

Visual SCSI Explorer

Technical Description

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1. Introduction

Visual SCSI Explorer application runs on Windows operating system platforms and is intended for advanced SCSI device testing. The application can handle SCSI devices connected to the host computer through such storage buses as Parallel SCSI, Fibre Channel (FC), Internet SCSI (iSCSI), Serial Attached SCSI (SAS), Storage Area Network (SAN), virtual, and others.

Application visualizes the host SCSI controller and device configuration as controller-device tree and properties. It is possible to rescan SCSI buses and to dynamically update the SCSI device list. Application functional interface is optimized for Media Changer, Tape Drive, Disk, and Multi-Media devices. Raw CDB feature allows user to execute any SCSI command for SCSI device of any type. Application visualizes the process of SCSI command execution, logs the command parameters, the outbound and inbound command data and parses them.

Application automates routine SCSI device test tasks by using JScript and VBScript scripting languages, service procedures, and test procedures. The scripting helps to automate the execution of arbitrary SCSI command sequence for the complex testing tasks. Service procedures implement the predefined sequence of SCSI commands for the simple and typical servicing/testing tasks. Test procedures combine multiple scripts as test modules and offer the highest level of automation of test process. Application can run multiple scripts, service procedures, and test procedures for different devices at the same time.

The range of the potential customers includes the next main groups.

- Developers of the SCSI device firmware will be able to execute each SCSI command manually and to verify the device functioning.
- Developers of the storage solutions that virtualize the SCSI and storage devices will be able to verify the correct implementation of the SCSI command protocol.
- Developers of SCSI initiator and target mode drivers for host bus adapters will find this application useful to test the drivers.
- Testers of the SCSI and storage devices and virtual solutions.

2. Supported operating system platforms

The following Windows operating system platforms are supported:

- Windows Server 2016 64 bit
- Windows 10 32-bit and 64-bit
- Windows 8.1 32-bit and 64-bit
- Windows Server 2012 64-bit
- Windows 8 32-bit and 64-bit
- Windows 7 32-bit and 64-bit
- Windows Server 2008 32-bit and 64-bit
- Windows Vista 32-bit and 64-bit
- Windows Server 2003 32-bit and 64-bit
- Windows XP 32-bit and 64-bit

NOTE: 64-bit operating system platforms are supported only for AMD64 (x64) processor architecture.

3. System requirements

Hardware requirements:

- 800 MHZ or faster Inter Pentium TM or equivalent CPU.
- 256 MB RAM. The optimal size of RAM depends on the installed Windows operating system.
- 10GB hard disk. The optimal size of hard disk depends on the installed Windows operating system.
- 15" or greater SVGA display.
- Standard keyboard and mouse.
- One or more host bus adapters.

Software requirements:

- Supported Windows operating system with the necessary service pack installed.
- Internet Explorer version 5.5 or higher.

NOTE: It is recommended to install all system patches from Windows Update site.

4. Product features

4.1. SCSI-3 support

The application supports the SCSI commands and the device parameters as described in the SCSI-3 standards documents. The implementation is based on the following standards documents.

- SCSI Architecture Model - 3 (SAM-3)
- SCSI Primary Commands - 3 (SPC-3)
- SCSI Block Commands -3 (SBC-3)
- SCSI Stream Commands - 4 (SSC-4)
- Multi-Media Commands - 6 (MMC-6)
- SCSI Media Changer Commands - 2 (SMC-2)

Some features from the latest standards documents are also implemented. The application supports mandatory SCSI commands and device parameters, and some optional commands and device parameters.

4.2. Primary commands and parameters support

The following commands from the primary command set (SPC) are supported.

- Inquiry (12h)
- Log Select (4Ch)
- Log Sense (4Dh)
- Mode Select (6) (15h)
- Mode Select (10) (55h)
- Mode Sense (6) (1Ah)
- Mode Sense (10) (5Ah)
- Persistent Reserve In (5Eh)
- Persistent Reserve Out (5Fh)
- Read Attribute (8Ch)
- Read Buffer (3Ch)
- Receive Diagnostic Results (1Ch)
- Report LUNs (A0h)
- Request Sense (03h)
- Security Protocol In (A2h)
- Security Protocol Out (B5h)
- Send Diagnostic (1Dh)
- Test Unit Ready (00h)
- Write Attribute (8Dh)
- Write Buffer (3Bh)

The following shared vital product data pages are supported.

