

The science behind the report:

# Enjoy better data analytics performance by upgrading to Dell EMC PowerEdge R7525 servers and Dell EMC PowerStore storage

This document describes what we tested, how we tested, and what we found. To learn how these facts translate into real-world benefits, read the report [Enjoy better data analytics performance by upgrading to Dell EMC PowerEdge R7525 servers and Dell EMC PowerStore storage](#).

We concluded our hands-on testing on 01/13/2021. During testing, we determined the appropriate hardware and software configurations and applied updates as they became available. The results in this report reflect configurations that we finalized on 01/27/2021 or earlier. Unavoidably, these configurations may not represent the latest versions available when this report appears.

## Our results

Table 1: Results of our testing. The Dell EMC™ solution comprised three Dell EMC PowerEdge™ R750 servers and a Dell EMC PowerStore™ 5000T storage array. The HPE Gen9 solution had three HPE ProLiant DL380 Gen9 servers, while the HPE Gen10 had three HPE ProLiant DL380 Gen10 servers. Both HPE solutions used a 3PAR StoreServ 8450 storage array.

	Dell EMC solution	HPE Gen10 solution	HPE Gen9 solution
Data analytics queries (seconds)	1,355	1,686	1,826
Throughput (MB/s)	1,491	1,184	1,170

## System configuration information

Table 2: Detailed information on the PowerEdge R7525 and the ProLiant DL380 Gen 9 systems we tested.

System configuration information	3 x Dell EMC PowerEdge R7525	3x HPE ProLiant DL380 Gen9
BIOS name and version	Dell 1.5.5	P89 v2.76
Non-default BIOS settings	N/A	None
Operating system name and version/build number	Windows Server 2019 1809	Microsoft Windows Server Datacenter 2019, 17763.1637
Date of last OS updates/patches applied	11/18/20	12/14/20
Power management policy	Balanced	High performance
Processor		
Number of processors	2	2
Vendor and model	AMD EPYC™ 7542	Intel® Xeon® E5-2699 v4
Core count (per processor)	32	22
Core frequency (GHz)	2.90	2.2
Stepping	N/A	B0
Memory module(s)		
Total memory in system (GB)	256	256
Number of memory modules	16	8
Vendor and model	Hynix HMA82GR7CJR8N-XN	Kingston HP24D4R7D4MAM-32
Size (GB)	16	32
Type	PC4-3200	DDR4
Speed (MHz)	3,200	2,400
Speed running in the server (MHz)	3,200	2,400
Storage controller		
Vendor and model	Dell BOSS-S1 Adapter	Smart Array P440ar Controller
Cache size (GB)	0	2
Firmware version	6.0.3-0005	7.0
Driver version	10.0.17763.1432	8.0.4.0
Local storage (type A)		
Number of drives	1	2
Drive vendor and model	1 x Intel SSDSCKJB120G7R / 2 x Intel SSDSC2KG480G8R	HP LK0800GEYMU
Drive size (GB)	1 x 120GB / 2 x 480GB	800
Drive information (speed, interface, type)	6Gbps, SATA MLC M.2, SSD	6Gbps, SATA, SSD

System configuration information	3 x Dell EMC PowerEdge R7525	3x HPE ProLiant DL380 Gen9
Network adapter		
Vendor and model	Broadcom BCM57414 NetXtreme-E 10Gb/25Gb	2 x Emulex FC16 LPe31002-M6 Adapter
Number and type of ports	2 x 10GbE	2 x 16GbE
Driver version	1.0.1	11.0.270.18
Network adapter #1		
Vendor and model	Emulex LPe35002-M2-D	N/A
Number and type of ports	2 32Gb Fibre Channel Adapter	N/A
Driver version	216.0.143.3	N/A
Network adapter #2		
Vendor and model	Broadcom Gigabit Ethernet BCM5720	HPE Ethernet 331i Adapter
Number and type of ports	2 x 1GbE	4 x 1GbE
Driver version	214.0.0.3	17.2.1.0
Cooling fans		
Vendor and model	Dell A1234	Nidec UltraFlo V60E12BS1M3-08T062
Number of cooling fans	5	6
Power supplies		
Vendor and model	Dell A5678	HPE 720479-B21
Number of power supplies	2	2
Wattage of each (W)	750	800

Table 3: Detailed information on the ProLiant DL380 Gen10 systems we tested. Because the three servers we used each contained RAM with differing model numbers, we present the servers in individual columns.

