.83	1,206.38
31	2,399.27	930.81	256.23	1,212.24	94	2,391.82	928.65	255.43	1,207.75	157	2,389.90	928.05	255.24	1,206.61
32	2,390.43	928.35	255.33	1,206.74	95	2,390.20	927.95	255.40	1,206.85	158	2,388.72	926.72	254.71	1,207.30
33	2,389.65	927.76	254.99	1,206.90	96	2,392.16	928.72	255.41	1,208.04	159	2,389.03	927.57	255.49	1,205.96
34	2,390.23	928.27	255.38	1,206.58	97	2,388.85	928.43	255.45	1,204.97	160	2,391.09	928.79	255.82	1,206.47
35	2,390.91	928.19	255.18	1,207.54	98	2,388.50	928.22	255.42	1,204.87	161	2,390.98	928.74	254.97	1,207.27
36	2,387.38	926.69	255.08	1,205.61	99	2,389.37	928.32	254.42	1,206.64	162	2,391.43	928.00	256.33	1,207.10
37	2,390.43	928.60	255.00	1,206.83	100	2,388.83	927.85	255.59	1,205.39	163	2,388.98	927.97	255.55	1,205.45
38	2,390.68	928.80	255.28	1,206.60	101	2,388.43	928.07	255.09	1,205.28	164	2,387.78	927.35	255.48	1,204.95
39	2,390.28	927.53	255.88	1,206.86	102	2,389.55	928.45	255.19	1,205.91	165	2,389.71	928.69	255.13	1,205.89
40	2,389.12	927.59	255.24	1,206.29	103	2,390.38	927.58	255.11	1,207.69	166	2,389.15	927.94	255.23	1,205.98
41	2,390.05	927.96	255.01	1,207.08	104	2,388.75	928.30	255.44	1,205.00	167	2,390.90	928.84	255.20	1,206.86
42	2,389.31	927.68	255.15	1,206.48	105	2,390.50	927.56	255.26	1,207.68	168	2,389.42	927.81	255.17	1,206.45
43	2,387.90	927.42	255.88	1,204.59	106	2,390.89	927.59	255.51	1,207.79	169	2,387.86	928.47	254.84	1,204.56
44	2,389.55	927.30	255.55	1,206.70	107	2,391.69	928.62	255.57	1,207.50	170	2,391.38	928.63	255.61	1,207.14
45	2,389.69	929.10	255.17	1,205.43	108	2,390.59	928.25	255.45	1,206.89	171	2,389.43	927.82	255.67	1,205.95
46	2,389.54	927.26	255.73	1,206.54	109	2,389.26	927.95	255.60	1,205.71	172	2,390.08	927.91	255.23	1,206.94
47	2,389.16	927.77	255.28	1,206.11	110	2,389.79	928.47	255.35	1,205.97	173	2,389.86	928.40	255.25	1,206.20
48	2,389.98	928.15	255.48	1,206.35	111	2,389.79	928.09	255.23	1,206.46	174	2,389.87	928.31	254.68	1,206.87
49	2,390.13	927.84	255.22	1,207.06	112	2,389.98	928.12	255.84	1,206.03	175	2,391.69	928.74	255.64	1,207.32
50	2,389.49	928.41	255.10	1,205.97	113	2,389.70	927.28	255.83	1,206.59	176	2,390.16	928.85	254.86	1,206.44
51	2,389.29	927.87	254.76	1,206.66	114	2,391.59	928.41	255.58	1,207.60	177	2,391.50	928.67	254.87	1,207.96
52	2,389.66	927.93	255.33	1,206.39	115	2,390.38	928.55	254.85	1,206.98	178	2,388.98	927.99	255.79	1,205.20
53	2,388.74	928.06	255.50	1,205.18	116	2,389.51	928.16	254.61	1,206.74	179	2,390.05	928.13	255.33	1,206.59
54	2,388.84	927.46	255.17	1,206.21	117	2,390.37	928.16	254.92	1,207.29	180	2,390.67	928.08	255.33	1,207.27
55	2,388.41	927.17	255.37	1,205.87	118	2,379.19	924.49	254.06	1,200.64	181	2,390.91	928.53	255.33	1,207.04
56	2,389.76	928.56	255.14	1,206.06	119	2,399.04	931.80	256.25	1,210.99	182	2,070.34	803.92	220.74	1,045.69
57	2,391.62	928.31	255.91	1,207.41	120	2,379.95	924.36	254.38	1,201.21					
58	2,390.75	928.72	255.41	1,206.61	121	2,401.19	932.31	256.69	1,212.18					
59	2,389.20	927.24	255.08	1,206.89	122	2,389.71	928.10	254.84	1,206.77					
60	2,391.34	928.81	255.12	1,207.41	123	2,389.23	928.11	255.42	1,205.70					
61	2,389.87	928.20	255.32	1,206.35	124	2,390.26	929.12	255.18	1,205.96					
62	2,390.27	927.71	254.78	1,207.78	125	2,391.60	928.10	255.40	1,208.11					

Sustainability – Data Rate Distribution Graph

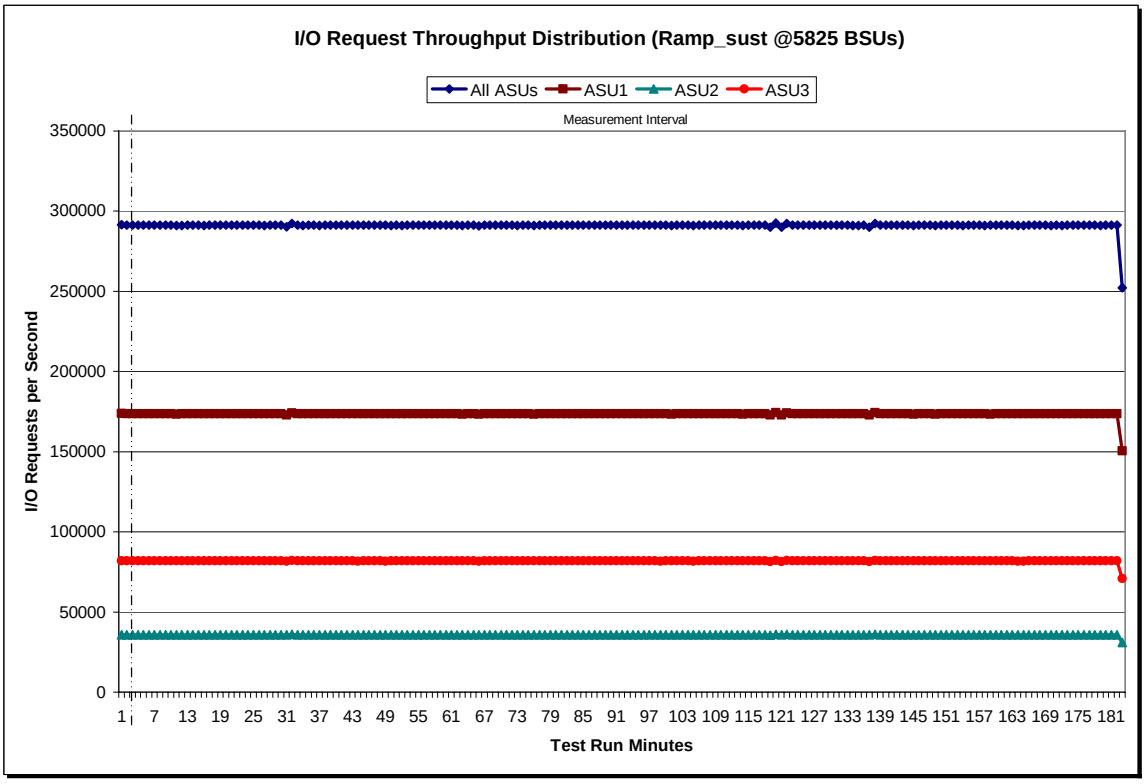


Sustainability – I/O Request Throughput Distribution Data

	Start	Stop	Interval	Duration
Ramp-Up/Start-Up	7:30:27	7:33:27	0-2	0:03:00
Measurement Interval	7:33:27	10:33:27	3-182	3:00:00

Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3
0	291,519.32	173,743.80	35,852.02	81,923.50	63	291,217.35	173,496.08	35,829.87	81,891.40	126	291,342.18	173,646.27	35,829.87	81,866.05
1	291,316.52	173,581.77	35,816.37	81,918.38	64	291,286.40	173,627.35	35,781.38	81,877.67	127	291,213.05	173,564.60	35,772.60	81,875.85
2	291,235.72	173,563.75	35,804.15	81,867.82	65	290,871.77	173,372.65	35,778.83	81,720.28	128	291,333.95	173,615.68	35,856.62	81,861.65
3	291,202.92	173,540.05	35,835.68	81,827.18	66	291,394.35	173,712.15	35,814.35	81,867.85	129	291,390.78	173,621.75	35,844.08	81,924.95
4	291,245.53	173,550.80	35,832.83	81,861.90	67	291,211.20	173,535.05	35,804.47	81,871.68	130	291,365.40	173,689.33	35,843.43	81,832.63
5	291,206.13	173,555.93	35,777.73	81,872.47	68	291,261.08	173,558.95	35,798.60	81,903.53	131	291,236.50	173,606.20	35,798.55	81,831.75
6	291,229.75	173,557.63	35,858.85	81,813.27	69	291,342.98	173,616.17	35,848.55	81,878.27	132	291,344.20	173,657.90	35,839.08	81,847.22
7	291,209.73	173,577.40	35,810.28	81,822.05	70	291,174.72	173,511.95	35,836.82	81,825.95	133	291,153.85	173,511.60	35,810.93	81,831.32
8	291,239.27	173,609.88	35,804.47	81,824.92	71	291,331.78	173,661.93	35,839.90	81,829.95	134	291,120.47	173,528.10	35,805.68	81,786.68
9	291,172.45	173,548.52	35,839.57	81,784.37	72	291,150.15	173,572.38	35,783.42	81,794.35	135	291,253.43	173,506.15	35,846.08	81,901.20
10	291,155.30	173,476.05	35,815.57	81,863.68	73	291,393.92	173,663.35	35,870.67	81,859.90	136	290,081.97	172,888.68	35,705.37	81,487.92
11	291,158.12	173,552.47	35,804.17	81,801.48	74	291,265.42	173,598.30	35,833.93	81,833.18	137	292,393.48	174,352.93	35,917.53	82,123.02
12	291,243.38	173,572.55	35,839.92	81,830.92	75	291,153.05	173,484.82	35,822.80	81,845.43	138	291,198.15	173,565.22	35,810.77	81,822.17
13	291,257.03	173,574.98	35,855.00	81,827.05	76	291,202.83	173,552.90	35,852.58	81,797.35	139	291,177.60	173,572.08	35,802.07	81,803.45
14	291,265.58	173,623.53	35,825.02	81,817.03	77	291,250.00	173,608.30	35,851.13	81,790.57	140	291,299.48	173,689.12	35,807.28	81,803.08
15	291,162.02	173,571.48	35,804.98	81,785.55	78	291,260.63	173,581.83	35,798.00	81,880.80	141	291,404.72	173,694.97	35,870.62	81,839.13
16	291,208.40	173,515.57	35,819.23	81,873.60	79	291,246.95	173,637.77	35,800.50	81,808.68	142	291,289.45	173,590.82	35,804.50	81,894.13
17	291,198.53	173,568.22	35,811.85	81,818.47	80	291,346.92	173,641.55	35,836.48	81,868.88	143	291,221.55	173,565.90	35,830.95	81,824.70
18	291,273.53	173,578.42	35,848.40	81,846.72	81	291,272.15	173,625.73	35,850.05	81,796.37	144	291,128.50	173,465.17	35,806.85	81,856.48
19	291,246.70	173,579.47	35,847.80	81,819.43	82	291,273.87	173,592.18	35,806.83	81,874.85	145	291,287.40	173,612.53	35,801.13	81,873.73
20	291,192.45	173,575.75	35,780.37	81,836.33	83	291,264.10	173,516.48	35,870.52	81,877.10	146	291,269.78	173,565.10	35,820.15	81,884.53
21	291,239.93	173,537.35	35,820.73	81,881.85	84	291,257.75	173,499.45	35,849.02	81,909.28	147	291,368.08	173,693.25	35,803.43	81,871.40
22	291,281.40	173,639.47	35,825.67	81,816.27	85	291,249.67	173,551.10	35,820.52	81,878.05	148	291,109.38	173,455.55	35,820.03	81,833.80
23	291,194.12	173,595.60	35,785.40	81,813.12	86	291,167.72	173,494.72	35,813.78	81,859.22	149	291,319.92	173,663.85	35,844.27	81,811.80
24	291,208.55	173,556.57	35,804.88	81,847.10	87	291,284.60	173,646.32	35,840.30	81,797.98	150	291,317.65	173,683.12	35,799.27	81,835.27
25	291,362.75	173,686.32	35,862.72	81,813.72	88	291,237.20	173,548.08	35,828.90	81,860.22	151	291,257.93	173,602.23	35,820.87	81,834.83
26	291,142.82	173,506.77	35,832.48	81,803.57	89	291,191.63	173,565.07	35,833.18	81,793.38	152	291,281.25	173,596.98	35,811.43	81,872.83
27	291,294.27	173,626.52	35,806.90	81,860.85	90	291,307.23	173,606.35	35,827.23	81,873.65	153	291,123.78	173,521.22	35,790.45	81,812.12
28	291,199.72	173,545.07	35,798.33	81,856.32	91	291,208.72	173,551.82	35,846.15	81,810.75	154	291,304.53	173,624.07	35,871.58	81,808.88
29	291,184.98	173,577.80	35,807.73	81,799.45	92	291,258.68	173,575.65	35,861.38	81,821.65	155	291,191.80	173,530.02	35,825.42	81,836.37
30	290,195.12	172,951.23	35,710.57	81,533.32	93	291,229.58	173,569.43	35,795.63	81,864.52	156	291,355.83	173,625.72	35,891.37	81,838.75
31	292,402.52	174,195.50	36,010.95	82,196.07	94	291,340.78	173,613.32	35,817.72	81,909.75	157	291,113.17	173,508.77	35,811.03	81,793.37
32	291,349.35	173,653.00	35,830.60	81,865.75	95	291,337.43	173,631.33	35,811.88	81,894.22	158	291,188.25	173,478.83	35,836.55	81,872.87
33	291,160.47	173,544.93	35,814.67	81,800.87	96	291,313.77	173,591.92	35,851.50	81,870.35	159	291,256.95	173,600.27	35,851.55	81,805.13
34	291,232.47	173,546.18	35,843.12	81,843.17	97	291,212.75	173,583.18	35,819.10	81,810.47	160	291,304.53	173,659.28	35,822.23	81,823.02
35	291,229.18	173,539.02	35,812.87	81,877.30	98	291,288.32	173,702.97	35,834.35	81,751.00	161	291,317.95	173,614.30	35,823.23	81,880.42
36	291,145.70	173,496.02	35,840.27	81,809.42	99	291,265.80	173,624.08	35,769.92	81,871.80	162	291,256.68	173,525.83	35,864.05	81,866.80
37	291,308.22	173,618.68	35,832.92	81,856.62	100	291,094.45	173,479.70	35,792.87	81,821.88	163	291,132.98	173,552.97	35,842.92	81,737.10
38	291,296.67	173,583.92	35,862.70	81,850.05	101	291,221.37	173,585.75	35,841.20	81,794.42	164	291,079.02	173,508.55	35,809.07	81,761.40
39	291,252.43	173,533.47	35,855.62	81,863.35	102	291,289.57	173,617.10	35,796.40	81,876.07	165	291,368.33	173,709.18	35,806.95	81,852.20
40	291,232.23	173,582.70	35,813.38	81,836.15	103	291,240.47	173,538.73	35,784.38	81,917.35	166	291,180.57	173,554.50	35,825.93	81,800.13
41	291,230.10	173,516.92	35,845.78	81,867.40	104	291,149.38	173,595.17	35,829.43	81,724.78	167	291,382.42	173,706.53	35,834.08	81,841.80
42	291,284.58	173,597.27	35,813.45	81,873.87	105	291,181.67	173,537.58	35,813.38	81,830.70	168	291,269.25	173,597.32	35,840.38	81,831.55
43	291,207.78	173,600.30	35,881.78	81,725.70	106	291,262.77	173,566.97	35,780.13	81,915.67	169	291,115.97	173,556.62	35,791.22	81,768.13
44	291,223.23	173,538.97	35,843.10	81,841.17	107	291,408.20	173,700.53	35,811.60	81,896.07	170	291,314.05	173,643.90	35,832.12	81,838.03
45	291,277.27	173,603.75	35,847.62	81,825.90	108	291,264.18	173,577.47	35,838.28	81,848.43	171	291,127.90	173,490.42	35,815.10	81,822.38
46	291,219.97	173,492.93	35,893.98	81,833.05	109	291,299.62	173,601.73	35,852.40	81,845.48	172	291,246.02	173,583.30	35,813.68	81,849.03
47	291,203.85	173,587.07	35,846.72	81,770.07	110	291,179.07	173,581.95	35,791.63	81,805.48	173	291,215.37	173,544.20	35,809.87	81,861.30
48	291,265.13	173,687.05	35,814.98	81,763.10	111	291,209.38	173,529.92	35,823.82	81,855.65	174	291,275.35	173,671.08	35,779.92	81,824.35
49	291,144.17	173,515.28	35,807.72	81,821.17	112	291,399.27	173,673.80	35,849.87	81,875.60	175	291,378.27	173,661.05	35,839.53	81,877.68
50	291,309.15	173,709.95	35,817.07	81,782.13	113	291,161.38	173,470.10	35,848.27	81,843.02	176	291,332.07	173,700.57	35,810.25	81,821.25
51	291,148.62	173,530.47	35,787.40	81,830.75	114	291,368.58	173,621.97	35,850.55	81,896.07	177	291,284.25	173,565.25	35,792.63	81,926.37
52	291,313.43	173,627.37	35,843.50	81,842.57	115	291,251.63	173,596.15	35,790.02	81,865.47	178	291,160.50	173,530.80	35,845.37	81,784.33
53	291,169.43	173,524.65	35,827.90	81,816.88	116	291,326.40	173,651.65	35,807.67	81,867.08	179	291,262.30	173,596.65	35,823.43	81,842.22
54	291,226.07	173,588.63	35,813.80	81,823.63	117	291,250.25	173,575.83	35,806.85	81,867.57	180	291,309.82	173,543.77	35,831.28	81,934.77
55	291,170.43	173,493.42	35,837.10	81,839.92	118	289,968.37	172,841.43	35,652.23	81,474.70	181	291,257.07	173,615.32	35,816.40	81,825.35
56	291,208.78	173,582.15	35,825.13	81,801.50	119	292,422.77	174,309.03	35,951.53	82,162.20	182	252,209.85	150,310.22	31,026.10	70,873.53
57	291,280.47	173,565.63	35,818.10	81,896.73	120	290,053.23	172,873.17	35,687.08	81,492.98	Average	291,028.41	173,453.28	35,797.31	81,777.82
58	291,225.17	173,591.50	35,810.93	81,822.73	121	292,341.38	174,225.00	35,989.62	82,126.77					
59	291,261.80	173,558.53	35,799.78	81,903.48	122	291,205.77	173,590.32	35,774.45	81,841.00					
60	291,200.38	173,640.80	35,786.83	81,772.75	123	291,336.27	173,631.62	35,844.22	81,860.43					
61	291,258.57	173,608.67	35,828.63	81,821.27	124	291,341.52	173,689.60	35,853.93	81,797.98					
62	291,135.98	173,483.42	35,800.48	81,852.08	125	291,345.28	173,580.02	35,850.97	81,914.30					