- Device Identification (83h)
- Supported VPD Pages (00h)
- Unit Serial Number (80h)

The following shared log pages are supported (only for Log Sense (4Dh) command).

- Application Client (0Fh)
- Buffer Over-Run/Under-Run (01h)
- Cache Memory Statistics (19h/20h)
- General Statistics and Performance (19h/00h)
- Informational Exceptions (2Fh)
- Last n Deferred Errors or Asynchronous Events (0Bh)
- Last n Error Events (07h)
- Non-Medium Error (06h)
- Power Condition Transitions (1Ah)
- Read Error Counter (03h)
- Read Reverse Error Counter (04h)
- Self-Test Results (10h)
- Start-Stop Cycle Counter (0Eh)
- Temperature (0Dh)
- Verify Error Counter (05h)
- Write Error Counter (02h)
- Supported Log Pages (00h/00h)
- Supported Log Pages and Subpages (00h/FFh)

The following shared mode pages are supported.

- Control (0Ah/00h)
- Disconnect-Reconnect (02h)
- Informational Exceptions Control (1Ch)
- Power Condition (1Ah)

4.3. Disk commands and parameters support

The following commands from the disk command set (SBC) are supported.

- Format Unit (04h)
- Pre-Fetch (10) (34h)
- Pre-Fetch (16) (90h)
- Read (6) (08h)
- Read (10) (28h)
- Read (12) (A8h)
- Read (16) (88h)
- Read (32) (7Fh/0009h)
- Read Capacity (10) (25h)
- Read Capacity (16) (9Eh/10h)
- Read Defect Data (10) (37h)
- Read Defect Data (12) (B7h)
- Read Long (10) (3Eh)
- Start Stop Unit (1Bh)
- Synchronize Cache (10) (35h)
- Synchronize Cache (16) (91h)
- Verify (10) (2Fh)
- Verify (12) (AFh)
- Verify (16) (8Fh)
- Verify (32) (7Fh/000Ah)
- Write (6) (0Ah)
- Write (10) (2Ah)
- Write (12) (AAh)

- Write (16) (8Ah)
- Write (32) (7Fh/000Bh)
- Write Long (10) (3Fh)

The following commands for the optical disk devices are supported.

- Erase (10) (2Ch)
- Erase (12) (ACh)

The following disk vital product data pages are supported.

- Block Device Characteristics (B1h)
- Block Limits (B0h)
- Logical Block Provisioning (B2h)
- Referrals (B3h)

The following disk log pages are supported (only for Log Sense (4Dh) command).

- Background Scan (15h)
- Format Status (08h)
- Logical Block Provisioning (0Ch)
- Non-Volatile Cache (17h)
- Solid State Media (11h)

The following disk mode pages are supported.

- Caching (08h)
- Format Device (03h)
- Read-Write Error Recovery (01h)
- Rigid Disk Device Geometry (04h)
- Verify Error Recovery (07h)
- XOR Control (10h)

4.4. Tape Drive commands and parameters support

The following commands from the tape drive command set (SSC) are supported.

- Allow Overwrite (82h)
- Erase (6) (19h)
- Erase (16) (93h)
- Format Medium (04h)
- Load Unload (1Bh)
- Locate (10) (2Bh)
- Locate (16) (92h)
- Prevent Allow Medium Removal (1Eh)
- Read (6) (08h)
- Read (16) (88h)
- Read Block Limits (05h)
- Read Position (34h)
- Read Reverse (6) (0Fh)
- Read Reverse (16) (81h)
- Recover Buffered Data (14h)
- Report Density Support (44h)
- Rewind (01h)
- Set Capacity (0Bh)
- Space (6) (11h)
- Space (16) (91h)
- Verify (6) (13h)

- Verify (16) (8Fh)
- Write (6) (0Ah)
- Write (16) (8Ah)
- Write Filemarks (6) (10h)
- Write Filemarks (16) (80h)

The following disk vital product data pages are supported.

- Automation Device Serial Number (B3h)
- Data Transfer Device Element Address (B4h)
- Manufacturer-assigned Serial Number (B1h)
- Sequential-access Device Capabilities (B0h)
- TapeAlert Supported Flags (B2h)

The following tape drive log pages are supported (only for Log Sense (4Dh) command).