System configuration information	HPE ProLiant DL380 Gen10	HPE ProLiant DL380 Gen10	HPE ProLiant DL380 Gen10
BIOS name and version	HPE U30 v2.36	HPE U30 v2.36	HPE U30 v2.36
Non-default BIOS settings	None	None	None
Operating system name and version/build number	Microsoft Windows Server Datacenter 2019, 17763.1577	Microsoft Windows Server Datacenter 2019, 17763.1577	Microsoft Windows Server Datacenter 2019, 17763.1577
Date of last OS updates/ patches applied	11/12/20	11/12/20	11/12/20
Power management policy	High performance	High performance	High performance
Processor			
Number of processors	2	2	2
Vendor and model	Intel Xeon Gold 6258R	Intel Xeon Gold 6258R	Intel Xeon Gold 6258R
Core count (per processor)	28	28	28
Core frequency (GHz)	2.7	2.7	2.7
Stepping	B1	B1	B1

System configuration information	HPE ProLiant DL380 Gen10	HPE ProLiant DL380 Gen10	HPE ProLiant DL380 Gen10
Memory module(s)			
Total memory in system (GB)	256	256	256
Number of memory modules	8	8	8
Vendor and model	Hynix Semiconductor HMA84GR7CJR4N-WM	Hynix Semiconductor HMA84GR7CJR4N-WM	6x Hynix Semiconductor HMA84GR7CJR4N-WM 2x Micron MTA36ASF4G72PZ-2G9E2VG
Size (GB)	32	32	32
Type	DDR4	DDR4	DDR4
Speed (MHz)	2,933	2,933	2,933
Speed running in the server (MHz)	2,933	2,933	2,933
Storage controller			
Vendor and model	HPE Smart Array P408i-a SR Gen10	HPE Smart Array P408i-a SR Gen10	HPE Smart Array P408i-a SR Gen10
Cache size (GB)	2	2	2
Firmware version	1.04	1.04	1.04
Driver version	106.178.0.1009	106.178.0.1009	106.178.0.1009
Local storage (type A)			
Number of drives	2	2	2
Drive vendor and model	Seagate ST600MM0088	Seagate ST600MM0088	Seagate ST600MM0088
Drive size (GB)	600	600	600
Drive information (speed, interface, type)	10K, 12Gb SAS, HDD	10K, 12Gb SAS, HDD	10K, 12Gb SAS, HDD
Network adapter #1			
Vendor and model	2x Emulex FC16 LPe31002-M6 Adapter	2x Emulex FC16 LPe31002-M6 Adapter	2x Emulex FC16 LPe31002-M6 Adapter
Number and type of ports	2x 16GbE	2x 16GbE	2x 16GbE
Driver version	11.4.225.8009	11.4.225.8009	11.4.225.8009
Network adapter #2			
Vendor and model	HPE Ethernet 331i Adapter	HPE Ethernet 331i Adapter	HPE Ethernet 331i Adapter
Number and type of ports	4x 1Gb Ethernet ports	4x 1Gb Ethernet ports	4x 1Gb Ethernet ports
Driver version	17.2.1.0	17.2.1.0	17.2.1.0
Cooling fans			
Vendor and model	AVC DBTA0638B2S	AVC DBTA0638B2S	AVC DBTA0638B2S
Number of cooling fans	6	6	6
Power supplies			
Vendor and model	HPE 865414-B21	HPE 865414-B21	HPE 865414-B21
Number of power supplies	2	2	2
Wattage of each (W)	800	800	800

Table 4: Detailed information on the storage systems we used.