Sustainability – I/O Request Throughput Distribution Graph

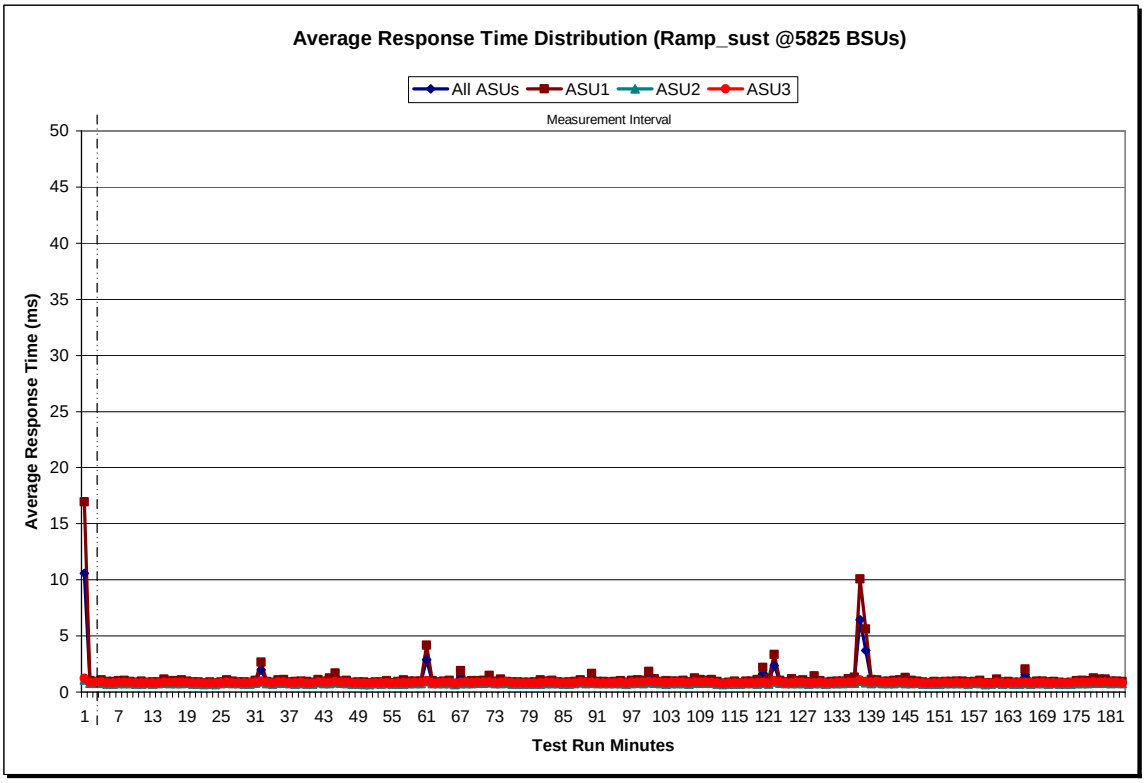


Sustainability – Average Response Time (ms) Distribution Data

	Start	Stop	Interval	Duration
Ramp-Up/Start-Up	7:30:27	7:33:27	0-2	0:03:00
Measurement Interval	7:33:27	10:33:27	3-182	3:00:00

Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3
0	10.59	16.96	1.10	1.23	63	0.91	0.97	0.76	0.86	126	0.98	1.08	0.76	0.86
1	0.94	1.00	0.78	0.87	64	0.95	1.03	0.76	0.86	127	0.87	0.91	0.74	0.83
2	0.91	0.95	0.78	0.87	65	0.76	0.77	0.68	0.77	128	1.19	1.44	0.75	0.84
3	0.99	1.08	0.79	0.88	66	1.47	1.92	0.75	0.85	129	0.94	1.02	0.76	0.86
4	0.88	0.94	0.74	0.83	67	0.90	0.95	0.77	0.86	130	0.84	0.88	0.72	0.82
5	0.87	0.92	0.73	0.82	68	0.92	0.99	0.75	0.84	131	0.89	0.95	0.74	0.83
6	0.93	1.00	0.77	0.86	69	0.94	1.01	0.78	0.87	132	0.91	0.96	0.75	0.85
7	0.96	1.05	0.77	0.87	70	0.98	1.06	0.81	0.90	133	0.92	0.99	0.76	0.86
8	0.90	0.94	0.77	0.86	71	1.23	1.47	0.81	0.91	134	1.05	1.20	0.78	0.87
9	0.84	0.88	0.72	0.81	72	0.91	0.98	0.74	0.83	135	1.14	1.34	0.78	0.88
10	0.90	0.97	0.73	0.83	73	1.02	1.15	0.77	0.87	136	6.44	10.10	0.97	1.07
11	0.85	0.87	0.74	0.84	74	0.91	0.95	0.79	0.89	137	3.71	5.62	0.84	0.93
12	0.85	0.90	0.72	0.81	75	0.85	0.89	0.73	0.82	138	1.00	1.12	0.76	0.86
13	0.87	0.92	0.74	0.84	76	0.85	0.89	0.74	0.83	139	1.00	1.07	0.83	0.93
14	1.02	1.14	0.77	0.87	77	0.82	0.85	0.71	0.80	140	0.89	0.94	0.76	0.85
15	0.95	1.02	0.77	0.87	78	0.82	0.85	0.71	0.80	141	0.92	0.98	0.77	0.86
16	0.94	1.01	0.77	0.86	79	0.84	0.89	0.71	0.80	142	0.96	1.06	0.76	0.85
17	0.99	1.09	0.77	0.87	80	0.97	1.08	0.73	0.82	143	1.00	1.09	0.81	0.91
18	0.93	0.98	0.78	0.88	81	0.92	0.97	0.77	0.87	144	1.10	1.28	0.77	0.87
19	0.85	0.89	0.73	0.82	82	0.96	1.06	0.75	0.85	145	0.95	1.05	0.74	0.84
20	0.86	0.91	0.73	0.82	83	0.86	0.88	0.75	0.84	146	0.93	0.98	0.78	0.88
21	0.78	0.79	0.69	0.78	84	0.83	0.86	0.73	0.82	147	0.87	0.91	0.73	0.82
22	0.85	0.89	0.71	0.80	85	0.86	0.91	0.72	0.81	148	0.81	0.84	0.70	0.80
23	0.78	0.79	0.70	0.79	86	0.87	0.92	0.74	0.83	149	0.88	0.93	0.73	0.82
24	0.86	0.90	0.75	0.84	87	1.00	1.08	0.81	0.91	150	0.86	0.91	0.72	0.81
25	0.99	1.08	0.78	0.88	88	0.88	0.91	0.77	0.86	151	0.88	0.92	0.75	0.85
26	0.92	0.99	0.75	0.84	89	1.34	1.67	0.79	0.88	152	0.88	0.92	0.74	0.84
27	0.86	0.90	0.74	0.83	90	0.87	0.92	0.75	0.84	153	0.91	0.96	0.76	0.85
28	0.86	0.91	0.73	0.82	91	0.89	0.95	0.74	0.84	154	0.90	0.97	0.74	0.83
29	0.83	0.86	0.72	0.82	92	0.87	0.90	0.74	0.84	155	0.86	0.91	0.73	0.82
30	0.96	1.03	0.78	0.88	93	0.88	0.93	0.74	0.84	156	0.89	0.93	0.78	0.88
31	1.98	2.67	0.89	0.99	94	0.94	1.02	0.75	0.85	157	0.97	1.05	0.77	0.87
32	0.90	0.95	0.76	0.85	95	0.82	0.86	0.71	0.80	158	0.78	0.80	0.70	0.79
33	0.83	0.86	0.71	0.80	96	0.97	1.06	0.77	0.87	159	0.81	0.84	0.70	0.80
34	1.00	1.08	0.80	0.90	97	0.98	1.08	0.77	0.87	160	1.03	1.16	0.78	0.88
35	1.01	1.12	0.79	0.89	98	0.97	1.06	0.77	0.87	161	0.86	0.90	0.73	0.82
36	0.87	0.92	0.75	0.84	99	1.46	1.84	0.83	0.93	162	0.89	0.95	0.75	0.84
37	0.87	0.92	0.73	0.82	100	1.06	1.20	0.79	0.89	163	0.83	0.86	0.72	0.82
38	0.92	0.99	0.76	0.86	101	0.89	0.93	0.76	0.86	164	0.83	0.85	0.74	0.83
39	0.87	0.93	0.71	0.80	102	0.93	1.02	0.73	0.82	165	1.57	2.06	0.77	0.87
40	0.83	0.87	0.72	0.81	103	0.93	0.99	0.77	0.86	166	0.84	0.88	0.73	0.82
41	1.03	1.12	0.82	0.91	104	0.91	0.97	0.76	0.85	167	0.91	0.97	0.75	0.84
42	0.90	0.96	0.76	0.85	105	0.95	1.04	0.76	0.85	168	0.92	0.99	0.76	0.85
43	1.08	1.24	0.76	0.86	106	0.87	0.92	0.73	0.82	169	0.86	0.90	0.74	0.83
44	1.38	1.70	0.83	0.93	107	1.10	1.26	0.80	0.90	170	0.89	0.93	0.75	0.84
45	0.93	0.98	0.78	0.87	108	1.00	1.10	0.78	0.87	171	0.84	0.88	0.72	0.81
46	0.96	1.04	0.76	0.86	109	0.98	1.05	0.80	0.90	172	0.82	0.84	0.72	0.82
47	0.83	0.86	0.72	0.81	110	1.00	1.10	0.78	0.87	173	0.83	0.85	0.72	0.82
48	0.85	0.88	0.72	0.82	111	0.87	0.93	0.72	0.81	174	0.93	0.99	0.76	0.86
49	0.84	0.89	0.70	0.79	112	0.77	0.78	0.68	0.77	175	0.95	1.03	0.77	0.86
50	0.79	0.82	0.69	0.78	113	0.82	0.85	0.72	0.81	176	0.94	1.01	0.76	0.86
51	0.86	0.89	0.75	0.84	114	0.91	0.99	0.74	0.83	177	1.11	1.27	0.80	0.90
52	0.85	0.89	0.73	0.82	115	0.82	0.84	0.72	0.81	178	1.03	1.15	0.77	0.87
53	0.94	1.02	0.75	0.84	116	0.90	0.96	0.75	0.84	179	1.05	1.16	0.81	0.91
54	0.82	0.84	0.71	0.81	117	0.91	0.97	0.75	0.85	180	0.91	0.96	0.76	0.86
55	0.87	0.92	0.73	0.82	118	0.98	1.12	0.72	0.82	181	0.92	0.97	0.78	0.88
56	0.96	1.08	0.72	0.82	119	1.65	2.20	0.78	0.87	182	0.88	0.92	0.75	0.84
57	0.90	0.96	0.74	0.84	120	1.01	1.17	0.70	0.80	Average	1.00	1.13	0.76	0.85
58	0.91	0.96	0.77	0.87	121	2.39	3.34	0.90	1.00					
59	0.92	0.98	0.77	0.87	122	0.98	1.06	0.80	0.90					
60	2.88	4.16	0.92	1.02	123	0.86	0.88	0.75	0.84					
61	0.94	1.02	0.75	0.85	124	1.03	1.18	0.75	0.84					
62	0.86	0.90	0.74	0.83	125	0.94	1.02	0.76	0.85					

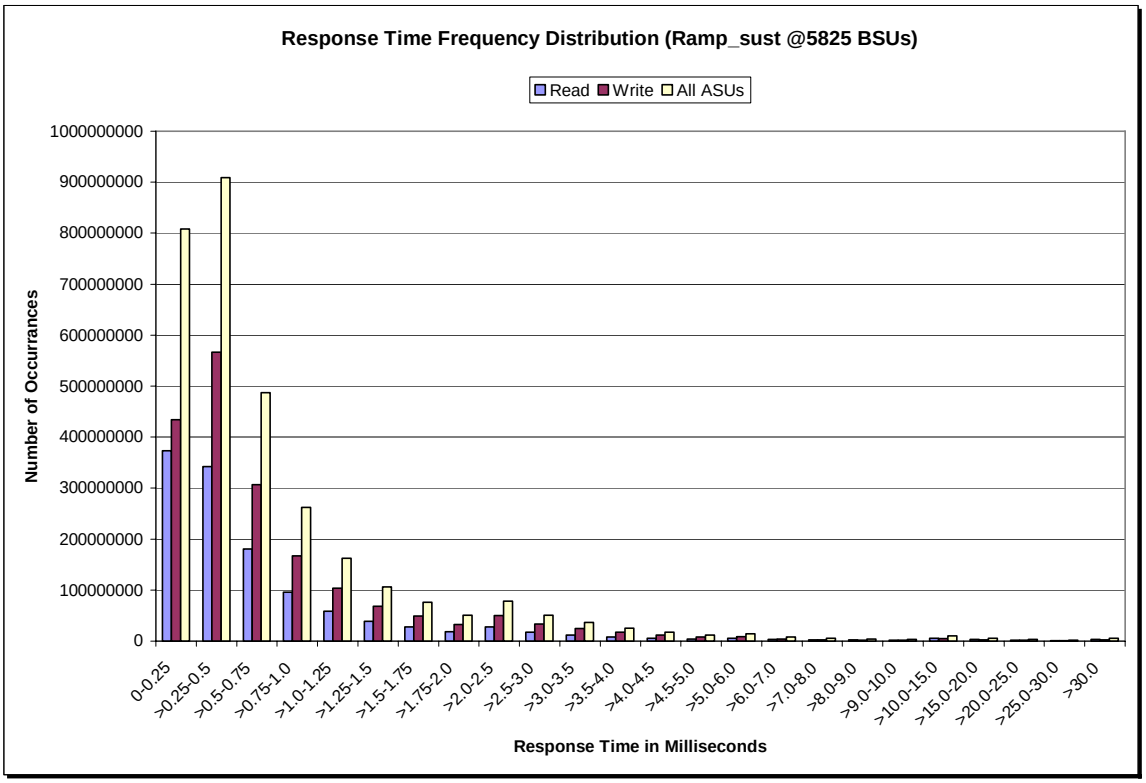
Sustainability – Average Response Time (ms) Distribution Graph