- Current Service Information (2Dh)
- Data Compression (1Bh)
- Device Statistics (14h)
- Requested Recovery (13h)
- Sequential-Access Device (0Ch)
- Tape Alert (2Eh)
- Tape Diagnostic Data (16h)
- Volume Statistics (17h)

The following tape drive mode pages are supported.

- Control Data Protection (0Ah/F0h)
- Data Compression (0Fh)
- Device Configuration (10h)
- Device Configuration Extension (10h/01h)
- Informational Exceptions Control (1Ch)
- Medium Configuration (1Dh)
- Medium Partition (11h)
- Read-Write Error Recovery (01h)

4.5. Media Changer commands and parameters support

The following commands from the media changer command set (SMC) are supported.

- Initialize Element Status (07h)
- Initialize Element Status With Range (37h)
- Move Medium (A5h)
- Position To Element (2Bh)
- Prevent/Allow Medium Removal (1Eh)
- Read Element Status (B8h)
- Release (17h)
- Request Volume Element Address (B5h)
- Reserve (16h)
- Re-Zero Unit (01h)
- Send Volume Tag (B6h)

The following media changer log pages are supported (only for Log Sense (4Dh) command).

- Element Statistics (15h)
- Media Changer Diagnostics Data (16h)
- Media Changer Statistics (14h)

- Tape Alert (2Eh)

The following media changer mode pages are supported.

- Device Capabilities (1Fh)
- Element Address Assignment (1Dh)
- Transport Geometry Descriptor (1Eh) (only for Mode Sense (X) commands)

4.6. Multi-Media commands and parameters support

The following commands from the multi-media command set (MMC) are supported.

- Blank (A1h)
- Close Track Session (5Bh)
- Get Configuration (46h)
- Get Event Status Notification (4Ah)
- Get Performance (ACh)
- Prevent/Allow Medium Removal (1Eh)
- Read (10) (28h)
- Read (12) (A8h)
- Read Capacity (25h)
- Read Disk Information (51h)
- Read Sub-Channel (42h)
- Read TOC/PMA/ATIP (43h)
- Read Track Information (52h)
- Start Stop Unit (1Bh)
- Write (10) (2Ah)

The following multi-media mode pages are supported.

- Caching (08h)
- CD Audio Control (0Eh)
- CD Parameters (0Dh)
- CD/DVD Capabilities and Mechanical Status (2Ah) - supported only for Mode Sense (10) (5A) command.
- Read-Write Error Recovery (01h)
- Timeout and Protect (1Dh)
- Write Parameters (05h)

4.7. Raw CDB

Application supports so-called "raw" CDB for manual and automated (scripting) SCSI command execution modes. User can make CDB manually using the binary editor. Also if command has outbound data, they can also be edited in binary data editor. Application offers well developed dialog box for the manual command mode. This feature makes it possible to execute arbitrary command and to set the reserved fields in the CDB and command data.

4.8. Hardware configuration view

The host SCSI hardware is represented in the hardware configuration window as adapter-device tree. Each SCSI adapter is represented as top level item in the tree. All devices that are connected to this adapter are represented as child items in the tree. When the adapter or device item is selected in the tree the properties of the selected item are shown in the properties window.

If the SCSI adapter item is selected in the hardware configuration window the following properties are displayed in the properties window.

- Zero-based SCSI adapter number in the system "\\.\ScsiN:" name space.
- Maximum data size in bytes that can be transferred by the controller in one command.
- Maximum number of discontinuous physical pages the HBA can manage in a single transfer.
- Alignment mask that indicates alignment restrictions for buffers required by the HBA for transfer operations.
- Indication if the HBA uses Programmed Input/Output (PIO) and requires the use of system-space virtual addresses mapped to physical memory for data buffers.
- Indication if the HBA scans down for BIOS devices, that is, the HBA begins scanning with the highest device number rather than the lowest.
- Indication if the HBA supports SCSI-tagged queuing and/or per-logical-unit internal queues, or the non-SCSI equivalent.
- Indication if the HBA supports synchronous transfers as a way of speeding up I/O.
- SCSI request block (SRB) type used by the HBA.
- SCSI device address type used by the HBA.
- Storage bus type.
- Storage bus major number.
- Storage bus minor number.
- Total number of SCSI/storage buses.
- Initiator SCSI IDs for supported SCSI/storage buses.
- HBA miniport driver type code.
- Indication if the HBA driver supports logical unit reset function.
- Indication if the HBA driver supports target reset function.