Storage configuration information	HPE 3PAR StoreServ 8450	Dell EMC PowerStore™ 5000T
Controller firmware version	3.3.1.648 (MU5)	1.0.2.1.3.273
Number of storage controllers	2	2
Number of storage shelves	1	1
Number of drives per shelf	24	21
Drive vendor and model number	SanDisk DOPE1920S5xnNMRI	Samsung MZ-WLL1T9C
Drive size (TB)	1.92	1.92
Drive information	SAS SSD	NVMe™ SSD
NVRAM count	0	4
NVRAM size (GB)	N/A	8.5

# How we tested

## Configuring the storage arrays

We configured the storage array volumes with the following steps. We assume that each array is initialized and that the management UI is accessible to the user. Additionally, we assume that each host system is already configured for volume mapping on each storage array.

### Creating the 3PAR volumes

1. In the 3PAR StoreServ portal, navigate to 3PAR StoreServ→Virtual Volumes.
2. Click Create virtual volume.
3. Choose the appropriate Name and System for the volume.
4. In the Provisioning dropdown menu, choose Full Provisioned.
5. Choose the appropriate CPG and Size for the volume you are creating.
6. In the Export section, click Add, and choose the host you would like to export the volume to.
7. Click Create.
8. Repeat steps 1 through 7 until you have created two 2,048GB data volumes and one 200GB log volume for each host, as well as one 500GB backup volume and one 2,048GB IOmeter volume.

### Creating the PowerStore volumes

1. From the PowerStore Management interface, select the Storage drop-down menu, and click Volumes.
2. Under Volumes, click Create.
3. For Properties, provide a name for the volume, set the size and Volume Performance Policy, and click Next.
4. For Host Mappings, select the host to which you would like to map the volume, and click Next.
5. Review the Summary, and click Next.
6. Repeat steps 1 through 5 until you have created two 2,048GB data volumes and one 200GB log volume for each host, as well as one 500GB backup volume and one 2,048GB IOmeter volume.

## Configuring the test servers

We configured three HPE ProLiant DL380 Gen9 servers, three HPE ProLiant DL380 Gen10 servers, and three Dell EMC PowerEdge R7525 servers according to the following procedure.

### Installing Microsoft Windows Server 2019

1. Insert the Microsoft Windows Server 2019 installation media.
2. Power on the server, and boot into the Windows installer.
3. Once the installer has copied the installation files into the memory, select the appropriate language, time and currency format, and keyboard layout. Click Next.
4. Click Install Now.
5. Enter the product key, and click Next.
6. Choose Windows Server 2016 Datacenter (Server with a GUI), and click Next.
7. Check I accept the license terms, and click Next.
8. Choose Custom: Install Windows only (advanced).
9. From the list, select the OS hard drive, and click Next. This will begin the installation.

### Configuring Windows Update on the server

1. In the left pane of the Server Manager window, click Local Server.
2. In the main frame, next to Windows Update, click Not configured.
3. In the Windows Update window, in the main pane, click Let me choose my settings.
4. Under Important updates, select Never check for updates (not recommended), and click OK.
5. In the left pane, click Check for updates, and install all available updates.
6. Close the Windows Update window.

### Configuring MPIO on Windows Server 2019 Hosts

1. Open Server Manager, and click Manage→Add Roles and Features.
2. In the Add Roles and Features Wizard, click Next.
3. Choose Role-based or feature-based installation, and click Next.
4. Choose Select a server from the server pool, choose the local server, and click Next.