Sustainability – Response Time Frequency Distribution Data

Response Time (ms)	0-0.25	>0.25-0.5	>0.5-0.75	>0.75-1.0	>1.0-1.25	>1.25-1.5	>1.5-1.75	>1.75-2.0
Read	373,584,149	342,005,086	180,686,930	95,503,471	58,858,842	38,485,965	27,430,569	18,274,085
Write	434,575,685	566,781,033	306,929,377	166,937,276	103,774,238	67,904,454	48,764,240	32,565,211
All ASUs	808,159,834	908,786,119	487,616,307	262,440,747	162,633,080	106,390,419	76,194,809	50,839,296
ASU1	539,673,093	533,536,131	274,329,372	145,387,276	90,010,893	59,063,876	42,231,004	28,050,469
ASU2	104,575,886	112,100,123	58,529,721	31,094,338	19,197,043	12,566,310	9,076,098	6,177,110
ASU3	163,910,855	263,149,865	154,757,214	85,959,133	53,425,144	34,760,233	24,887,707	16,611,717
Response Time (ms)	**>2.0-2.5**	**>2.5-3.0**	**>3.0-3.5**	**>3.5-4.0**	**>4.0-4.5**	**>4.5-5.0**	**>5.0-6.0**	**>6.0-7.0**
Read	28,000,951	17,470,453	11,880,441	8,063,072	5,579,324	4,035,664	5,394,071	3,504,489
Write	50,235,552	33,370,963	24,253,996	17,420,191	11,882,404	8,124,239	8,873,145	4,094,249
All ASUs	78,236,503	50,841,416	36,134,437	25,483,263	17,461,728	12,159,903	14,267,216	7,598,738
ASU1	42,253,828	25,520,007	16,715,442	11,141,019	7,777,046	5,856,020	8,465,041	5,983,517
ASU2	10,040,192	7,232,097	5,600,710	4,060,551	2,685,777	1,688,350	1,500,938	388,645
ASU3	25,942,483	18,089,312	13,818,285	10,281,693	6,998,905	4,615,533	4,301,237	1,226,576
Response Time (ms)	**>7.0-8.0**	**>8.0-9.0**	**>9.0-10.0**	**>10.0-15.0**	**>15.0-20.0**	**>20.0-25.0**	**>25.0-30.0**	**>30.0**
Read	2,688,294	2,100,210	1,789,850	5,618,476	2,918,332	1,627,357	961,153	3,115,930
Write	2,489,567	1,756,802	1,455,941	4,484,791	2,321,422	1,295,579	764,800	2,474,516
All ASUs	5,177,861	3,857,012	3,245,791	10,103,267	5,239,754	2,922,936	1,725,953	5,590,446
ASU1	4,771,461	3,762,596	3,220,083	10,086,545	5,235,506	2,918,699	1,722,939	5,583,527
ASU2	81,440	12,676	1,802	759	86	51	22	236
ASU3	324,960	81,740	23,906	15,963	4,162	4,186	2,992	6,683

Sustainability – Response Time Frequency Distribution Graph



Sustainability – Measured Intensity Multiplier and Coefficient of Variation

Clause 3.4.3

IM – Intensity Multiplier: *The ratio of I/Os for each I/O stream relative to the total I/Os for all I/O streams (ASU1-1 – ASU3-1) as required by the benchmark specification.*

Clauses 5.1.0 and 5.3.13.2

MIM – Measured Intensity Multiplier: *The Measured Intensity Multiplier represents the ratio of measured I/Os for each I/O stream relative to the total I/Os measured for all I/O streams (ASU1-1 – ASU3-1). This value may differ from the corresponding Expected Intensity Multiplier by no more than 5%.*

Clause 5.3.13.3

COV – Coefficient of Variation: *This measure of variation for the Measured Intensity Multiplier cannot exceed 0.2.*

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	***0.0350***	***0.2810***	***0.0700***	***0.2100***	***0.0180***	***0.0700***	***0.0350***	***0.2810***
MIM	0.035	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2810
COV	0.001	0.000	0.001	0.000	0.002	0.001	0.001	0.000

Primary Metrics Test – IOPS Test Phase

Clause 5.4.2.2

The IOPS Test Phase consists of one Test Run at the 100% load point with a Measurement Interval of ten (10) minutes. The IOPS Test Phase immediately follows the Sustainability Test Phase without any interruption or manual intervention.

The IOPS Test Run generates the SPC-1 IOPS™ primary metric, which is computed as the I/O Request Throughput for the Measurement Interval of the IOPS Test Run.

The Average Response Time is computed for the IOPS Test Run and cannot exceed 30 milliseconds. If the Average Response Time exceeds the 30 millisecond constraint, the measurement is invalid.

Clause 9.2.4.7.2

For the IOPS Test Phase the FDR shall contain:

1. *I/O Request Throughput Distribution (data and graph).*
2. *A Response Time Frequency Distribution.*
3. *An Average Response Time Distribution.*
4. *The human readable Test Run Results File produced by the Workload Generator.*
5. *A listing or screen image of all input parameters supplied t the Workload Generator.*
6. *The total number of I/O Requests completed in the Measurement Interval as well as the number of I/O Requests with a Response Time less than or equal to 30 milliseconds and the number of I/O Requests with a Response Time greater than 30 milliseconds.*

SPC-1 Workload Generator Input Parameters

The SPC-1 Workload Generator input parameters for the Sustainability, IOPS, Response Time Ramp, Repeatability, and Persistence Test Runs are documented in "Appendix E: SPC-1 Workload Generator Input Parameters" on Page 63.

IOPS Test Results File

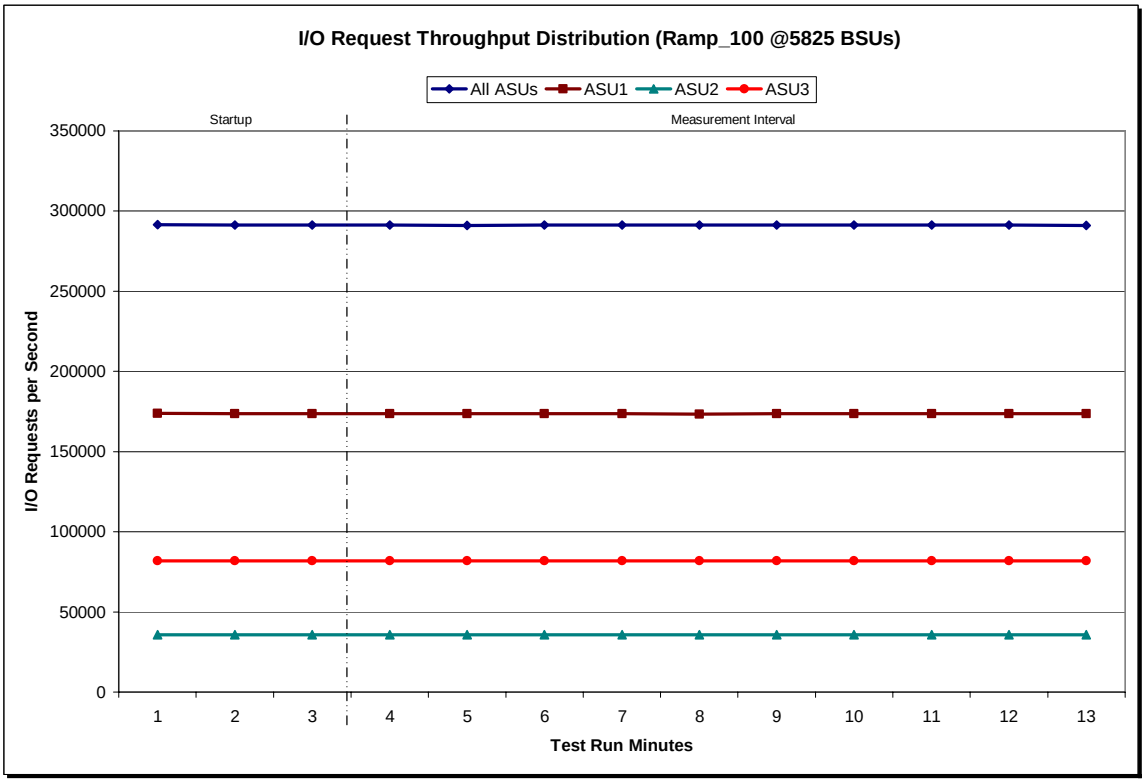
A link to the test results file generated from the IOPS Test Run is listed below.

IOPS Test Results File

IOPS Test Run – I/O Request Throughput Distribution Data

5828 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	10:34:12	10:37:13	0-2	0:03:01
Measurement Interval	10:37:13	10:47:13	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	291,572.52	173,788.10	35,835.28	81,949.13
1	291,289.93	173,550.10	35,839.90	81,899.93
2	291,242.77	173,569.05	35,801.48	81,872.23
3	291,257.27	173,546.72	35,858.62	81,851.93
4	291,155.38	173,510.75	35,784.32	81,860.32
5	291,202.22	173,558.40	35,780.58	81,863.23
6	291,180.42	173,519.90	35,812.33	81,848.18
7	291,165.12	173,478.82	35,855.75	81,830.55
8	291,208.50	173,547.82	35,828.68	81,832.00
9	291,243.32	173,603.55	35,831.55	81,808.22
10	291,202.68	173,569.75	35,821.03	81,811.90
11	291,326.00	173,641.03	35,824.22	81,860.75
12	291,144.85	173,524.58	35,771.38	81,848.88
Average	291,208.58	173,550.13	35,816.85	81,841.60

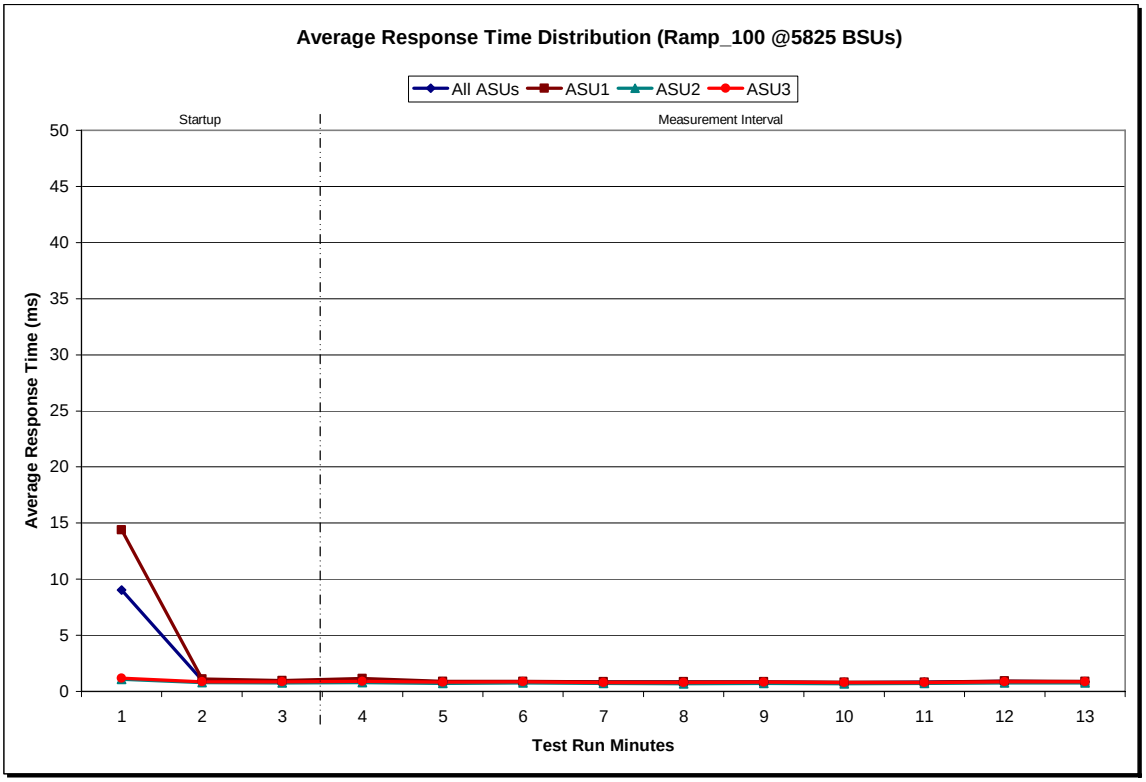
IOPS Test Run – I/O Request Throughput Distribution Graph



IOPS Test Run – Average Response Time (ms) Distribution Data

5828 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	10:34:12	10:37:13	0-2	0:03:01
Measurement Interval	10:37:13	10:47:13	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	9.04	14.39	1.07	1.18
1	1.01	1.12	0.78	0.87
2	0.92	0.97	0.76	0.86
3	1.02	1.14	0.79	0.88
4	0.87	0.91	0.74	0.83
5	0.88	0.91	0.77	0.87
6	0.82	0.85	0.72	0.81
7	0.81	0.85	0.70	0.79
8	0.84	0.87	0.73	0.82
9	0.81	0.84	0.70	0.79
10	0.81	0.84	0.71	0.80
11	0.90	0.94	0.76	0.85
12	0.87	0.90	0.76	0.86
Average	0.86	0.90	0.74	0.83

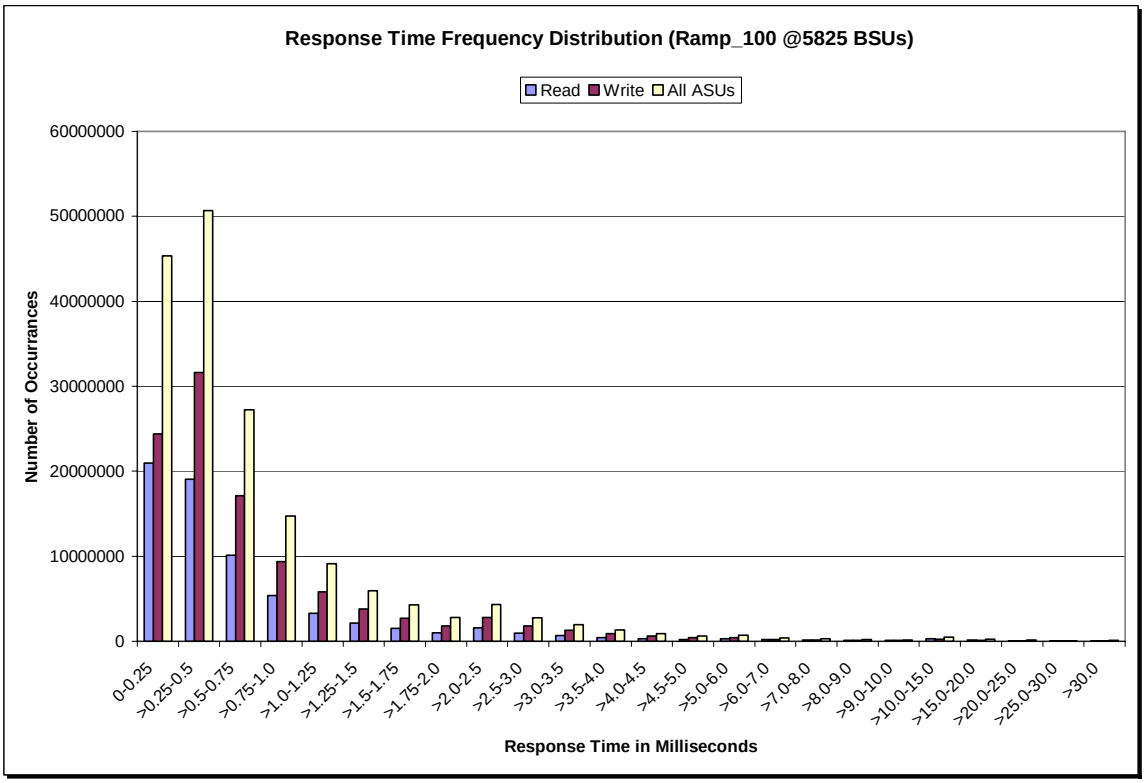
IOPS Test Run – Average Response Time (ms) Distribution Graph