If the SCSI device item is selected in the hardware configuration window the device properties are displayed in the properties window together with the property group selector.

If the SCSI property group is selected the following properties are displayed.

- SCSI bus number the device is connected to.
- Target SCSI ID of the device.
- Logical unit number of the device.
- Device type as defined in the standard inquiry data for the device.
- Version number as defined in the standard inquiry data for the device.
- T10 vendor identification as defined in the standard inquiry data for the device.
- Product identification as defined in the standard inquiry data for the device.
- Product revision level as defined in the standard inquiry data for the device.
- Device object name in the system name space ([\\.\<name>](#)).
- Device unit serial number.

If the Command property group is selected the list of active and pending SCSI commands is displayed. The list includes only those SCSI commands that were issued manually from the Visual SCSI Explorer application. The list includes the command name and formatted command parameters.

If the Script property group is selected the list of the active scripts is displayed. The list includes the scripts that are running for the device. The list item includes the script name and the full path to the script file.

If the Service property group is selected the list of the active service procedures is displayed. The list includes the service procedures that are running for the device. The list item includes the procedure name, the formatted parameter string, and the status string.

4.9. Rescanning of SCSI bus

User can rescan the SCSI bus of selected adapter. After the rescanning the application updates the list of devices that are attached to the selected adapter and reflects the changes immediately in the hardware configuration view. It is possible to enable automatic rescanning of the SCSI buses for all adapters during the application startup.

4.10. Transparent access to all SCSI devices

Application allows the SCSI command execution for all SCSI devices that are currently present in the host hardware configuration even if the operating system has installed the class drivers for those devices.

The application supports the following SCSI initiator interfaces.

- SCSI Pass Through. The SCSI controllers and devices are accessed through VseKmd.sys kernel-mode driver using the kernel-mode SCSI Pass Through interface.
- SCSI class driver. The SCSI controllers and devices are accessed through VseKmd.sys kernel-mode driver using the kernel-mode class driver interface. The driver uses the storage class driver interface that is supported by the system kernel-mode components.

The SCSI Pass Through (SPT) interface is a native Windows interface to SCSI controllers and devices that is provided for the user-mode and kernel-mode components. The VseKmd.sys is the special auxiliary kernel-mode driver that is installed by the Visual SCSI Explorer product.

The interface type can be selected on the SCSI options page of the application options dialog box. Refer to the application help system for more detailed information about the supported SCSI interfaces.

4.11. Manual mode of SCSI command execution

User can execute SCSI commands in manual mode using the application window menus. If SCSI command has additional parameters the suitable dialog box is shown that allows the user to specify additional command parameters like page code, allocation length, etc. The process of the command execution is reflected in the device log window. If the SCSI command succeeds the received data (if any) are parsed. If the SCSI command fails the parsed sense data (if available) are logged together with the status values.

4.12. Automated (scripting) mode of SCSI command execution

The scripting helps to automate the execution of SCSI command sequence for the complex testing tasks. Application can run the scripts that are written for such popular scripting languages as JScript and VBScript. The script is being executed on the script engine. The application creates separate instance of the script engine for each active (running) script. The scripts and script engines are running in the context of the application. The script can be executed in two different modes: the script editor mode and the device mode. It is possible to terminate the script execution at any time. The list of the active scripts is shown in the device properties.

It is possible to define so-called startup arguments for the script. The script can get the values of the startup arguments while executing. Startup arguments allow further customization of tasks that can be executed by single script module.

It is possible to specify additional script files to be included before the first line of the main script file. This feature may be used to move common definitions and frequently used functions to separate files and to leave in main script file only code that is specific to task. This feature also simplifies the use of previously developed script libraries.

4.13. Service procedures

The service procedure is the predefined sequence of SCSI commands that can be executed once or in the loop. Each service procedure implements some useful function like firmware upload or simple testing tasks. If service procedure has additional parameters the suitable dialog box is shown that allows the user to specify additional procedure parameters like number of iterations, data file path, etc. It is possible to run multiple service procedures for single or multiple devices. It is possible to terminate the service procedure execution at any time. The list of the active service procedures together with the procedure status is shown in the device properties.

The following service procedures are implemented for all device types.

- Get Dump. The procedure receives the dump data for the specified buffer ID from the device and saves the data to the specified file.

