

## IBM TS3100 and TS3200 Tape Libraries

### IBM Redbooks Product Guide

This IBM® Redbooks® Product Guide describes the IBM TS3100 and TS3200 Tape Libraries, which are well-suited for handling backup, restore, and archive data-storage needs for small-to-medium environments. The TS3100 and TS3200 units are shown in Figure 1.



Figure 1. TS3100 (3573 L2U) Tape Library and TS3200 (3573 L4U) Tape Library

The TS3100 library with its use of one IBM Linear Tape-Open (LTO) Ultrium 6 or LTO Ultrium 5 Full-High tape drive, or up to two LTO Ultrium 6 or LTO Ultrium 5 Half-High tape drives and 24 tape cartridge capacity has a library capacity of 150 TB compressed 2:5:1 (60 TB native). The TS3200 48 tape cartridge capacity and use of up to two LTO Ultrium 6 or 5 Full-High tape drives or up to four LTO Ultrium 6 or 5 Half-High tape drives scale to 300 TB compressed 2:5:1 (120 TB native). The LTO Ultrium 6 tape drive supports up to 160 MBps native data transfer; LTO Ultrium 5 tape drive supports up to 140 MBps native data-transfer.

Both libraries include, as standard, a bar-code reader, supporting their operation in sequential or random access mode. The design of the remote library management through a standard web interface offers flexibility and greater administrative control of storage operations. Path Failover, an optional feature for the libraries, provides automatic control path failover to a preconfigured redundant control path, if a host adapter or control path drive is lost, without aborting the current job in process.

### Did you know?

The TS3100 and TS3200 Tape Libraries are designed for storage management, capacity, performance, data protection, reliability, affordability, and application requirements. They are functionally rich, high-capacity, entry-level tape-storage solutions that incorporate the latest generation of IBM LTO Ultrium 6 tape technology. Both IBM TS3100 and TS3200 models are excellent solutions for large-capacity or high-performance tape backup with or without random access. They are also excellent choices for tape automation for IBM Power Systems™, IBM System x®, System x (Lenovo), and other open systems.

## Highlights

The IBM TS3100 and TS3200 take advantage of LTO technology to cost-effectively handle growing storage requirements:

- The TS3100 uses one LTO Full-High tape drive or up to two LTO Half-High tape drives and 24 tape cartridges capacity. The library is configured with two removable cartridge magazines, one on the left (12 data cartridge slots) and one on the right (12 data cartridge slots). In addition, the left magazine includes a single mail slot to help support continuous library operation while importing and exporting media.
- The TS3200 scales with the use of up to two LTO Full-High tape drives or up to four LTO Half-High tape drives and 48 tape cartridges capacity. The library is configured with four removable cartridge magazines, two on the left (24 data cartridge slots) and two on the right (24 data cartridge slots). In addition, the lower left magazine includes a three-slot I/O station to help support continuous library operation while importing and exporting media.

## LTO Technology

The IBM LTO Ultrium 6 tape drive supports up to 160 MBps native data-transfer. IBM LTO standards leadership continues with the LTO Ultrium 5 tape drive, doubling the storage capacity of the LTO Ultrium 4 tape drive with 3.0 TB compressed (1.5 TB native) on LTO Ultrium 5 media, and LTO Ultrium 6, doubling the storage capacity of the LTO Ultrium 5 tape drive with 6.25 TB compressed 2:5:1 on LTO Ultrium 6 media. The backward compatibility (read and write) is as follows: the LTO Ultrium 6 tape drive can read and write LTO Ultrium 6 tape cartridges; read and write to LTO Ultrium 5 tape cartridges; and read LTO Ultrium 4 tape cartridges with improved data rates. The LTO Ultrium 5 tape drive can read and write LTO Ultrium 5 tape cartridges and can read and write to LTO Ultrium 4 media.

## Security

Data is one of the most highly valued resources in a competitive business environment. Protecting that data, controlling access to it, and verifying its authenticity while maintaining its availability are priorities in our security-conscious world. Increasing regulatory requirements are also helping to direct the need for the adequate security of data. LTO Ultrium 6, 5, and 4 drive technology helps address security and compliance requirements with its continued Write Once Read Many (WORM) and Application Managed Encryption (AME) capability.