5. On the Select server roles screen, click Next.
6. On the Select features screen, choose Multipath I/O, and click Next.
7. On the Confirmation screen, click Install.
8. When the installation is complete, reboot the server.
9. For HPE systems, take the following actions:
  - a. When the server finishes rebooting, open the Start menu, and type `MPIO`.
  - b. In the MPIO app, click the Discover Multi-Paths tab.
  - c. Select the desired multipath device, and click Add.
  - d. When the app is finished, close the window.
  - e. For Dell EMC systems, we also ran the following commands as per the [PowerStore Host configuration guide](#):

```
Set-MPIOSetting -NewPathVerificationState Enabled
Set-MPIOSetting -NewPathVerificationPeriod 30
Set-MPIOSetting -NewPDORemovePeriod 20
Set-MPIOSetting -NewRetryCount 3
Set-MPIOSetting -NewRetryInterval 3
Set-MPIOSetting -custompathrecovery enabled
Set-MPIOSetting -newpathrecoveryinterval 10
Set-MPIOSetting -NewDiskTimeout 30
```

## Adding the drives in Windows Server 2019

1. Log into the Windows Server 2019 host.
2. Right-click the Start menu, and click Disk Management.
3. Right-click the new disks, and click Online.
4. Right-click the new disks, and click Initialize. At the pop-up, ensure GPT is selected as the initialization type, and click OK.
5. Right-click each new disk, and click New Simple Volume.
6. To create a new drive with the chosen drive letter and NTFS formatting, follow the wizard.
7. In Windows Explorer, right-click the drive, and choose Format.
8. In the Allocation unit size field, choose 64K, and click Start.
9. Repeat steps 1 through 8 for all drives.

## Installing Microsoft SQL Server 2019

1. Attach the SQL Server 2019 installation media .ISO to the VM.
2. Click Run SETUP.EXE.
3. In the left pane, click Installation.
4. Click New SQL Server stand-alone installation or add features to an existing installation.
5. To accept the license terms, click the checkbox, and click Next.
6. Click Use Microsoft Update to check for updates, and click Next.
7. To install the setup support files, click Install.
8. If the installer doesn't display any failures, click Next.
9. At the Setup Role screen, choose SQL Server Feature Installation, and click Next.
10. At the Feature Selection screen, select Database Engine Services, Full-Text and Semantic Extractions for Search, Client Tools Connectivity, and Client Tools Backwards Compatibility.
11. Click Next.
12. At the Instance Configuration screen, leave the instance default selection, and click Next.
13. At the Database Engine Configuration screen, select the authentication method you prefer. For our testing purposes, we selected Mixed Mode.
14. For the system administrator account, enter and confirm a password.
15. Click Add Current user. This may take several seconds.
16. Click the Data Directories tab.
17. Change the database directory, the database log directory, and the backup directory storage locations to the data, log, and backup volumes.
18. Click the TempDB tab.
19. Change the number of files to 8.
20. Change the initial file size to 1,024 MB.
21. Change the Data Directory to the data volume.
22. Change the initial size of the log to 1,024 MB.
23. Change the Log Directory to the log volume.
24. Click Next.

25. At the Error and usage reporting screen, click Next.
26. At the Installation Configuration Rules screen, check that there are no failures or relevant warnings, and click Next.
27. At the Ready to Install screen, click Install.
28. Once the installation finishes, navigate to the Installation tab in the Installation Center, and click Install SQL Server Management Tools.
29. In the browser that pops up, click Download SQL Server Management Studio 17.X.
30. To open the installer, click the download.
31. Click Run.
32. Click Install.
33. Once the installation completes, close the installation window.

## Enabling the Windows option for locking pages in memory

1. In the Start menu, click Run. In the Open box, type `gpedit.msc`
2. On the Local Group Policy Editor console, expand Computer Configuration, and expand Windows Settings.
3. Expand Security Settings, and expand Local Policies.
4. Select the User Rights Assignment folder.
5. In the details pane, double-click Lock pages in memory.
6. In the dialog box for Local Security Setting - Lock pages in memory, click Add User or Group.
7. In the dialog box for Select Users, Service Accounts, or Groups, select the SQL Server Service account.
8. For this setting to take effect, restart the SQL Server Service.