IOPS Test Run – Response Time Frequency Distribution Data

Response Time (ms)	0-0.25	>0.25-0.5	>0.5-0.75	>0.75-1.0	>1.0-1.25	>1.25-1.5	>1.5-1.75	>1.75-2.0
Read	20961563	19,045,345	10,108,470	5,358,351	3,297,138	2,142,713	1,533,616	1,015,553
Write	24378885	31,617,559	17,137,184	9,356,832	5,820,011	3,783,105	2,724,841	1,805,700
All ASUs	45340448	50,662,904	27,245,654	14,715,183	9,117,149	5,925,818	4,258,457	2,821,253
ASU1	30271513	29,726,450	15,333,981	8,154,758	5,046,280	3,288,970	2,360,404	1,560,147
ASU2	5867921	6,249,333	3,269,536	1,743,439	1,075,319	699,057	506,059	340,778
ASU3	9201014	14,687,121	8,642,137	4,816,986	2,995,550	1,937,791	1,391,994	920,328
Response Time (ms)	**>2.0-2.5**	**>2.5-3.0**	**>3.0-3.5**	**>3.5-4.0**	**>4.0-4.5**	**>4.5-5.0**	**>5.0-6.0**	**>6.0-7.0**
Read	1,553,856	955,966	643,493	430,782	298,154	212,851	283,288	182,733
Write	2,789,307	1,801,854	1,285,967	898,688	608,159	410,069	450,152	208,662
All ASUs	4,343,163	2,757,820	1,929,460	1,329,470	906,313	622,920	733,440	391,395
ASU1	2,354,005	1,406,113	919,448	607,873	425,044	314,769	449,847	313,599
ASU2	553,065	382,684	288,390	202,779	132,923	82,541	72,993	18,389
ASU3	1,436,093	969,023	721,622	518,818	348,346	225,610	210,600	59,407
Response Time (ms)	**>7.0-8.0**	**>8.0-9.0**	**>9.0-10.0**	**>10.0-15.0**	**>15.0-20.0**	**>20.0-25.0**	**>25.0-30.0**	**>30.0**
Read	137,599	106,226	88,876	271,821	129,008	69,626	35,991	51,239
Write	127,626	88,581	72,078	216,791	103,470	55,452	28,864	40,716
All ASUs	265,225	194,807	160,954	488,612	232,478	125,078	64,855	91,955
ASU1	244,468	189,846	159,747	488,250	232,478	125,078	64,855	91,955
ASU2	4,206	597	61	-	-	-	-	-
ASU3	16,551	4,364	1,146	362	-	-	-	-

IOPS Test Run –Response Time Frequency Distribution Graph



IOPS Test Run – I/O Request Information

I/O Requests Completed in the Measurement Interval	I/O Requests Completed with Response Time = or < 30 ms	I/O Requests Completed with Response Time > 30 ms
174,724,811	174,632,856	91,955

IOPS Test Run – Measured Intensity Multiplier and Coefficient of Variation

Clause 3.4.3

IM – Intensity Multiplier: *The ratio of I/Os for each I/O stream relative to the total I/Os for all I/O streams (ASU1-1 – ASU3-1) as required by the benchmark specification.*

Clauses 5.1.0 and 5.3.13.2

MIM – Measured Intensity Multiplier: *The Measured Intensity Multiplier represents the ratio of measured I/Os for each I/O stream relative to the total I/Os measured for all I/O streams (ASU1-1 – ASU3-1). This value may differ from the corresponding Expected Intensity Multiplier by no more than 5%.*

Clause 5.3.13.3

COV – Coefficient of Variation: *This measure of variation for the Measured Intensity Multiplier cannot exceed 0.2.*

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	***0.0350***	***0.2810***	***0.0700***	***0.2100***	***0.0180***	***0.0700***	***0.0350***	***0.2810***
MIM	0.0350	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2810
COV	0.002	0.000	0.001	0.000	0.001	0.001	0.001	0.000

Primary Metrics Test – Response Time Ramp Test Phase

Clause 5.4.2.3

The Response Time Ramp Test Phase consists of five Test Runs, one each at 95%, 90%, 80%, 50%, and 10% of the load point (100%) used to generate the SPC-1 IOPS™ primary metric. Each of the five Test Runs has a Measurement Interval of ten (10) minutes. The Response Time Ramp Test Phase immediately follows the IOPS Test Phase without any interruption or manual intervention.

The five Response Time Ramp Test Runs, in conjunction with the IOPS Test Run (100%), demonstrate the relationship between Average Response Time and I/O Request Throughput for the Tested Storage Configuration (TSC) as illustrated in the response time/throughput curve on page 12.

In addition, the Average Response Time measured during the 10% Test Run is the value for the SPC-1 LRT™ metric. That value represents the Average Response Time of a lightly loaded TSC.

Clause 9.2.4.7.3

The following content shall appear in the FDR for the Response Time Ramp Phase:

1. *A Response Time Ramp Distribution.*
2. *The human readable Test Run Results File produced by the Workload Generator for each Test Run within the Response Time Ramp Test Phase.*
3. *For the 10% Load Level Test Run (SPC-1 LRT™ metric) an Average Response Time Distribution.*
4. *A listing or screen image of all input parameters supplied to the Workload Generator.*

SPC-1 Workload Generator Input Parameters

The SPC-1 Workload Generator input parameters for the Sustainability, IOPS, Response Time Ramp, Repeatability, and Persistence Test Runs are documented in "Appendix E: SPC-1 Workload Generator Input Parameters" on Page 63.

Response Time Ramp Test Results File

A link to each test result file generated from each Response Time Ramp Test Run list listed below.

95% Load Level

90% Load Level

80% Load Level

50% Load Level

10% Load Level

Response Time Ramp Distribution (IOPS) Data

The five Test Runs that comprise the Response Time Ramp Phase are executed at 95%, 90%, 80%, 50%, and 10% of the Business Scaling Unit (BSU) load level used to produce the SPC-1 IOPS™ primary metric. The 100% BSU load level is included in the following Response Time Ramp data tables and graphs for completeness.

100% Load Level - 5828 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	10:34:12	10:37:13	0-2	0:03:01
Measurement Interval	10:37:13	10:47:13	3-12	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	291,572.52	173,788.10	35,835.28	81,949.13
1	291,289.93	173,550.10	35,839.90	81,899.93
2	291,242.77	173,569.05	35,801.48	81,872.23
3	291,257.27	173,546.72	35,858.62	81,851.93
4	291,155.38	173,510.75	35,784.32	81,860.32
5	291,202.22	173,558.40	35,780.58	81,863.23
6	291,180.42	173,519.90	35,812.33	81,848.18
7	291,165.12	173,478.82	35,855.75	81,830.55
8	291,208.50	173,547.82	35,828.68	81,832.00
9	291,243.32	173,603.55	35,831.55	81,808.22
10	291,202.68	173,569.75	35,821.03	81,811.90
11	291,326.00	173,641.03	35,824.22	81,860.75
12	291,144.85	173,524.58	35,771.38	81,848.88
Average	291,208.58	173,550.13	35,816.85	81,841.60

95% Load Level - 5533 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	10:47:44	10:50:45	0-2	0:03:01
Measurement Interval	10:50:45	11:00:45	3-12	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	276,307.85	164,729.28	33,996.52	77,582.05
1	277,053.90	165,130.73	34,065.28	77,857.88
2	276,567.28	164,830.50	34,003.05	77,733.73
3	276,601.62	164,860.80	34,002.02	77,738.80
4	276,660.12	164,907.98	34,033.50	77,718.63
5	276,639.03	164,905.77	34,040.30	77,692.97
6	276,601.80	164,855.83	34,017.40	77,728.57
7	276,698.68	164,964.82	33,998.63	77,735.23
8	276,594.58	164,848.67	34,012.55	77,733.37
9	276,659.08	164,871.17	34,052.32	77,735.60
10	276,628.98	164,864.57	34,013.10	77,751.32
11	276,733.52	164,941.17	34,032.68	77,759.67
12	276,737.68	164,914.85	34,040.67	77,782.17
Average	276,655.51	164,893.56	34,024.32	77,737.63

90% Load Level - 5242 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	11:01:15	11:04:16	0-2	0:03:01
Measurement Interval	11:04:16	11:14:16	3-12	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	261,970.85	156,180.17	32,220.73	73,569.95
1	262,130.87	156,184.02	32,263.07	73,683.78
2	262,126.60	156,274.52	32,229.78	73,622.30
3	262,141.42	156,228.60	32,209.53	73,703.28
4	262,081.20	156,221.13	32,238.78	73,621.28
5	262,158.82	156,275.97	32,231.35	73,651.50
6	262,075.75	156,162.90	32,299.33	73,613.52
7	262,026.10	156,176.88	32,265.97	73,583.25
8	262,096.03	156,196.48	32,236.13	73,663.42
9	262,021.03	156,111.53	32,234.72	73,674.78
10	262,138.97	156,279.57	32,212.58	73,646.82
11	262,099.92	156,275.35	32,231.58	73,592.98
12	262,053.98	156,183.28	32,257.15	73,613.55
Average	262,089.32	156,211.17	32,241.71	73,636.44

80% Load Level - 4660 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	11:14:44	11:17:45	0-2	0:03:01
Measurement Interval	11:17:45	11:27:45	3-12	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	233,110.70	138,910.78	28,667.03	65,532.88
1	232,945.00	138,832.03	28,661.25	65,451.72
2	233,007.42	138,894.32	28,635.27	65,477.83
3	232,911.68	138,823.63	28,643.65	65,444.40
4	233,019.38	138,882.30	28,623.08	65,514.00
5	232,996.92	138,834.50	28,651.23	65,511.18
6	232,980.22	138,858.35	28,633.55	65,488.32
7	232,991.08	138,915.72	28,666.77	65,408.60
8	233,016.32	138,857.10	28,673.15	65,486.07
9	233,111.20	138,947.83	28,626.80	65,536.57
10	232,979.95	138,804.62	28,643.60	65,531.73
11	232,953.22	138,850.63	28,644.35	65,458.23
12	232,955.67	138,809.18	28,667.82	65,478.67
Average	232,991.56	138,858.39	28,647.40	65,485.78

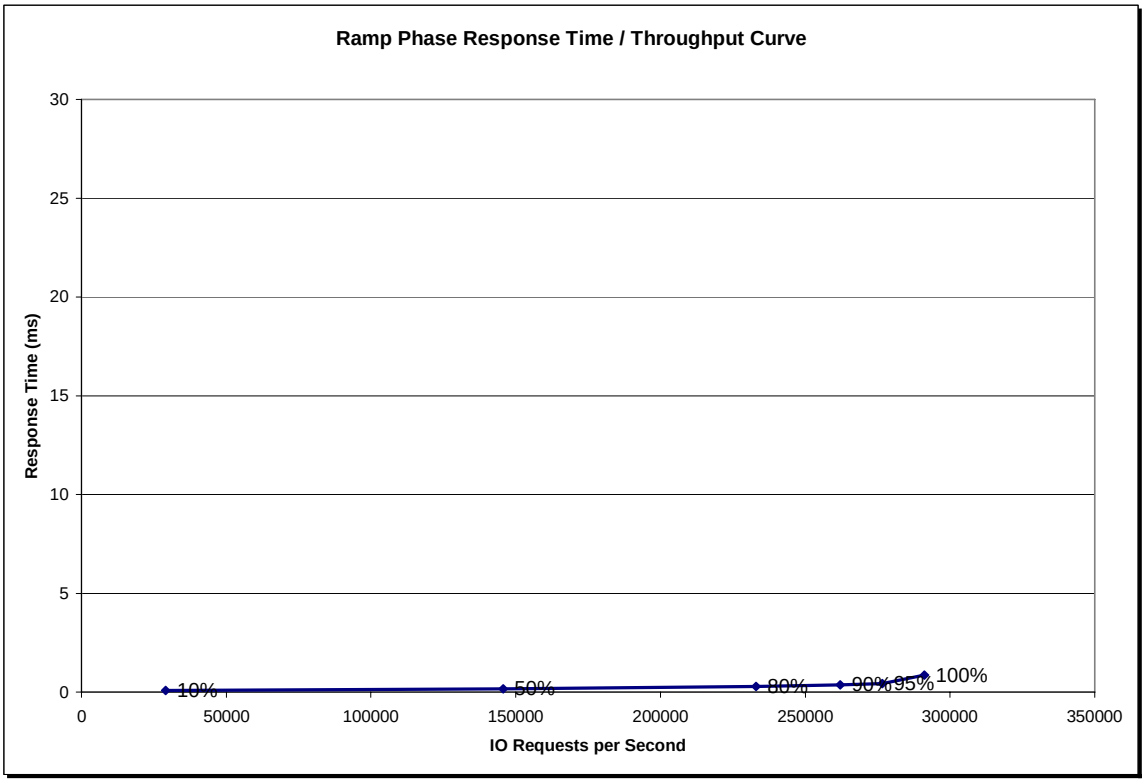
50% Load Level - 2912 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	11:28:04	11:31:05	0-2	0:03:01
Measurement Interval	11:31:05	11:41:05	3-12	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	145,539.22	86,759.15	17,892.83	40,887.23
1	145,537.75	86,743.03	17,918.83	40,875.88
2	145,664.40	86,802.33	17,919.23	40,942.83
3	145,543.77	86,727.02	17,922.25	40,894.50
4	145,659.12	86,771.95	17,922.92	40,964.25
5	145,617.32	86,806.25	17,934.28	40,876.78
6	145,683.08	86,863.13	17,895.32	40,924.63
7	145,610.03	86,783.03	17,907.83	40,919.17
8	145,633.63	86,833.60	17,912.18	40,887.85
9	145,585.65	86,777.67	17,898.57	40,909.42
10	145,579.45	86,764.03	17,896.07	40,919.35
11	145,604.43	86,810.20	17,878.02	40,916.22
12	145,541.38	86,740.03	17,890.07	40,911.28
Average	145,605.79	86,787.69	17,905.75	40,912.35

10% Load Level - 582 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	11:41:13	11:44:14	0-2	0:03:01
Measurement Interval	11:44:14	11:54:14	3-12	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	29,126.23	17,343.95	3,576.15	8,206.13
1	29,068.68	17,327.60	3,578.72	8,162.37
2	29,098.92	17,348.77	3,574.82	8,175.33
3	29,078.63	17,340.62	3,572.30	8,165.72
4	29,106.98	17,365.63	3,572.33	8,169.02
5	29,073.68	17,351.27	3,567.88	8,154.53
6	29,090.70	17,346.95	3,580.72	8,163.03
7	29,123.23	17,336.73	3,582.47	8,204.03
8	29,104.53	17,352.85	3,576.52	8,175.17
9	29,138.63	17,363.80	3,588.65	8,186.18
10	29,109.00	17,346.38	3,584.77	8,177.85
11	29,108.07	17,364.02	3,574.82	8,169.23
12	29,150.13	17,344.17	3,593.07	8,212.90
Average	29,108.36	17,351.24	3,579.35	8,177.77