Advanced encryption through Library Managed Encryption (LME) and System Managed Encryption (SME) are available as optional Transparent LTO Encryption feature 5900. For key management for encryption, IBM Security Key Lifecycle Manager V2 (formerly IBM Tivoli® Key Lifecycle Manager) is required. Whether encryption is application- or hardware-based, vital data can securely be stored to help ensure compliancy with data security, information disclosure, and privacy regulations for data at rest.

## IBM Linear Tape File System (LTFS)

IBM Linear Tape File System™ (LTFS) is the first file system that works in conjunction with LTO generation 5 tape technology to set a new standard for ease-of-use and portability for open systems tape storage. This drive is the first LTO generation to introduce media partitioning, which allows LTO Ultrium 5 media to be divided into segments, improving accessibility by providing the ability to quickly locate data to retrieve or update.

IBM Spectrum Archive™, a member of the IBM Spectrum Storage™ family, enables direct, intuitive and graphical access to data stored in IBM tape drives and libraries by incorporating the Linear Tape File System™ (LTFS) format standard for reading, writing and exchanging descriptive metadata on formatted tape cartridges. Spectrum Archive eliminates the need for additional tape management and software to access data. Spectrum Archive offers three software solutions for managing your digital files with the LTFS format: Single Drive Edition, Library Edition, and Enterprise Edition. The TS3100 and TS3200 Tape Libraries also support IBM LTFS Library Edition software for IBM LTO Ultrium 6 and 5 tape drives.

With LTFS, accessing data stored on an IBM tape cartridge became as easy and intuitive as using a USB flash drive. With LTFS file manager, reading data on a tape cartridge is as easy as dragging and dropping. Users can run any application designed for disk files against tape data without being concerned that the data is physically stored on tape. Originally built on the LTO Ultrium 5 format standard, IBM Linear Tape File System Library Edition provides a direct, intuitive, graphical access to data stored in IBM tape drives and libraries using LTO Ultrium 5 or 6 tape cartridges.

Benefits of LTFS Library Edition (LE) are as follows:

- The graphical user interface helps reduce complexity by enabling an icon-based view of an LTO Ultrium 5 or LTO Ultrium 6 library, including tape cartridges and files using the operating system's file manager.
- LE helps reduce costs because it does not require any additional tape management software or utilities.
- The file system API of the operating system is used to provide a basic read/write interface to the tape library for applications without any additional operating system enhancements such as “plug-ins” or service packs.
- “Mount-less” cartridge inquiry for fast access is achieved after the tape library is inventoried. Tape cartridges do not have to be remounted to retrieve content index data, and basic cartridge information like volume name, serial number, and others.
- LTFS LE software can be ordered concurrently with hardware, or as software only for installed supported tape libraries. LTFS LE for LTO Ultrium 5 or 6 tape drives can be ordered as product identifier (PID) software base order number 5639-LT1. The feature number is 5806.

## Part number information

Table 1 lists part numbers and feature codes for the TS3100 and TS3200.