## Setting the maximum memory in SQL Server Management Studio

1. In SQL Server Management Studio, connect to the desired SQL Server database engine, right-click the desired instance, and click Properties.
2. In the Server Properties dialog box, from the left-hand list, select the Memory item.
3. In the Maximum server memory (in MB) option, enter `241591910`
4. Click OK.

## Configuring the test database

### Creating the database

1. Open SQL Server Management Studio.
2. Right-click Databases→New Database.
3. Name the database. We named ours TPC\_H\_CS\_1000.
4. To add seven more database files, click Add.
5. Name the database files, and click OK.

### Installing HammerDB

1. Download the latest version of HammerDB from [www.hammerdb.com/download.html](http://www.hammerdb.com/download.html).
2. Double-click the .EXE file, choose English, and click OK.
3. Click Yes.
4. Click Next.
5. Choose a destination location, and click Next.
6. Click Next.
7. Click Finish.

### Populating the database

1. Open HammerDB, and click Options→Benchmark.
2. Choose MSSQL Server and TPC-H.
3. Expand SQL Server→TPC-H→Schema Build.
4. Double-click Options.
5. Choose 1000 scale and 7 virtual users.
6. Check the boxes for TCP and Clustered Columnstore.
7. Click OK.
8. Double-click Build. This build could take several hours.

### Backing up the database

1. Open SQL Server Management Studio.
2. Right-click the TPC-H database, and click Tasks→Back up....
3. Choose a location to store the backup, and click OK.



## Splitting tempdb files

1. In SQL Server Management Studio, to set half of the tempdb files to the second data volume, execute the following script:

```
USE [master]
GO
ALTER DATABASE tempdb MODIFY FILE ( NAME = tempdev , FILENAME = 'D:\DATA\tempdb.mdf' )
GO
ALTER DATABASE tempdb MODIFY FILE ( NAME = temp3 , FILENAME = 'D:\DATA\tempdb_mssql_3.ndf' )
GO
ALTER DATABASE tempdb MODIFY FILE ( NAME = temp5 , FILENAME = 'D:\DATA\tempdb_mssql_5.ndf' )
GO
ALTER DATABASE tempdb MODIFY FILE ( NAME = temp7 , FILENAME = 'D:\DATA\tempdb_mssql_7.ndf' )
GO
```

2. Right-click the SQL Server instance, and click Stop.
3. In Windows Explorer, match the tempdb files to the files in the script above by moving those same tempdb files to the second data volume.
4. In SQL Server Management Studio, right-click the SQL Server instance, and click Start.
5. Delete any leftover duplicate tempdb files from the first data volume.

## Installing and configuring Iometer

1. On a separate Hyper-V server, create a Windows Server 2019 VM with 4 vCPUs and 4,096 MB of RAM
2. On the VM you just created, download Iometer 1.1.0 from <http://www.iometer.org/>.
3. Unzip the downloaded files, and run Iometer.exe.
4. On the Intel Open Source License window, click I agree.
5. See the images below to learn how we configured the Access Specifications and Test Setup tabs.