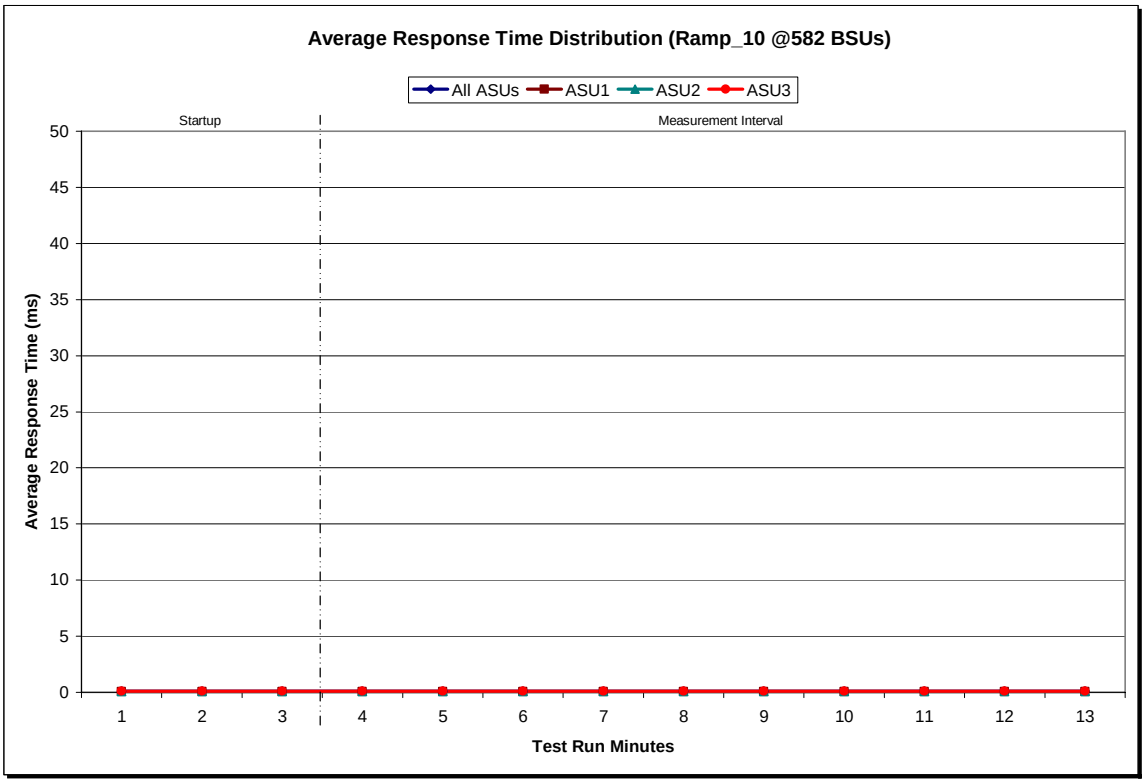
Response Time Ramp Distribution (IOPS) Graph



SPC-1 LRT™ Average Response Time (ms) Distribution Data

582 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	11:41:13	11:44:14	0-2	0:03:01
Measurement Interval	11:44:14	11:54:14	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	0.09	0.08	0.09	0.11
1	0.09	0.08	0.09	0.11
2	0.09	0.08	0.09	0.12
3	0.09	0.08	0.09	0.11
4	0.09	0.08	0.09	0.11
5	0.09	0.08	0.09	0.11
6	0.09	0.08	0.09	0.11
7	0.09	0.08	0.09	0.11
8	0.09	0.08	0.09	0.11
9	0.09	0.08	0.09	0.11
10	0.09	0.08	0.09	0.11
11	0.09	0.08	0.09	0.11
12	0.09	0.08	0.09	0.12
Average	0.09	0.08	0.09	0.11

SPC-1 LRT™ Average Response Time (ms) Distribution Graph



SPC-1 LRT™ (10%) – Measured Intensity Multiplier and Coefficient of Variation

Clause 3.4.3

IM – Intensity Multiplier: *The ratio of I/Os for each I/O stream relative to the total I/Os for all I/O streams (ASU1-1 – ASU3-1) as required by the benchmark specification.*

Clauses 5.1.0 and 5.3.13.2

MIM – Measured Intensity Multiplier: *The Measured Intensity Multiplier represents the ratio of measured I/Os for each I/O stream relative to the total I/Os measured for all I/O streams (ASU1-1 – ASU3-1). This value may differ from the corresponding Expected Intensity Multiplier by no more than 5%.*

Clause 5.3.13.3

COV – Coefficient of Variation: *This measure of variation for the Measured Intensity Multiplier cannot exceed 0.2.*

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	***0.0350***	***0.2810***	***0.0700***	***0.2100***	***0.0180***	***0.0700***	***0.0350***	***0.2810***
MIM	0.0350	0.2810	0.0700	0.2101	0.0180	0.0699	0.0350	0.2809
COV	0.005	0.001	0.004	0.002	0.006	0.003	0.003	0.002

Repeatability Test

Clause 5.4.5

The Repeatability Test demonstrates the repeatability and reproducibility of the SPC-1 IOPS™ primary metric and SPC-1 LRT™ metric generated in earlier Test Runs.

There are two identical Repeatability Test Phases. Each Test Phase contains two Test Runs. Each of the Test Runs will have a Measurement Interval of no less than ten (10) minutes. The two Test Runs in each Test Phase will be executed without interruption or any type of manual intervention.

The first Test Run in each Test Phase is executed at the 10% load point. The Average Response Time from each of the Test Runs is compared to the SPC-1 LRT™ metric. Each Average Response Time value must be less than the SPC-1 LRT™ metric plus 5%.

The second Test Run in each Test Phase is executed at the 100% load point. The I/O Request Throughput from the Test Runs is compared to the SPC-1 IOPS™ primary metric. Each I/O Request Throughput value must be greater than the SPC-1 IOPS™ primary metric minus 5%. In addition, the Average Response Time for each Test Run cannot exceed 30 milliseconds.

If any of the above constraints are not met, the benchmark measurement is invalid.

Clause 9.2.4.7.4

The following content shall appear in the FDR for each Test Run in the two Repeatability Test Phases:

1. *A table containing the results of the Repeatability Test.*
2. *An I/O Request Throughput Distribution graph and table.*
3. *An Average Response Time Distribution graph and table.*
4. *The human readable Test Run Results File produced by the Workload Generator.*
5. *A listing or screen image of all input parameters supplied to the Workload Generator.*

SPC-1 Workload Generator Input Parameters

The SPC-1 Workload Generator input parameters for the Sustainability, IOPS, Response Time Ramp, Repeatability, and Persistence Test Runs are documented in "Appendix E: SPC-1 Workload Generator Input Parameters" on Page 63.

Repeatability Test Results File

The values for the SPC-1 IOPS™, SPC-1 LRT™, and the Repeatability Test measurements are listed below.

	SPC-1 IOPS™	SPC-1 LRT™
Primary Metrics	***291,208.58***	***0.09***
Repeatability Test Phase 1	291,278.37	0.09
Repeatability Test Phase 2	291,269.98	0.09

A link to the test result file generated from each Repeatability Test Run list is listed below.

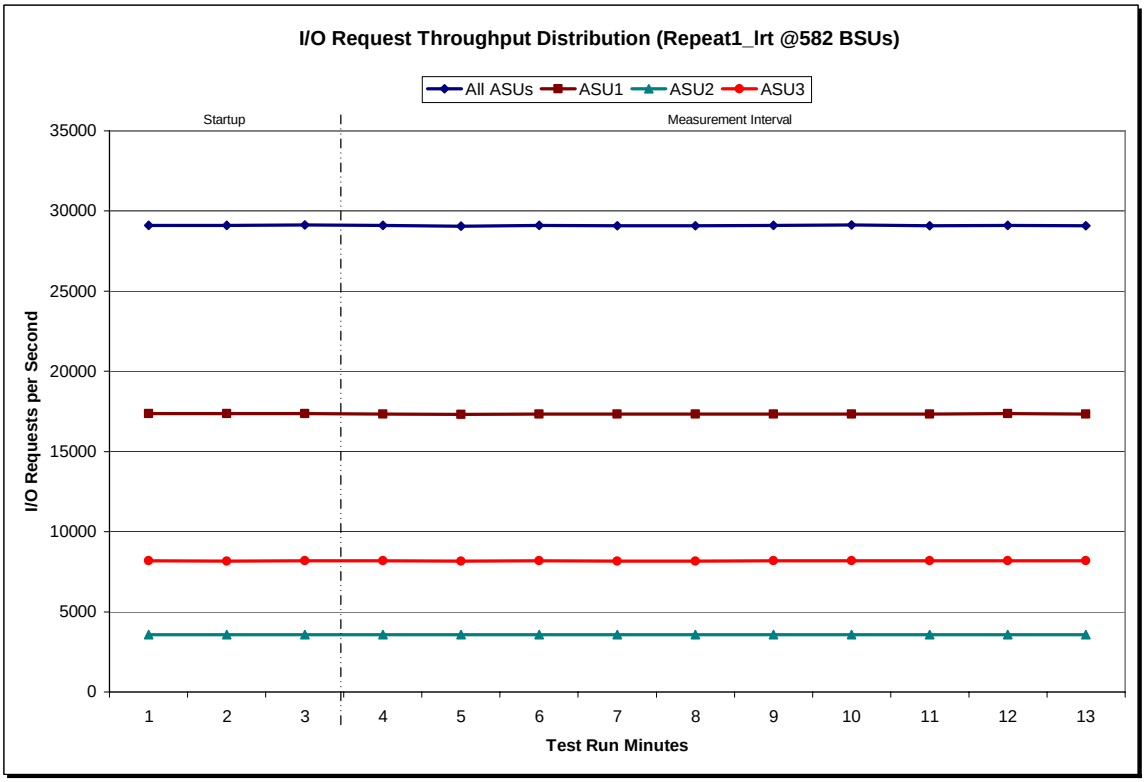
Repeatability Test Phase 1, Test Run 1 (LRT)
Repeatability Test Phase 1, Test Run 2 (IOPS)
Repeatability Test Phase 2, Test Run 1 (LRT)
Repeatability Test Phase 2, Test Run 2 (IOPS)

Repeatability 1 LRT – I/O Request Throughput Distribution Data

582 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	11:54:48	11:57:48	0-2	0:03:00
Measurement Interval	11:57:48	12:07:48	3-12	0:10:00

60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	29,113.32	17,356.07	3,570.98	8,186.27
1	29,100.95	17,357.67	3,574.57	8,168.72
2	29,134.00	17,362.50	3,587.45	8,184.05
3	29,097.12	17,329.05	3,570.47	8,197.60
4	29,059.77	17,323.00	3,579.10	8,157.67
5	29,095.17	17,339.02	3,573.60	8,182.55
6	29,078.68	17,343.72	3,582.03	8,152.93
7	29,074.65	17,331.42	3,579.90	8,163.33
8	29,096.25	17,331.30	3,584.82	8,180.13
9	29,120.17	17,339.88	3,586.15	8,194.13
10	29,084.02	17,331.65	3,574.33	8,178.03
11	29,108.87	17,359.32	3,572.07	8,177.48
12	29,089.35	17,330.03	3,581.60	8,177.72
Average	29,090.40	17,335.84	3,578.41	8,176.16

Repeatability 1 LRT – I/O Request Throughput Distribution Graph

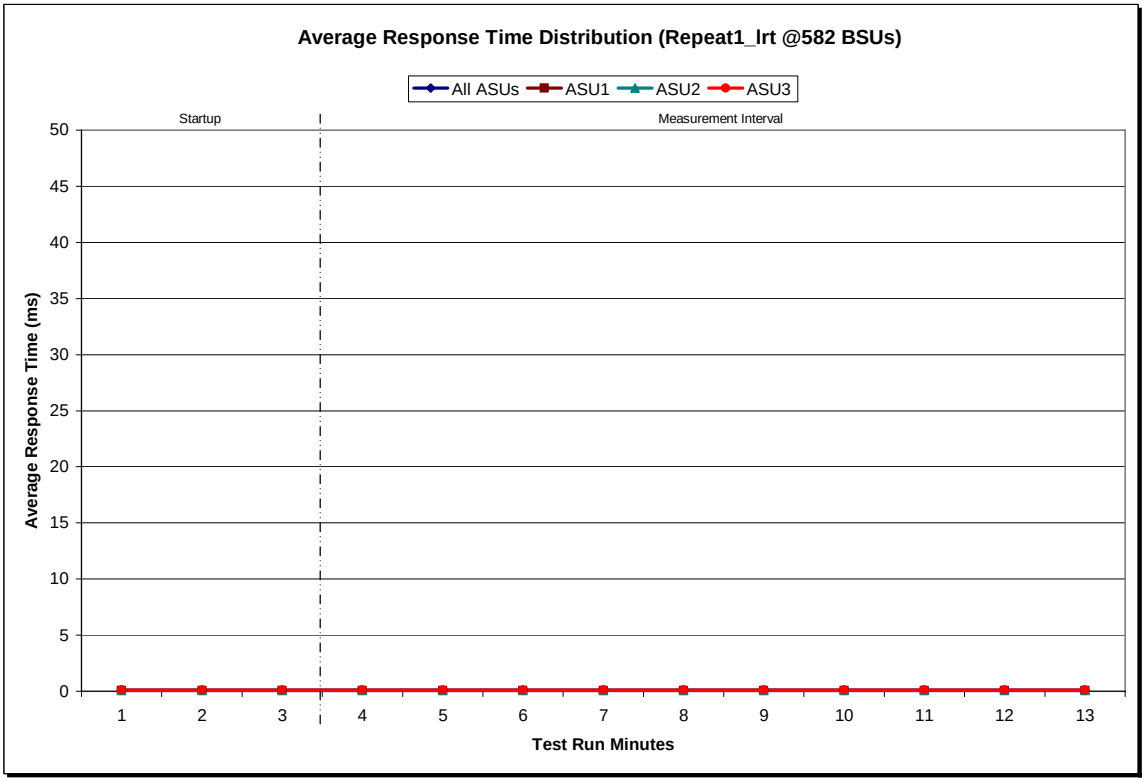


Repeatability 1 LRT –Average Response Time (ms) Distribution Data

582 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	11:54:48	11:57:48	0-2	0:03:00
Measurement Interval	11:57:48	12:07:48	3-12	0:10:00

60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	0.09	0.08	0.09	0.11
1	0.09	0.08	0.09	0.11
2	0.09	0.08	0.09	0.11
3	0.09	0.08	0.09	0.11
4	0.09	0.08	0.09	0.11
5	0.09	0.08	0.09	0.11
6	0.09	0.08	0.09	0.11
7	0.09	0.08	0.09	0.11
8	0.09	0.08	0.09	0.11
9	0.09	0.08	0.09	0.12
10	0.09	0.08	0.09	0.12
11	0.09	0.08	0.09	0.11
12	0.09	0.08	0.09	0.11
Average	0.09	0.08	0.09	0.11

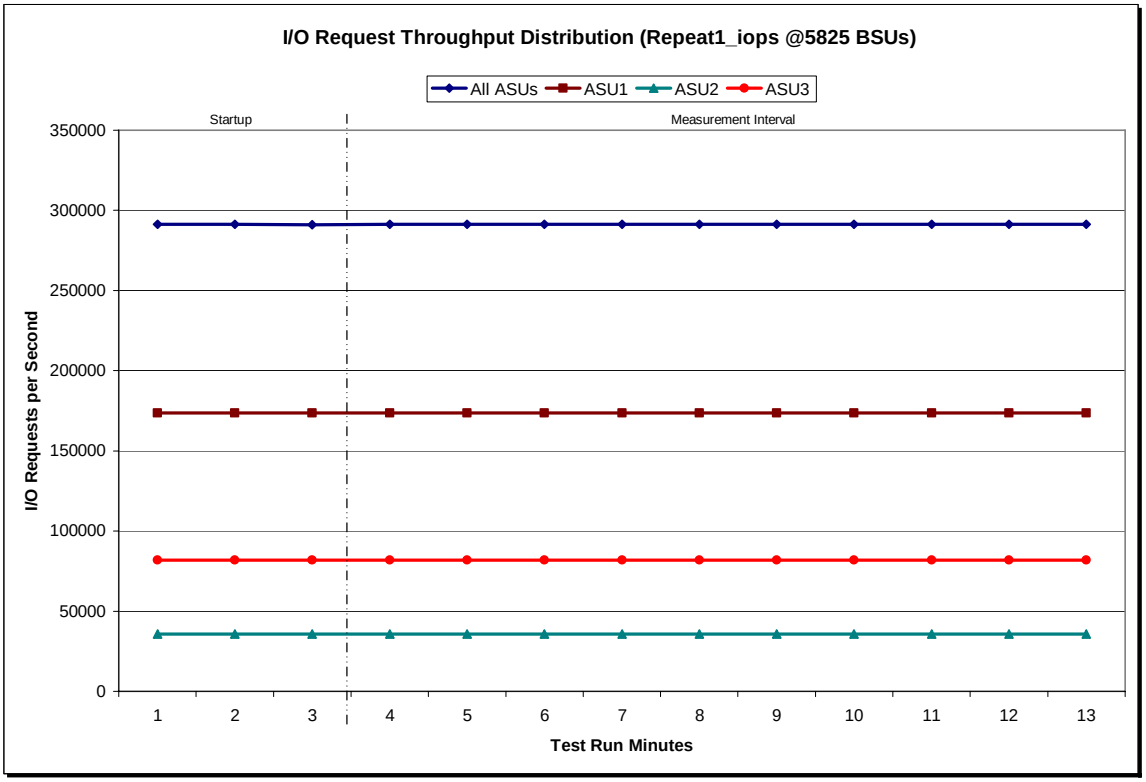
Repeatability 1 LRT –Average Response Time (ms) Distribution Graph