Table 1. TS3100 and TS3200 ordering information

TS3100	TS3200	Description		HVEC	MTM
Yes	No	Tape Library Model L2U Driveless		35732UL	3573 L2U
No	Yes	Tape Library Model L4U Driveless		35734UL	3573 L4U
Drive options				Part number	Feature code
Yes	Yes	Ultrium 6 Full-High	8 Gbps Fibre Channel	35P1609	8344
Yes	Yes	Ultrium 6 Half-High	6 Gbps SAS	35P1619	8347
Yes	Yes		8 Gbps Fibre Channel	35P1624	8348
Yes	Yes	Ultrium 5 Full-High	6 Gbps SAS	46X2683	8245
Yes	Yes		8 Gbps Fibre Channel	46X2682	8244
Yes	Yes	Ultrium 5 Half-High	6 Gbps SAS	46X2685	8247
Yes	Yes		8 Gbps Fibre Channel	46X2684	8248
Yes	Yes	Ultrium 4 Full-High	LVD SCSI	95P5002	8143
Yes	Yes		3 Gbps SAS	95P5006	8145
Yes	Yes		4 Gbps Fibre Channel	95P5004	8144
Yes	Yes	Ultrium 4 Half-High	6 Gbps SAS	46X7117	8149
Yes	Yes		8 Gbps Fibre Channel	46X6912	8148
Yes	Yes	Ultrium 3 Half-High	6 Gbps SAS	46X7122	8049
Optional feature codes					
Yes	Yes	Path Failover (at least 2 drives required)		45E9503	1682
Yes	Yes	Transparent LTO Encryption		45E3081	5900
Yes	Yes	Rack mount		23R6998	7002
Yes	Yes	Right-side magazine set		23R6999	8106
Yes	No	Left-side magazine		45E2237	8109
No	Yes	Left-side magazine, upper		45E2225	8107
No	Yes	Left-side magazine, lower		45E2231	8108
		Ultrium tape cartridges WORM media*	Ultrium 6 media 5-packs	35P1902	8605
Yes	Yes		Ultrium 5 media 5-packs	46C2084	8505
Yes	Yes		Ultrium 4 media 5-packs	95P4278	8405
Yes	Yes		Ultrium 3 media 5-packs	95P2020	8305
Yes	Yes	Ultrium Cleaning Cartridge		23R7008	8002
No	Yes	Additional Power Supply		23R7263	1901

\* Ultrium 3, 4, 5, and 6 WORM media and tape cartridge options can be ordered at: <http://www.ibm.com/systems/storage/media/>

The IBM Ultrium WORM cartridges (Machine Type 3589) were designed for applications, such as archiving and data retention, and for applications that require an audit trail. IBM Ultrium 3, 4, 5, and 6 Tape Drive WORM support allows vital data to be stored in a non-erasable, non-rewritable format provided for these types of applications. The IBM Ultrium WORM cartridges work with the IBM LTO Ultrium tape drives to help prevent the alteration or deletion of user data. In addition, IBM took several steps to reduce the possibility of tampering with the information:

- The bottom of the cartridge is molded in a different color than rewritable cartridges.
- The special cartridge memory helps protect the WORM nature of the media.
- A unique format is factory-written on each WORM cartridge.

Table 2 lists the cabling ordering information for the TS3100 and TS3200.

Table 2. TS3100 and TS3200 cabling ordering information

<b>Cables</b>	<b>Part number</b>
4.5 m VHDCI/HD68 SCSI Cable	23R7134
10.0 m VHDCI/HD68 SCSI Cable	23R7135
13.0 m LC/LC Fibre Cable	23R7137
25.0 m LC/LC Fibre Cable	23R7138
LC-SC Fibre Cable Interposer	23R7140
2M SAS/Mini-SAS 1x Cable	95P4711
2M Mini-SAS/Mini-SAS 1x Cable	95P4713
SAS/Mini-SAS 4x Interposer	95P4994
Mini-SAS/Mini-SAS 4x Interposer	95P4996

Table 3 lists the common specifications for the TS3100 and TS3200.

Table 3. TS3100 and TS3200 specifications

<b>Specifications</b>	
Tape drive type	<ul style="list-style-type: none"> <li>● IBM LTO Ultrium 6 Full-High and Half-High</li> <li>● IBM LTO Ultrium 5 Full-High and Half-High</li> <li>● IBM LTO Ultrium 4 Full-High and Half-High</li> <li>● IBM LTO Ultrium 3 Half-High</li> </ul>
Tape drive physical capacity	<ul style="list-style-type: none"> <li>● Up to 6.25 TB per cartridge compressed 2:5:1; 2.5 TB native with LTO-6 media</li> <li>● Up to 3.0 TB per cartridge compressed; 1.5 TB native with LTO-5 media</li> <li>● Up to 1.6 TB per cartridge compressed; 800 GB native with LTO-4 media</li> <li>● Up to 800 GB per cartridge compressed; 400 GB native with LTO-3 media</li> </ul>
Data transfer rate (per drive)	<ul style="list-style-type: none"> <li>● Up to 160 Mbps native with LTO-6 tape drive</li> <li>● Up to 140 MBps native with LTO-5 tape drive</li> <li>● Up to 120 MBps native with LTO-4 tape drive</li> <li>● Up to 80 MBps native with LTO-3 tape drive</li> </ul>
Attachment support	<ul style="list-style-type: none"> <li>● 8 Gbps fibre channel and 6 Gbps SAS interfaces</li> <li>● LVD SCSI (LTO-4 Full-High)</li> <li>● 4 Gbps fibre channel and 3 Gbps SAS interfaces (LTO-4 Full-High)</li> </ul>
Warranty	Three-year, customer-replaceable unit (CRU) service in most countries
<b>Operating environment</b>	
Temperature	50 to 113 degrees F (10 to 45 degrees C)
Relative humidity	10% RH to 80% RH (non-condensing)
Electrical power	4.0 amps at 100 V ac; 2.0 amps at 240 V ac 0.1 KVA