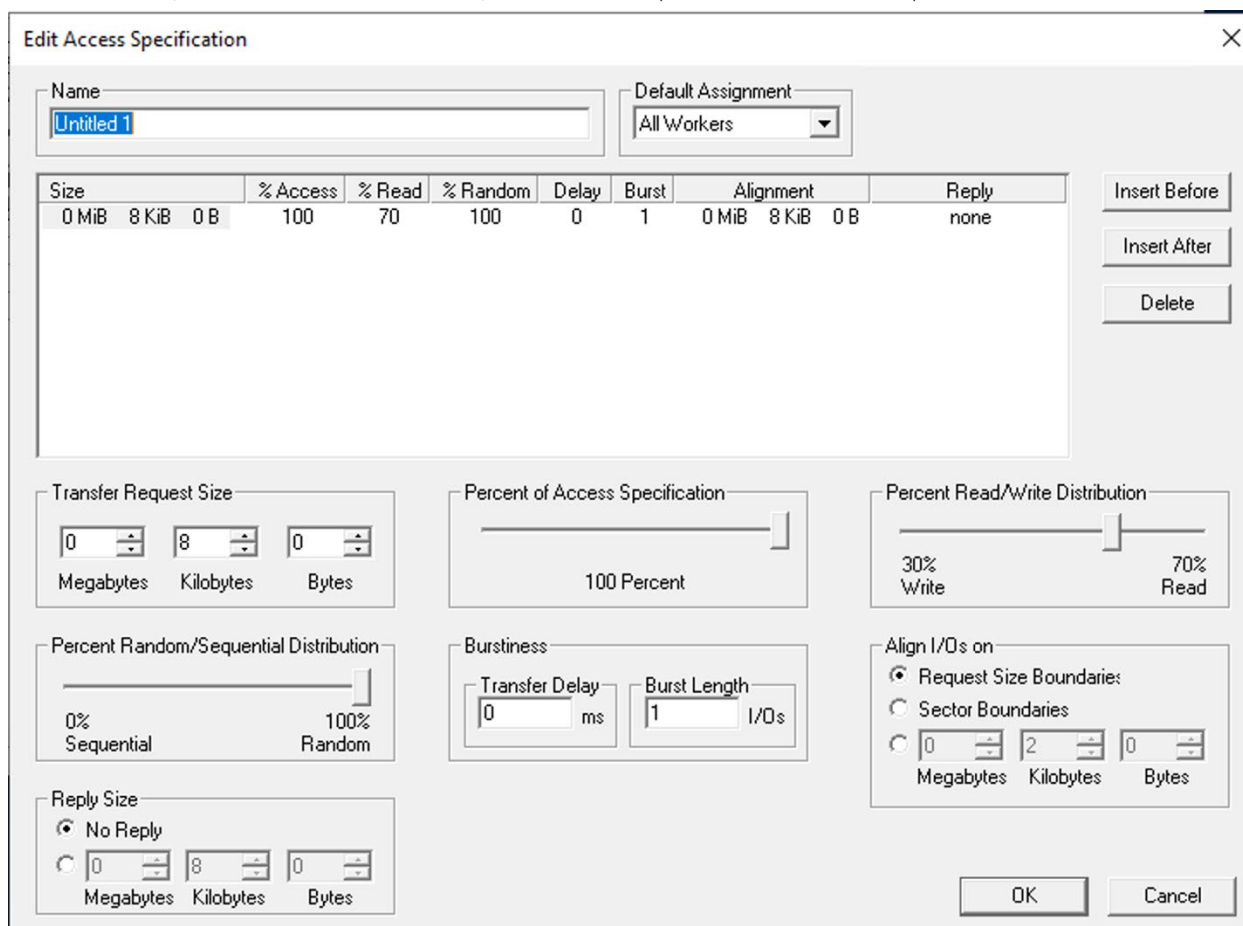


Figure 1: Our configuration for the Iometer Access Specifications tab.