Repeatability 1 IOPS – I/O Request Throughput Distribution Data

5828 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	12:08:21	12:11:22	0-2	0:03:01
Measurement Interval	12:11:22	12:21:22	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	291,245.10	173,537.87	35,832.93	81,874.30
1	291,203.58	173,559.13	35,804.72	81,839.73
2	291,135.93	173,531.43	35,806.87	81,797.63
3	291,285.67	173,627.17	35,795.50	81,863.00
4	291,246.05	173,544.98	35,828.00	81,873.07
5	291,323.32	173,700.98	35,794.52	81,827.82
6	291,193.47	173,553.28	35,831.18	81,809.00
7	291,222.02	173,580.32	35,811.22	81,830.48
8	291,311.67	173,628.62	35,808.37	81,874.68
9	291,357.40	173,599.80	35,852.08	81,905.52
10	291,375.53	173,626.07	35,827.92	81,921.55
11	291,212.73	173,619.10	35,815.50	81,778.13
12	291,255.82	173,618.67	35,812.08	81,825.07
Average	291,278.37	173,609.90	35,817.64	81,850.83

Repeatability 1 IOPS – I/O Request Throughput Distribution Graph

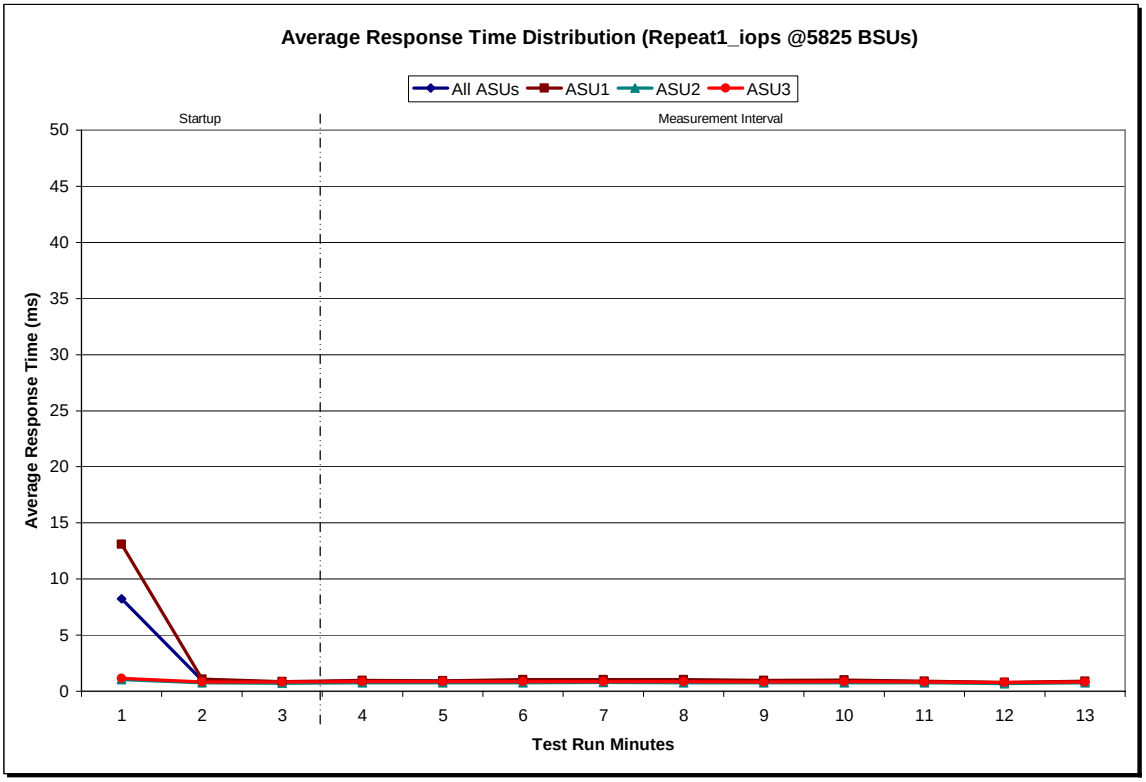


Repeatability 1 IOPS –Average Response Time (ms) Distribution Data

5828 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	12:08:21	12:11:22	0-2	0:03:01
Measurement Interval	12:11:22	12:21:22	3-12	0:10:00

60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	8.25	13.09	1.04	1.15
1	0.96	1.07	0.75	0.84
2	0.83	0.87	0.72	0.81
3	0.90	0.96	0.76	0.85
4	0.90	0.95	0.75	0.85
5	0.94	1.03	0.75	0.85
6	0.96	1.03	0.78	0.88
7	0.96	1.05	0.77	0.87
8	0.91	0.97	0.74	0.84
9	0.94	1.01	0.77	0.86
10	0.86	0.90	0.74	0.83
11	0.77	0.78	0.69	0.78
12	0.86	0.89	0.74	0.83
Average	0.90	0.96	0.75	0.84

Repeatability 1 IOPS –Average Response Time (ms) Distribution Graph

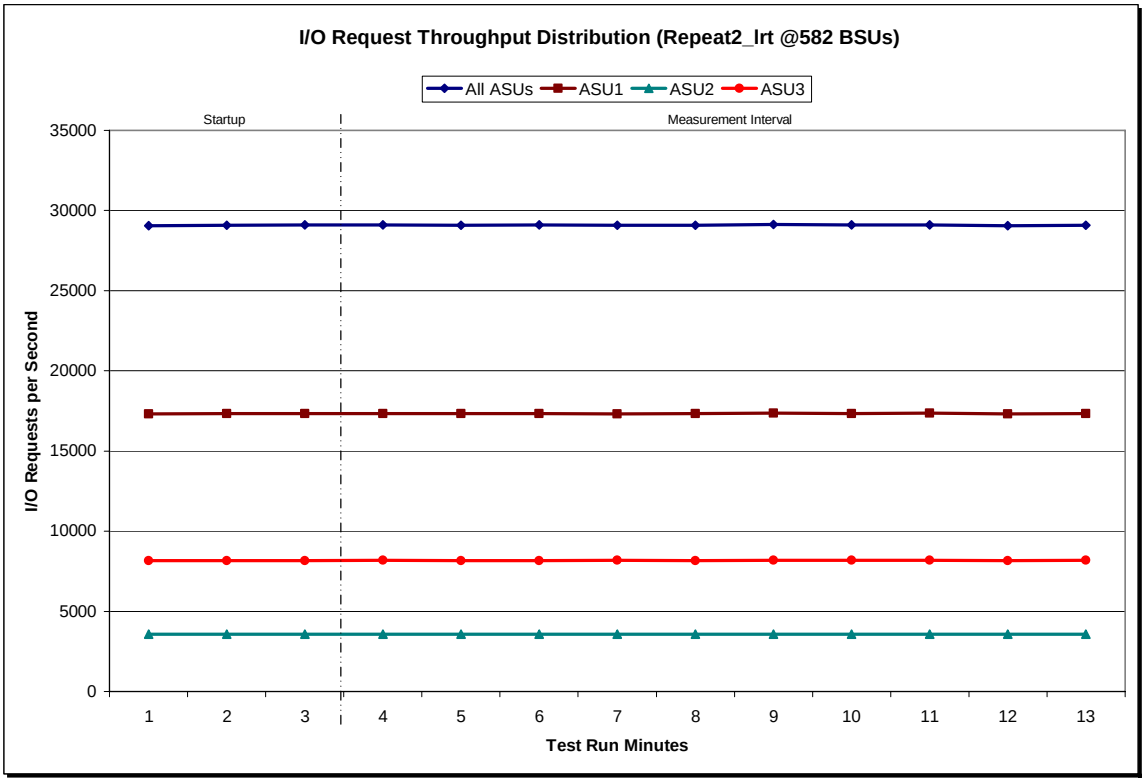


Repeatability 2 LRT – I/O Request Throughput Distribution Data

582 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	12:21:54	12:24:54	0-2	0:03:00
Measurement Interval	12:24:54	12:34:54	3-12	0:10:00

60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	29,065.02	17,318.37	3,573.30	8,173.35
1	29,089.93	17,346.92	3,585.37	8,157.65
2	29,091.70	17,331.95	3,584.93	8,174.82
3	29,110.78	17,331.62	3,590.17	8,189.00
4	29,074.93	17,327.63	3,571.20	8,176.10
5	29,096.83	17,342.58	3,579.75	8,174.50
6	29,070.13	17,313.35	3,576.55	8,180.23
7	29,085.47	17,333.32	3,580.67	8,171.48
8	29,124.55	17,354.85	3,586.98	8,182.72
9	29,116.17	17,345.52	3,578.52	8,192.13
10	29,099.85	17,353.87	3,569.17	8,176.82
11	29,056.55	17,301.87	3,585.62	8,169.07
12	29,090.57	17,327.67	3,577.78	8,185.12
Average	29,092.58	17,333.23	3,579.64	8,179.72

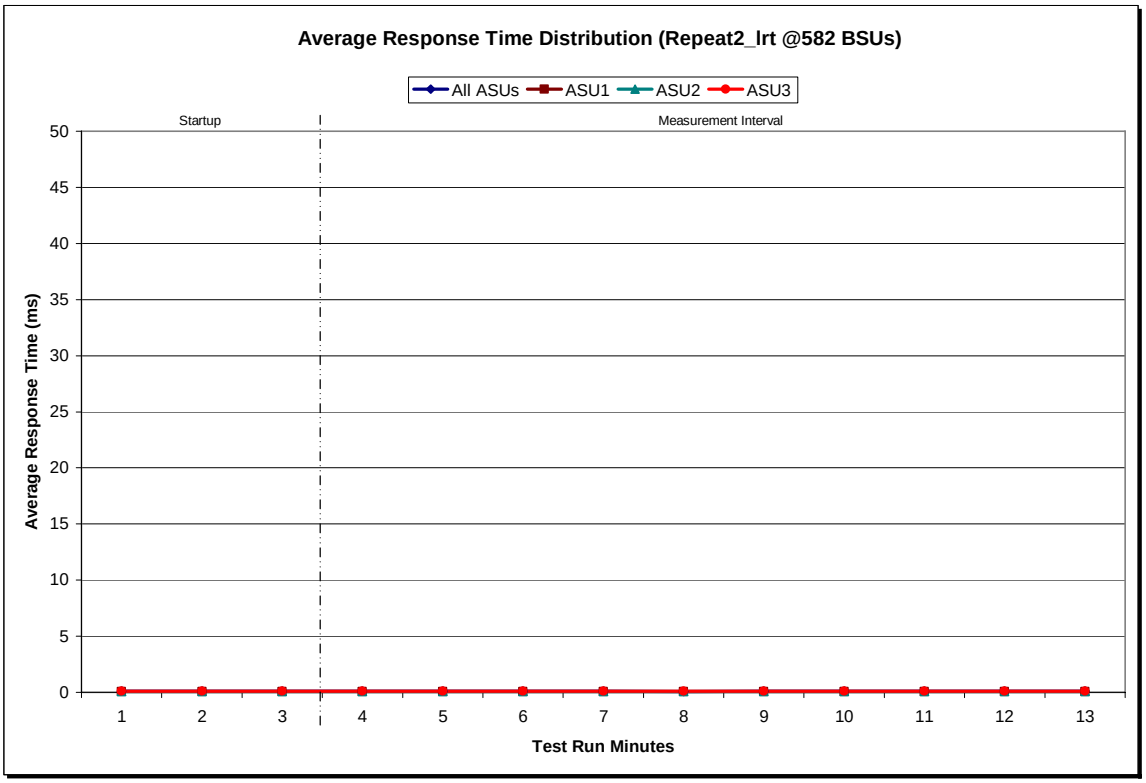
Repeatability 2 LRT – I/O Request Throughput Distribution Graph



Repeatability 2 LRT –Average Response Time (ms) Distribution Data

582 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	12:21:54	12:24:54	0-2	0:03:00
Measurement Interval	12:24:54	12:34:54	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	0.09	0.08	0.09	0.11
1	0.09	0.08	0.09	0.11
2	0.09	0.08	0.09	0.11
3	0.09	0.08	0.09	0.11
4	0.09	0.08	0.09	0.11
5	0.09	0.08	0.09	0.11
6	0.09	0.08	0.09	0.12
7	0.09	0.08	0.09	0.11
8	0.09	0.08	0.09	0.11
9	0.09	0.08	0.09	0.11
10	0.09	0.08	0.09	0.11
11	0.09	0.08	0.09	0.11
12	0.09	0.08	0.09	0.11
Average	0.09	0.08	0.09	0.11

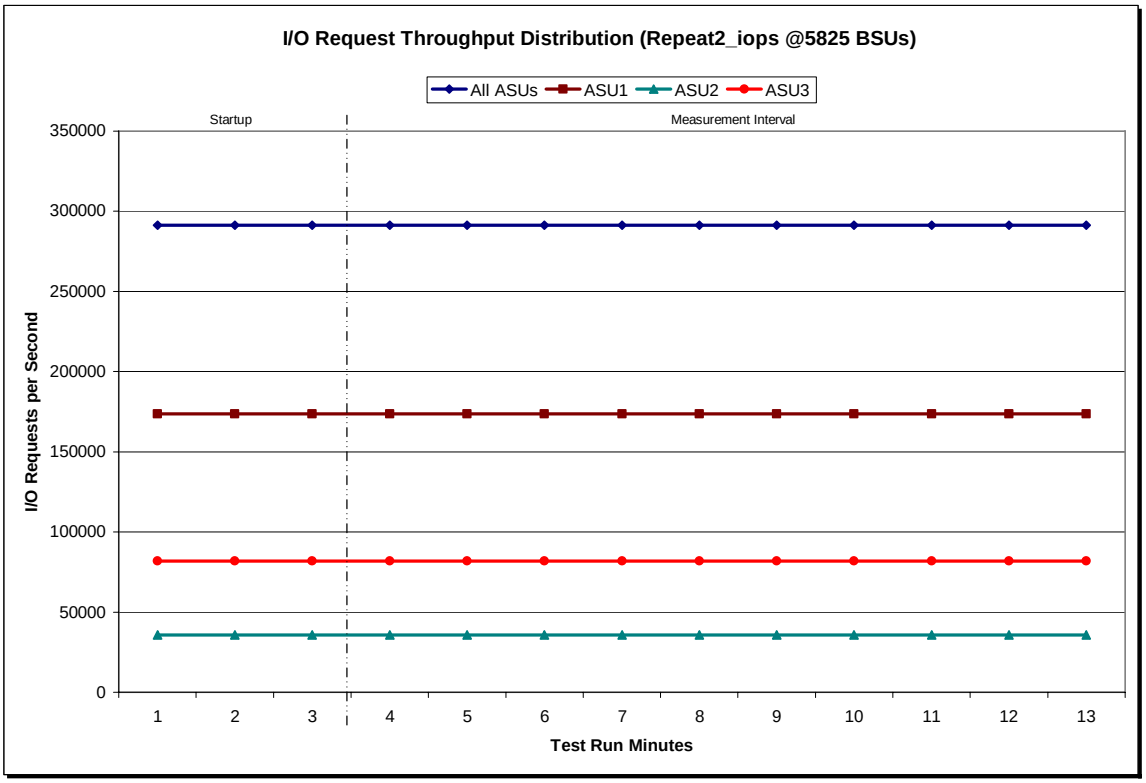
Repeatability 2 LRT –Average Response Time (ms) Distribution Graph