Table 4 lists the unique specifications of the TS3100.

Table 4. TS3100 unique specifications

<b>TS3100 specifications</b>	
Number of drives	1 Full-High or up to 2 Half-Highs
Number of tape cartridges	24
Number of mail slots	1
Library physical capacity	<ul style="list-style-type: none"> <li>● Up to 150 TB per tape library compressed 2:5:1; 120 TB native with LTO Ultrium 6 media</li> <li>● Up to 72 TB per tape library compressed; 36 TB native with LTO Ultrium 5 media</li> <li>● Up to 38.4 TB per tape library compressed; 19.2 TB native with LTO Ultrium 4 media</li> <li>● Up to 19.2 TB per tape library compressed; 9.6 TB native with LTO Ultrium 3 media</li> </ul>
<b>Dimensions (width x height x depth)</b>	
Stand-alone	17.6 in. (447.5 mm) x 3.84 in. (97.6 mm) x 31.9 in. (810 mm)
Rack-mount	17.6 in. (447.5 mm) x 3.44 in. (87.6 mm) x 29.13 in. (740 mm)
Weight	33 lb (15 kg) without rack mount

## What's in the TS3100 shipping box?

The box contains the following items:

- Tape Library Model L2U Driveless
- 12 data cartridge left magazine
- 12 data cartridge right magazine
- IBM Ultrium Drives (ordered separately)
- Power cord (must be selected)
- One IBM Ultrium Cleaning Cartridge (universal)
- *IBM System Storage® TS3100/TS3200 Tape Setup, Operator and Service Guide*
- *IBM System Storage TS3100/TS3200 Tape Library Installation Quick Reference*
- Quality hotline card
- Device driver readme sheet
- Safety pointer multi-language readme sheet
- License Agreement for Machine Code
- NLS Translated Safety CD
- Misc documents CD

Table 5 lists the unique specifications for the TS3200.

Table 5. TS3200 unique specifications

<b>TS3200 specifications</b>	
Number of drives	Up to 2 Full-Highs or up to 4 Half-Highs
Number of tape cartridges	48
Number of mail slots	3
Library physical capacity	<ul style="list-style-type: none"> <li>● Up to 300 TB per tape library compressed 2:5:1; 120 TB native with LTO Ultrium 6 media</li> <li>● Up to 144 TB per tape library compressed; 72 TB native with LTO Ultrium 5 media</li> <li>● Up to 76.8 TB per tape library compressed; 38.4 TB native with LTO Ultrium 4 media</li> <li>● Up to 38.4 TB per tape library compressed; 19.2 TB native with LTO Ultrium 3 media</li> </ul>
<b>Dimensions (W x H x D)</b>	
Stand-alone	17.6 in (447.5 mm) x 7.29 in (185.2 mm) x 31.9 in (810 mm)
Rack-mount	17.6 in (447.5 mm) x 6.89 in (175.2 mm) x 29.13 in (740 mm)
Weight	47 lb. (21.3 kg) without rack mount

## What's in the TS3200 shipping box?

The box contains the following items:

- Tape Library Model L4U Driveless
- 12 data cartridge left upper magazine
- 12 data cartridge left lower magazine
- Two 12 data cartridge right magazines
- IBM Ultrium drives (ordered separately)
- Power cord (must be selected)
- One IBM Ultrium Cleaning Cartridge (universal)
- *IBM System Storage TS3100/TS3200 Tape Setup, Operator and Service Guide*
- *IBM System Storage TS3100/TS3200 Tape Library Installation Quick Reference*
- Quality hotline card
- Device driver readme sheet
- Safety pointer multi-language readme sheet
- License Agreement for Machine Code
- NLS Translated Safety CD
- Misc documents CD



## Supported hardware platforms

Supported hardware platforms for TS3100 and TS3200 are as follows:

- IBM BladeCenter®
- IBM Flex System®
- IBM Power Systems (p6 or later)
- IBM System p® (p5 or older)
- IBM System i®
- IBM System x
- System x (Lenovo)
- IBM System z® and S/390®
- Advanced Micro Devices (AMD)
- Hewlett Packard
- Intel (x86 and x86\_64)
- Sun

## Supported operating systems

Supported operating systems for TS3100 and TS3200 are as follows:

- IBM AIX® 7.1 or later
- IBM i 7.1 or later
- IBM VIOS 2.2.0 or later with client IBM i
- HP HP-UX 11iv2 (11.23) or later
- Microsoft Windows Server 2008 or 2008 R2 or later
- Microsoft Windows Server 2012 or 2012 R2 or later
- Novell SUSE Linux Enterprise 11 SP2 or later
- Oracle Solaris 11.1
- Red Hat Linux Enterprise 5.8 or later
- Sun Solaris 9 and 10

Check the latest support levels and configuration information for LTO drives, platforms, operating systems, and attachments at the Systems Storage Interoperation Center (SSIC):

<http://www.ibm.com/systems/support/storage/config/ssic>

## Supported software products

Supported software products for TS3100 and TS3200 are as follows:

- IBM Backup Recovery and Media Services (BRMS)
- IBM High Performance Storage System (HPSS)
- IBM Linear Tape File System Library Edition
- IBM Spectrum Protect: IBM Tivoli Storage Manager
- IBM Security Key Lifecycle Manager
- Atempo Time Navigator 4.1/4.2
- CA ARCserve Backup
- CommVault Systems Galaxy
- Dell NetVault (formerly BakBone Software NetVault)
- EMC NetWorker
- Front Porch Digital DIVArchive
- HP OpenView Storage Data Protector 5.5/6.0/6.1
- Microsoft System Center Data Protection Manager 2007
- Symantec Backup Exec 12.5 and 2010
- Symantec NetBackup
- Thales Encryption Manager for Storage
- Yosemite Backup

For current IBM software products and independent software vendor products that support TS3100 and TS3200, see the Independent Software Vendor (ISV) matrix for 3592 and LTO tape drives:

[http://www.ibm.com/systems/resources/lto\\_isv\\_matrix.pdf](http://www.ibm.com/systems/resources/lto_isv_matrix.pdf)

## Warranty period and warranty service

Every TS3100 and TS3200 is covered by the following warranty:

- System three-year, customer-replaceable unit (CRU) service in most countries

Optional IBM features initially installed in an IBM system carry the same warranty and warranty service support category as the system. If installed after the initial system installation, they carry the balance of the system warranty or the optional feature warranty, whichever is greater.

### Customer-replaceable unit (CRU) service

IBM provides replacement CRUs for you to install. CRU information and replacement instructions are included with your machine and are available from IBM upon your request.

Table 6 lists the various warranty options for the TS3100 and TS3200 Tape Libraries.