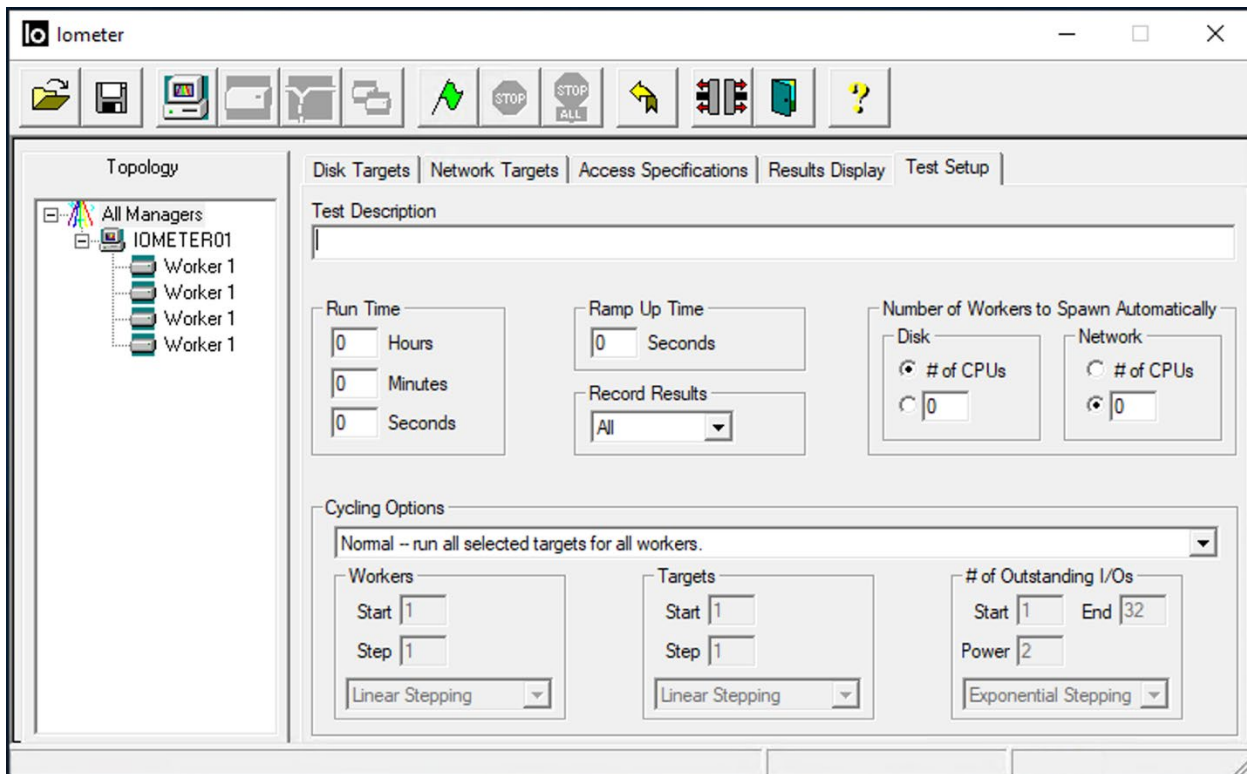


Figure 2: Our configuration for the Iometer Test Setup tab.

## Performing the test on Windows Server 2019

1. On the Iometer client server, open Iometer, and click Start.
2. When prompted, enter a file name. Click Save.
3. On each server under test, start HammerDB.
4. Set the database server to SQL Server, and set the workload to TPC-H.
5. Open the Options panel for the Schema Build: SQL Server→TPC-H→Schema Build→Options.
6. Change the ODBC Driver to ODBC Driver 17 for SQL Server.
7. Change the MAXDOP to 16.
8. For the Scale Factor, select 1000.
9. Click OK.
10. Open the Options panel for the Virtual Users: SQL Server→TPC-H→Virtual User→Options.
11. Use 7 Virtual Users.
12. Select the following: Show Output, Log Output to Temp, and Use Unique Log Name.
13. Click OK.
14. Open the Options panel for the Driver: SQL Server→TPC-H→Driver Script→Options.
15. Set Total Query Sets per User to 1.
16. Click OK.
17. Load the Driver Script: SQL Server→PC-H→Driver Script→Load.
18. Start a custom Perfmon data collector set to capture CPU, RAM, and disk performance counters.
19. Click the green arrow.
20. Note the name of the log file. To start the run, click OK.
21. When the run finishes, stop Perfmon.
22. Save the HammerDB results text file and Perfmon output.

Read the report at <http://facts.pt/umA9PGq> ►

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