Repeatability 2 IOPS – I/O Request Throughput Distribution Data

5828 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	12:35:28	12:38:29	0-2	0:03:01
Measurement Interval	12:38:29	12:48:29	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	291,307.28	173,589.80	35,847.02	81,870.47
1	291,299.73	173,610.52	35,839.08	81,850.13
2	291,341.28	173,669.82	35,804.58	81,866.88
3	291,352.67	173,696.30	35,817.27	81,839.10
4	291,269.87	173,539.30	35,855.23	81,875.33
5	291,301.15	173,611.13	35,848.47	81,841.55
6	291,240.75	173,538.57	35,848.05	81,854.13
7	291,279.05	173,622.42	35,794.73	81,861.90
8	291,327.58	173,647.00	35,826.05	81,854.53
9	291,239.02	173,629.85	35,787.40	81,821.77
10	291,169.63	173,576.52	35,790.83	81,802.28
11	291,328.32	173,664.20	35,801.30	81,862.82
12	291,191.77	173,488.73	35,834.87	81,868.17
Average	291,269.98	173,601.40	35,820.42	81,848.16

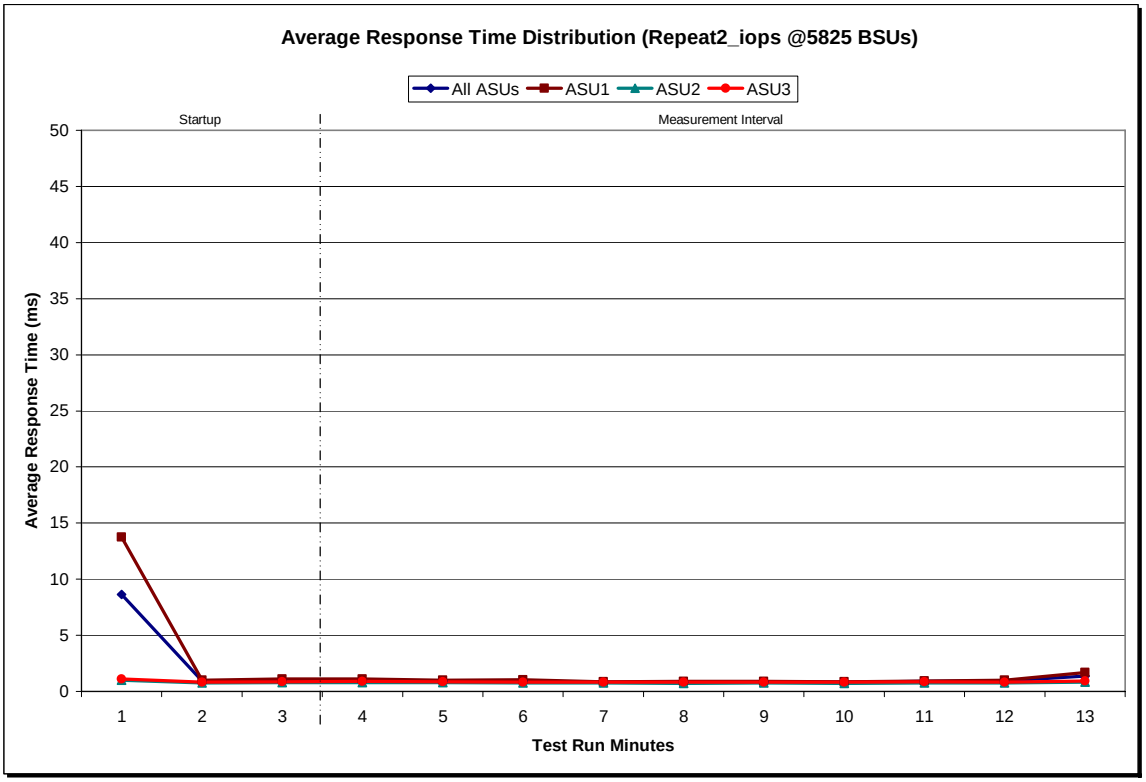
Repeatability 2 IOPS – I/O Request Throughput Distribution Graph



Repeatability 2 IOPS –Average Response Time (ms) Distribution Data

5828 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	12:35:28	12:38:29	0-2	0:03:01
Measurement Interval	12:38:29	12:48:29	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	8.64	13.76	1.02	1.12
1	0.93	1.01	0.75	0.84
2	1.01	1.12	0.78	0.88
3	1.01	1.11	0.79	0.89
4	0.94	1.01	0.78	0.87
5	0.95	1.05	0.75	0.84
6	0.84	0.86	0.74	0.83
7	0.85	0.89	0.72	0.81
8	0.87	0.91	0.74	0.83
9	0.83	0.85	0.72	0.81
10	0.90	0.94	0.76	0.85
11	0.93	1.00	0.75	0.84
12	1.38	1.71	0.82	0.92
Average	0.95	1.03	0.76	0.85

Repeatability 2 IOPS –Average Response Time (ms) Distribution Graph



Repeatability 1 (LRT)
Measured Intensity Multiplier and Coefficient of Variation

Clause 3.4.3

IM – Intensity Multiplier: *The ratio of I/Os for each I/O stream relative to the total I/Os for all I/O streams (ASU1-1 – ASU3-1) as required by the benchmark specification.*

Clauses 5.1.0 and 5.3.13.2

MIM – Measured Intensity Multiplier: *The Measured Intensity Multiplier represents the ratio of measured I/Os for each I/O stream relative to the total I/Os measured for all I/O streams (ASU1-1 – ASU3-1). This value may differ from the corresponding Expected Intensity Multiplier by no more than 5%.*

Clause 5.3.13.3

COV – Coefficient of Variation: *This measure of variation for the Measured Intensity Multiplier cannot exceed 0.2.*

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	***0.0350***	***0.2810***	***0.0700***	***0.2100***	***0.0180***	***0.0700***	***0.0350***	***0.2810***
MIM	0.0350	0.2809	0.0700	0.2100	0.0180	0.0700	0.0350	0.2811
COV	0.004	0.001	0.003	0.002	0.005	0.002	0.003	0.001

Repeatability 1 (IOPS)
Measured Intensity Multiplier and Coefficient of Variation

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	***0.0350***	***0.2810***	***0.0700***	***0.2100***	***0.0180***	***0.0700***	***0.0350***	***0.2810***
MIM	0.0350	0.2810	0.0700	0.2101	0.0180	0.0700	0.0350	0.2810
COV	0.001	0.000	0.001	0.000	0.001	0.001	0.001	0.000

Repeatability 2 (LRT)
Measured Intensity Multiplier and Coefficient of Variation

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	***0.0350***	***0.2810***	***0.0700***	***0.2100***	***0.0180***	***0.0700***	***0.0350***	***0.2810***
MIM	0.349	0.2810	0.0700	0.2099	0.0180	0.0700	0.0350	0.2812
COV	0.003	0.001	0.003	0.002	0.002	0.003	0.004	0.001

Repeatability 2 (IOPS)
Measured Intensity Multiplier and Coefficient of Variation

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	***0.0350***	***0.2810***	***0.0700***	***0.2100***	***0.0180***	***0.0700***	***0.0350***	***0.2810***
MIM	0.0350	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2810
COV	0.001	0.000	0.001	0.001	0.002	0.001	0.001	0.000

Data Persistence Test

Clause 6

The Data Persistence Test demonstrates the Tested Storage Configuration (TSC):

- *Is capable of maintain data integrity across a power cycle.*
- *Ensures the transfer of data between Logical Volumes and host systems occurs without corruption or loss.*

The SPC-1 Workload Generator will write 16 block I/O requests at random over the total Addressable Storage Capacity of the TSC for ten (10) minutes at a minimum of 25% of the load used to generate the SPC-1 IOP™ primary metric. The bit pattern selected to be written to each block as well as the address of the block will be retained in a log file.

The Benchmark Configuration will be shutdown and restarted using a power off/power on cycle at the end of the above sequence of write operations. In addition, any caches employing battery backup must be flushed/emptied.

The SPC-1 Workload Generator will then use the above log file to verify each block written contains the correct bit pattern.

Clause 9.2.4.8

The following content shall appear in this section of the FDR:

1. *A listing or screen image of all input parameters supplied to the Workload Generator.*
2. *For the successful Data Persistence Test Run, a table illustrating key results. The content, appearance, and format of this table are specified in Table 9-12. Information displayed in this table shall be obtained from the Test Run Results File referenced below in #3.*
3. *For the successful Data Persistence Test Run, the human readable Test Run Results File produced by the Workload Generator.*

SPC-1 Workload Generator Input Parameters

The SPC-1 Workload Generator input parameters for the Sustainability, IOPS, Response Time Ramp, Repeatability, and Persistence Test Runs are documented in "Appendix E: SPC-1 Workload Generator Input Parameters" on Page 63.

Data Persistence Test Results File

A link to each test result file generated from each Data Persistence Test is listed below.

Persistence 1 Test Results File

Persistence 2 Test Results File

Data Persistence Test Results

Data Persistence Test Results	
Data Persistence Test Run Number: 1	
Total Number of Logical Blocks Written	488,860,832
Total Number of Logical Blocks Verified	16,777,120
Total Number of Logical Blocks that Failed Verification	0
Time Duration for Writing Test Logical Blocks	10 minutes
Size in Bytes of each Logical Block	512
Number of Failed I/O Requests in the process of the Test	0

In some cases the same address was the target of multiple writes, which resulted in more Logical Blocks Written than Logical Blocks Verified. In the case of multiple writes to the same address, the pattern written and verified must be associated with the last write to that address.

PRICED STORAGE CONFIGURATION AVAILABILITY DATE

Clause 9.2.4.9

The committed delivery data for general availability (Availability Date) of all products that comprise the Priced Storage Configuration must be reported. When the Priced Storage Configuration includes products or components with different availability dates, the reported Availability Date must be the date at which all components are committed to be available.

The FDR shall state: "The Priced Storage Configuration, as documented in this Full Disclosure Report will be available for shipment to customers on MMMM DD, YYYY." Where Priced Storage Configuration is the TSC Configuration Name as described in Clause 9.2.4.3.3 and MMMM is the alphanumeric month, DD is the numeric day, and YYYY is the numeric year of the date that the Priced Storage Configuration, as documented, is available for shipment to customers as described above.

The Texas Memory Systems RamSan-400 as documented in this Full Disclosure Report is currently available for customer purchase and shipment.

PRICING INFORMATION

Clause 9.2.4.11

A statement of the respective calculations for pricing must be included.

Clause 9.2.4.11.3

A list of all differences between the Tested Storage Configuration (TSC) and Priced Storage Configuration must be included.

Pricing information may found in the Tested Storage Configuration Pricing section on page 13. A list of all differences between the Tested Storage Configuration (TSC) and Priced Storage Configuration may be found in the Executive Summary portion of this document on page 13.

ANOMALIES OR IRREGULARITIES

Clause 9.2.4.10

The FDR shall include a clear and complete description of any anomalies or irregularities encountered in the course of executing the SPC-1 benchmark that may in any way call into question the accuracy, verifiability, or authenticity of information published in this FDR.

There were no anomalies or irregularities encountered during the SPC-1 Onsite Audit of the Texas Memory Systems RamSan-400.

APPENDIX A: SPC-1 GLOSSARY

"Decimal" *(powers of ten)* Measurement Units

In the storage industry, the terms "kilo", "mega", "giga", "tera", "peta", and "exa" are commonly used prefixes for computing performance and capacity. For the purposes of the SPC workload definitions, all of the following terms are defined in "powers of ten" measurement units.

- A kilobyte (KB) is equal to 1,000 (10^3) bytes.
- A megabyte (MB) is equal to 1,000,000 (10^6) bytes.
- A gigabyte (GB) is equal to 1,000,000,000 (10^9) bytes.
- A terabyte (TB) is equal to 1,000,000,000,000 (10^{12}) bytes.
- A petabyte (PB) is equal to 1,000,000,000,000,000 (10^{15}) bytes
- An exabyte (EB) is equal to 1,000,000,000,000,000,000 (10^{18}) bytes

"Binary" *(powers of two)* Measurement Units

The sizes reported by many operating system components use "powers of two" measurement units rather than "power of ten" units. The following standardized definitions and terms are also valid and may be used in this document.

- A kibibyte (KiB) is equal to 1,024 (2^{10}) bytes.
- A mebibyte (MiB) is equal to 1,048,576 (2^{20}) bytes.
- A gigibyte (GiB) is equal to 1,073,741,824 (2^{30}) bytes.
- A tebibyte (TiB) is equal to 1,099,511,627,776 (2^{40}) bytes.
- A pebibyte (PiB) is equal to 1,125,899,906,842,624 (2^{50}) bytes.
- An exbibyte (EiB) is equal to 1,152,921,504,606,846,967 (2^{60}) bytes.

SPC-1 Data Repository Definitions

Total ASU Capacity: The total storage capacity read and written in the course of executing the SPC-1 benchmark.

Application Storage Unit (ASU): The logical interface between the storage and SPC-1 Workload Generator. The three ASUs (Data, User, and Log) are typically implemented on one or more Logical Volume.

Logical Volume: The division of Addressable Storage Capacity into individually addressable logical units of storage used in the SPC-1 benchmark. Each Logical Volume is implemented as a single, contiguous address space.

Addressable Storage Capacity: The total storage (sum of Logical Volumes) that can be read and written by application programs such as the SPC-1 Workload Generator.

Configured Storage Capacity: This capacity includes the Addressable Storage Capacity and any other storage (parity disks, hot spares, etc.) necessary to implement the Addressable Storage Capacity.

Physical Storage Capacity: The formatted capacity of all storage devices physically present in the Tested Storage Configuration (TSC).

Data Protection Overhead: The storage capacity required to implement the selected level of data protection.

Required Storage: The amount of Configured Storage Capacity required to implement the Addressable Storage Configuration, excluding the storage required for the three ASUs.

Global Storage Overhead: The amount of Physical Storage Capacity that is required for storage subsystem use and unavailable for use by application programs.

Total Unused Storage: The amount of storage capacity available for use by application programs but not included in the Total ASU Capacity.

SPC-1 Data Protection Levels

RAID5: User data is distributed across the disks in the array. Check data corresponding to user data is distributed across multiple disks in the form of bit-by-bit parity.

Mirroring: Two or more identical copies of user data are maintained on separate disks.

Other Protection Level: Any data protection other than **RAID5** or **Mirroring**.

Unprotected: There is no data protection provided.

SPC-1 Test Execution Definitions

Average Response Time: The sum of the Response Times for all Measured I/O Requests divided by the total number of Measured I/O Requests.

Completed I/O Request: An I/O Request with a Start Time and a Completion Time (see "I/O Completion Types" below).

Completion Time: The time recorded by the Workload Generator when an I/O Request is satisfied by the TSC as signaled by System Software.

Data Rate: The data transferred in all Measured I/O Requests in an SPC-1 Test Run divided by the length of the Test Run in seconds.

Expected I/O Count: For any given I/O Stream and Test Phase, the product of 50 times the BSU level, the duration of the Test Phase in seconds, and the Intensity Multiplier for that I/O Stream.

Failed I/O Request: Any I/O Request issued by the Workload Generator that could not be completed or was signaled as failed by System Software. A Failed I/O Request has no Completion Time (see "I/O Completion Types" below).

I/O Request Throughput: The total number of Measured I/O requests in an SPC-1 Test Run divided by the duration of the Measurement Interval in seconds.

In-Flight I/O Request: An I/O Request issued by the I/O Command Generator to the TSC that has a recorded Start Time, but does not complete within the Measurement Interval (see "I/O Completion Types" below).

Measured I/O Request: A Completed I/O Request with a Completion Time occurring within the Measurement Interval (see "I/O Completion Types" below).

Measured Intensity Multiplier: The percentage of all Measured I/O Requests that were issued by a given I/O Stream.

Measurement Interval: The finite and contiguous time period, after the TSC has reached Steady State, when data is collected by a Test Sponsor to generate an SPC-1 test result or support an SPC-1 test result.

Ramp-Up: The time required for the Benchmark Configuration (BC) to produce Steady State throughput after the Workload Generator begins submitting I/O Requests to the TSC for execution.

Ramp-Down: The time required for the BC to complete all I/O Requests issued by the Workload Generator. The Ramp-Down period begins when the Workload Generator ceases to issue new I/O Requests to the TSC.

Response Time: The Response Time of a Measured I/O Request is its Completion Time minus its Start Time.

Start Time: The time recorded by the Workload Generator when an I/O Request is submitted, by the Workload Generator, to the System Software for execution on the Tested Storage Configuration (TSC).