Table 6. Warranties and maintenance

IBM ServicePac®	TS3100 L2U	TS3200 L4U
<b>Warranty and maintenance option</b>		
3 Year Onsite Repair 24x7 4 Hour Response	42V1346	42V1541
3 Year Onsite Repair 9x5 Next Business Day	42V1345	42V1540
5 Year Onsite Repair 24x7 4 Hour Response	42V1347	42V1542
<b>Maintenance agreement</b>		
1 Year Onsite Repair 24x7 4 Hour Response	42V1349	42V1544
1 Year Onsite Repair 9x5 Next Business Day	42V1348	42V1543
2 Year Onsite Repair 24x7 4 Hour Response	42V1351	42V1546
2 Year Onsite Repair 9x5 Next Business Day	42V1350	42V1545
<b>Remote technical support</b>		
RTS for Tape Devices: 1-year	91Y8855	91Y8855
RTS for Tape Devices: 3-year	91Y8856	91Y8856

**Note:** Each ServicePac is country-specific and is valid only when purchased and registered in the country in which IBM service will be provided. For a complete list of the ServicePac part numbers that are specific to your country, see the IBM ServicePac Worldwide Product Matrix:

<https://www-304.ibm.com/sales/gss/download/spst/servicepac/extProductSelectorWWW.do>

## Related publications

For more information, see the following resources:

- *IBM System Storage interactive product guide*  
<http://public.dhe.ibm.com/common/ssi/ecm/ts/en/tso00364usen/TSO00364USEN.PDF>
- *IBM System Storage TS3100 Tape Library and TS3200 Tape Library Setup, Operator, and Service Guide, GA32-0545*  
<http://publibfp.dhe.ibm.com/epubs/pdf/32054510.pdf>
- IBM Linear Tape-Open: LTO Ultrium tape drives, libraries, and autoloaders  
<http://www.ibm.com/systems/storage/tape/index.html>
- *IBM Tape Library Guide for Open Systems*, SG24-5946  
<http://www.redbooks.ibm.com/abstracts/sq245946.html>
- *IBM Half-High LTO Generation 6 SAS Tape Drive, IBM Redbooks Product Guide, TIPS0978*  
<http://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/tips0978.html>
- *IBM Linear Tape File System Installation and Configuration*, SG24-8090  
<http://www.redbooks.ibm.com/abstracts/sq248090.html>
- *IBM Linear Tape File System Enterprise Edition V1.1.1.2: Installation and Configuration Guide, SG24-8143*  
<http://www.redbooks.ibm.com/abstracts/SG248143.html>
- IBM TS3100 Tape Library Express Model  
<http://www.ibm.com/systems/storage/tape/ts3100/>
- IBM TS3200 Tape Library Express Model  
<http://www.ibm.com/systems/storage/tape/ts3200/>
- IBM LTO Ultrium 6 Data Cartridge  
[http://www.ibm.com/systems/storage/media/lto\\_6/index.html](http://www.ibm.com/systems/storage/media/lto_6/index.html)
- IBM LTO Ultrium 5 1.5 TB Data Cartridge  
[http://www.ibm.com/systems/storage/media/lto\\_5/index.html](http://www.ibm.com/systems/storage/media/lto_5/index.html)
- IBM Spectrum Archive: Linear Tape File System  
<http://www.ibm.com/systems/storage/tape/lufs/index.html>
- IBM Security Key Lifecycle Manager  
<http://www.ibm.com/software/products/en/key-lifecycle-manager>

# Notices

This information was developed for products and services offered in the U.S.A.

IBM may not offer the products, services, or features discussed in this document in other countries. Consult your local IBM representative for information on the products and services currently available in your area. Any reference to an IBM product, program, or service is not intended to state or imply that only that IBM product, program, or service may be used. Any functionally equivalent product, program, or service that does not infringe any IBM intellectual property right may be used instead. However, it is the user's responsibility to evaluate and verify the operation of any non-IBM product, program, or service. IBM may have patents or pending patent applications covering subject matter described in this document. The furnishing of this document does not give you any license to these patents. You can send license inquiries, in writing, to:

*IBM Director of Licensing, IBM Corporation, North Castle Drive, Armonk, NY 10504-1785 U.S.A.*

**The following paragraph does not apply to the United Kingdom or any other country where such provisions are inconsistent with local law:** INTERNATIONAL BUSINESS MACHINES CORPORATION PROVIDES THIS PUBLICATION "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Some states do not allow disclaimer of express or implied warranties in certain transactions, therefore, this statement may not apply to you. This information could include technical inaccuracies or typographical errors. Changes are periodically made to the information herein; these changes will be incorporated in new editions of the publication. IBM may make improvements and/or changes in the product(s) and/or the program(s) described in this publication at any time without notice.

Any references in this information to non-IBM Web sites are provided for convenience only and do not in any manner serve as an endorsement of those Web sites. The materials at those Web sites are not part of the materials for this IBM product and use of those Web sites is at your own risk. IBM may use or distribute any of the information you supply in any way it believes appropriate without incurring any obligation to you. Information concerning non-IBM products was obtained from the suppliers of those products, their published announcements or other publicly available sources. IBM has not tested those products and cannot confirm the accuracy of performance, compatibility or any other claims related to non-IBM products. Questions on the capabilities of non-IBM products should be addressed to the suppliers of those products. This information contains examples of data and reports used in daily business operations. To illustrate them as completely as possible, the examples include the names of individuals, companies, brands, and products. All of these names are fictitious and any similarity to the names and addresses used by an actual business enterprise is entirely coincidental.

Any performance data contained herein was determined in a controlled environment. Therefore, the results obtained in other operating environments may vary significantly. Some measurements may have been made on development-level systems and there is no guarantee that these measurements will be the same on generally available systems. Furthermore, some measurement may have been estimated through extrapolation. Actual results may vary. Users of this document should verify the applicable data for their specific environment.

## COPYRIGHT LICENSE:

This information contains sample application programs in source language, which illustrate programming techniques on various operating platforms. You may copy, modify, and distribute these sample programs in any form without payment to IBM, for the purposes of developing, using, marketing or distributing application programs conforming to the application programming interface for the operating platform for which the sample programs are written. These examples have not been thoroughly tested under all conditions. IBM, therefore, cannot guarantee or imply reliability, serviceability, or function of these programs.

**© Copyright International Business Machines Corporation 2014-2015. All rights reserved.**

Note to U.S. Government Users Restricted Rights -- Use, duplication or disclosure restricted by GSA ADP Schedule Contract with IBM Corp.

This document was created or updated on May 6, 2015.

Send us your comments in one of the following ways:

- Use the online **Contact us** review form found at:  
[ibm.com/redbooks](http://ibm.com/redbooks)
- Send your comments in an e-mail to:  
[redbooks@us.ibm.com](mailto:redbooks@us.ibm.com)
- Mail your comments to:  
IBM Corporation, International Technical Support Organization  
Dept. HYTD Mail Station P099  
2455 South Road  
Poughkeepsie, NY 12601-5400 U.S.A.

This document is available online at <http://www.ibm.com/redbooks/abstracts/tips1219.html> .

## Trademarks

IBM, the IBM logo, and [ibm.com](http://ibm.com) are trademarks or registered trademarks of International Business Machines Corporation in the United States, other countries, or both. These and other IBM trademarked terms are marked on their first occurrence in this information with the appropriate symbol (® or ™), indicating US registered or common law trademarks owned by IBM at the time this information was published. Such trademarks may also be registered or common law trademarks in other countries. A current list of IBM trademarks is available on the Web at <http://www.ibm.com/legal/copytrade.shtml>

The following terms are trademarks of the International Business Machines Corporation in the United States, other countries, or both:

AIX®	Redbooks®	System i®
BladeCenter®	Redbooks (logo)®	System p®
IBM®	S/390®	System Storage®
IBM Flex System®	ServicePac®	System x®
Linear Tape File System™	Spectrum Archive™	System z®
Power Systems™	Spectrum Storage™	Tivoli®

The following terms are trademarks of other companies:

Intel, Intel logo, Intel Inside logo, and Intel Centrino logo are trademarks or registered trademarks of Intel Corporation or its subsidiaries in the United States and other countries.

Linux is a trademark of Linus Torvalds in the United States, other countries, or both.

Linear Tape-Open, LTO, Ultrium, the LTO Logo and the Ultrium logo are trademarks of HP, IBM Corp. and Quantum in the U.S. and other countries.

Microsoft, Windows, and the Windows logo are trademarks of Microsoft Corporation in the United States, other countries, or both.

Linux is a trademark of Linus Torvalds in the United States, other countries, or both.

Other company, product, or service names may be trademarks or service marks of others.