Start-Up: The period that begins after the Workload Generator starts to submit I/O requests to the TSC and ends at the beginning of the Measurement Interval.

Shut-Down: The period between the end of the Measurement Interval and the time when all I/O Requests issued by the Workload Generator have completed or failed.

Steady State: The consistent and sustainable throughput of the TSC. During this period the load presented to the TSC by the Workload Generator is constant.

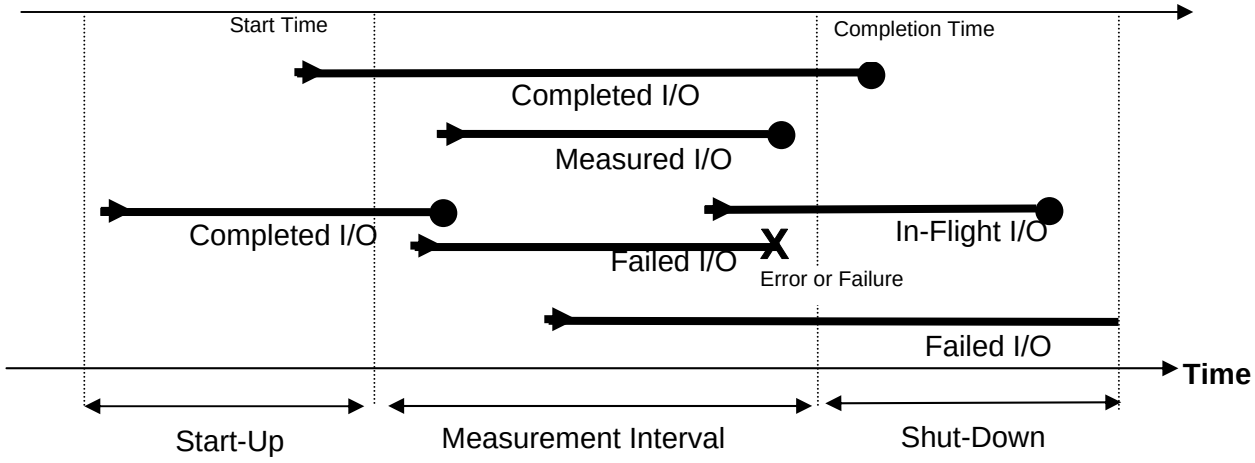
Test: A collection of Test Phases and or Test Runs sharing a common objective.

Test Run: The execution of SPC-1 for the purpose of producing or supporting an SPC-1 test result. SPC-1 Test Runs may have a finite and measured Ramp-Up period, Start-Up

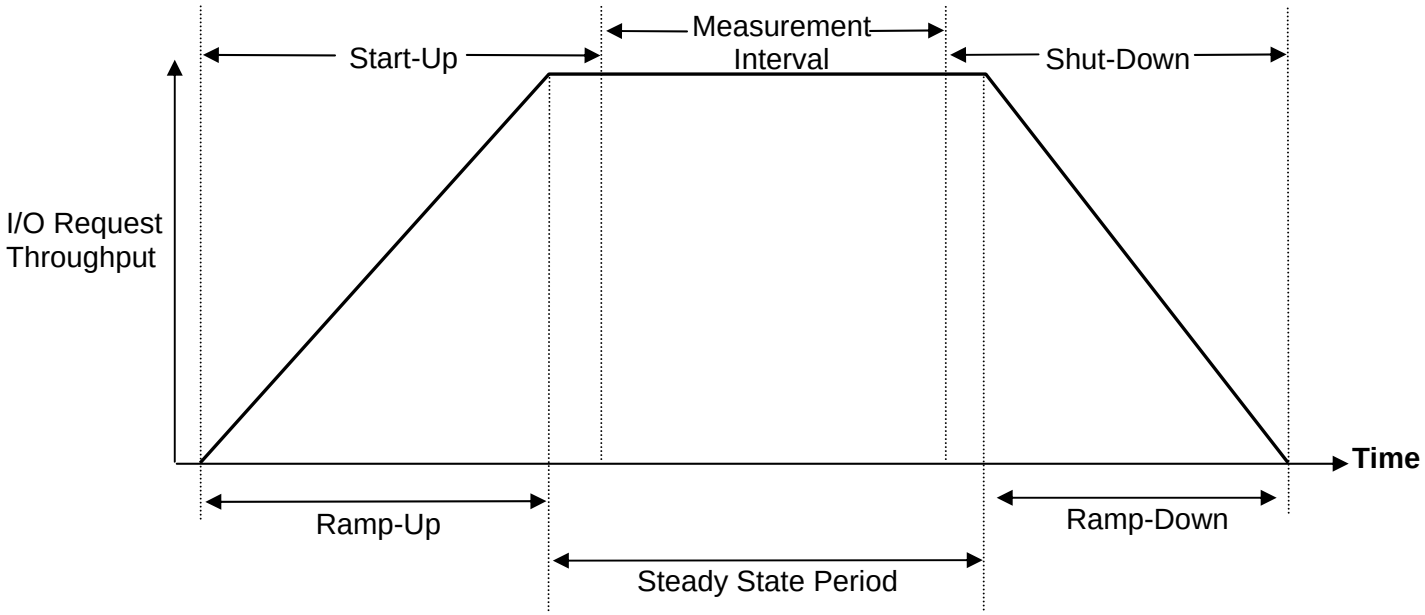
period, Shut-Down period, and Ramp-Down period as illustrated in the "SPC-1 Test Run Components" below. All SPC-1 Test Runs shall have a Steady State period and a Measurement Interval.

Test Phase: A collection of one or more SPC-1 Test Runs sharing a common objective and intended to be run in a specific sequence.

I/O Completion Types



SPC-1 Test Run Components



APPENDIX B: CUSTOMER TUNABLE PARAMETERS AND OPTIONS

The TMS Multipath driver was installed on each host system. In the driver's registry settings, the value DefaultLoadBalancePolicy was created with a data of 2 in the "HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\tmsdsm\LoadBalanceSettings" registry key. This set all connected storage to "active/active" multipath groups.

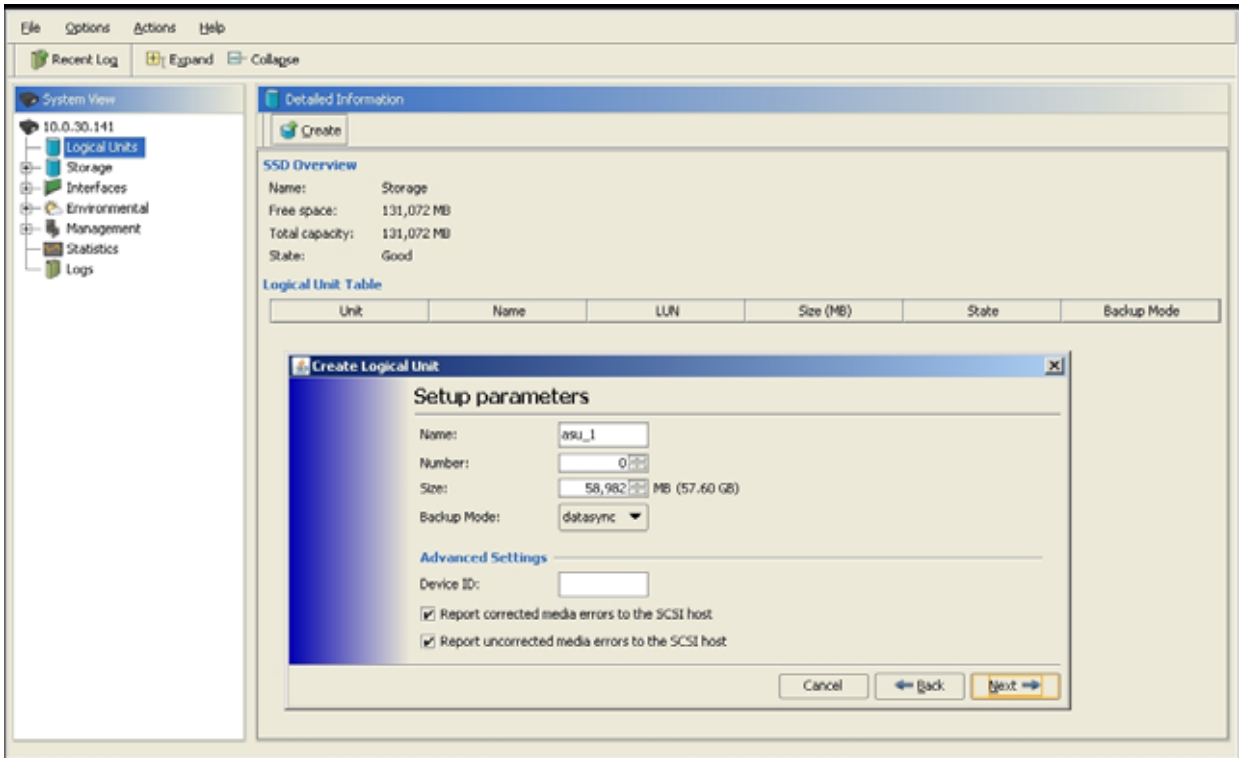
On each connected QLE2462 HBA port, the Execution Throttle was reduced to 4 from the default value of 16.

Zones were created on the Qlogic 5600 FC switches to associate 4 host ports with each RamSan port. Each switch with 3 RamSan ports connected had 3 zones of 5 ports each. The 3rd Qlogic switch, which was connected to the 2 remaining RamSan ports, contained 2 5-port zones.

APPENDIX C: TESTED STORAGE CONFIGURATION (TSC) CREATION

Step 1: Create Logical Units on RamSan

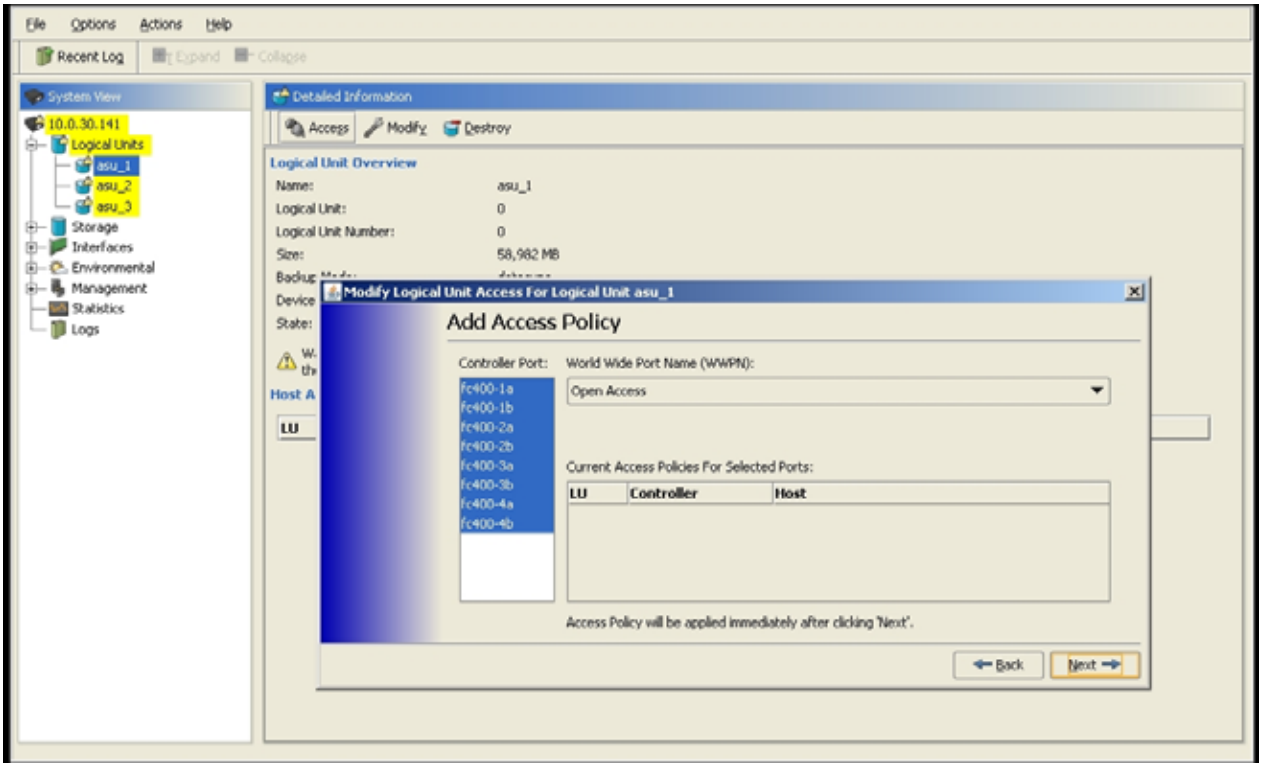
Using the Create Logical Unit Wizard, a Logical Unit was created specifying a Name, LUN, size, and Backup Mode. For ASU-1, the name was given asu_1, the LUN was assigned 0, the size was 58,982MB (1,048,576 bytes per MB), and the Backup Mode was assigned.



Likewise, ASU-2 was created with 58,982MB as LUN 1, and ASU-3 was created with the remaining 13,108MB as LUN 2.

Step 2: Bind Fibre Ports to Logical Units

The ASU-1 Logical Unit was assigned Access Policies to bind to the fibre ports. Using the Logical Unit Access Wizard, all 8 ports were selected and the WWPN mask of "Open Access" was assigned. This exported the Logical Unit to all 8 ports with no restriction on the connecting hosts.



Again, this step was repeated for the ASU-2 and ASU-3 Logical Units.

A rescan was performed through Windows' Disk Management to detect the attached LUNs.

APPENDIX D: SPC-1 WORKLOAD GENERATOR STORAGE COMMANDS AND PARAMETERS

The contents of the SPC-1 Workload Generator command and parameter files used for the Primary Metrics and Repeatability Tests are listed below.

Master Host System

```
host=master
javaparms="-Xmx512M -Xms512M"
slaves=(c601,c602,c603,c604,c611,c612,c613,c614,c621,c622,c623,c624,c631,c63
2,c633,c634,c641,c642,c643,c644,c651,c652,c653,c654,c661,c662,c663,c664,c671
,c672,c673,c674,c681,c682,c683,c684,c691,c692,c693,c694,c701,c702,c703,c704,
c711,c712,c713,c714,c441,c442,c443,c444,c451,c452,c453,c454,c461,c462,c463,c
464,c471,c472,c473)
sd=asu1_1,lun=\\.\PhysicalDrive1
sd=asu2_1,lun=\\.\PhysicalDrive2
sd=asu3_1,lun=\\.\PhysicalDrive3
```

Slave Host Systems

Each file for the Slave Host Systems were identical with the exception of the "host=" value, which varied dependent upon the specific Slave Host System.

```
master=10.0.40.239
host=c471
sd=asu1_1,lun=\\.\PhysicalDrive1
sd=asu2_1,lun=\\.\PhysicalDrive2
sd=asu3_1,lun=\\.\PhysicalDrive3
```

The contents of the SPC-1 Workload Generator command and parameter file used for the Persistence Test is listed below.

Persistence Test

```
sd=asu1_1,lun=\\.\PhysicalDrive1
sd=asu2_1,lun=\\.\PhysicalDrive2
sd=asu3_1,lun=\\.\PhysicalDrive3
```

APPENDIX E: SPC-1 WORKLOAD GENERATOR INPUT PARAMETERS

Primary Metrics Test, Repeatability Test, and Persistence Test Run 1

The following script was used to execute the Primary Metrics Test *(Sustainability Test Phase, IOPS Test Phase, and Response Time Ramp Test Phase)*, Repeatability Test *(Repeatability Test Phase 1 and Repeatability Test Phase 2)*, and Persistence Test Run 1 in an uninterrupted sequence.

```
del spc1.cfg /Q
copy spc1-multi.cfg spc1.cfg

REM Metrics run
java -Xmx512m -Xms512m metrics -b 5825

REM Repeat 1
java -Xmx512m -Xms512m repeat1 -b 5825

REM Repeat 2
java -Xmx512m -Xms512m repeat2 -b 5825


del spc1.cfg /Q
copy spc1-persist.cfg spc1.cfg

REM Run Persist1 first
java -Xmx900m -Xms900m -Xss64k persist1 -b 5825
```

Persistence Test Run 2

The following CLI command was used to execute Persistence Test Run 2:

```
java -Xmx900m -Xms900m -Xss64k persist2
```