- SCSI Chip Test. The procedure checks the proper functioning of the SCSI circuit (hardware connection between the HBA and the device and the SCSI protocol chips at both ends of this connection).
- Write Microcode. The procedure loads the new microcode image from the specified file and then writes it to the device.
- Quick Test. The procedure performs quick self-test for the device.
- Clear Device Logs. The procedure clears all log parameters and device error history.

The following service procedures are implemented for Disk devices.

- Disk Bad Block Scan. The procedure reads the data from the disk and detects unreadable/bad logical blocks.
- Disk Performance Test. The procedure measures the disk I/O performance for Read (X) or Write (X) SCSI commands.
- Disk Read Test. The procedure reads the data from the disk on the random addresses and checks the results of the reading operation.
- Disk Write Test. The procedure writes the data to the disk and verifies written data.
- Disk LBA Map Test. The procedure checks whether logical block addresses are mapped to the virtual or physical storage in right way.
- Save Disk Logical Blocks. The procedure saves the range of disk logical blocks to data file. The procedure reads the data from disk starting from specified logical block address and writes them to the data file.
- Restore Disk Logical Blocks. The procedure restores the range of disk logical blocks from data file. The procedure reads the data from data file and writes them to the disk starting from specified logical block address. The previous contents of disk logical blocks being restored is destroyed completely.
- Save Disk Image. The procedure saves raw disk image into specified file.
- Restore Disk Image. The procedure restores the disk from raw image file.
- Disk Copy. Copies the contents of the selected disk to the other disk.

The following service procedures are implemented for Tape Drive devices.

- Tape Load/Unload Test. The procedure checks the proper functioning of the tape loading mechanism in the tape drive device.

The following service procedures are implemented for Media Changer devices.

- Element Status Verification. The procedure verifies that the media changer device returns the same element status data after the multiple initialization of the element status.
- Export Media. The procedure moves the media that conform to the volume tag template from the storage elements to the available empty import/export elements until either all media are moved or all import/export elements become full.
- Import Media. The procedure moves the media that conform to the volume tag template from the import/export elements to the available empty storage elements until either all media are moved or all storage elements become full.
- Mount Test. The procedure performs the random moves of the media between the storage and data transfer elements.
- Move Test. The procedure performs the random moves of the media between the elements of the different types.
- Position Test. The procedure selects at the random basis the destination element and then positions the gripper to the destination element.

4.14. Test procedures

Test procedure is a sequence of test modules. The test module refers to the script module. Each test module performs certain number of testing operations for the device being tested. When test procedure is running the test modules are being executed sequentially in the same order as they are present in the list. After the test procedure finishes the result of execution of test modules is indicated in the status column for

each module. The test procedure execution can either be terminated immediately on first test module failure or can run to the end regardless to the result of test module execution. Multiple test procedures can be running for different devices at the same time. Application provides test procedure window that allows the user to manage the test procedure. It is possible to save the test procedure to the file and open it later for editing and/or execution.

4.15. Asynchronous SCSI command execution

All SCSI commands are being executed asynchronously. When user selects the SCSI command in the menu for execution the SCSI command is queued for execution on the device. If no other commands are queued previously, the execution of current SCSI command is being started immediately. Otherwise the command is put to the queue and will be executed later when the previously queued commands are completed. It is possible to queue multiple SCSI commands while the first command is being executed. Also one can execute SCSI commands manually while the service procedure(s) and/or script(s) are also executing SCSI commands for the same device. The list of the active and pending SCSI commands is shown in the device properties.

4.16. Detailed logging

Various types of information are being logged during the SCSI command execution. Each device has its own message log. When SCSI device is selected in the hardware configuration window, the device's log is shown in the log window.

When SCSI command is being executed, the application logs the CDB itself and its parameters, any outbound or inbound data, and the completion status. If the data are known, the application parses the data and logs the values of the data fields. If the command is completed with CHECK CONDITION SCSI status, the application logs SCSI sense data.

The scripts and service procedures also log various messages.

The content of the log window can be saved into the text file for further analysis.

4.17. Text editor for script editing

Application has well developed text editor for editing the script text.

4.18. Running multiple service procedures and scripts in parallel

Multiple service procedures and scripts can be running for single device at the same time. Single service procedure or script can be running in multiple instances for multiple devices.

4.19. Sample script library

There is a library of sample JScript and VBScript script that illustrate the use of all properties and methods of exported Device and Application objects. Application help system has detailed description of arguments and returned values for each method and property.

4.20. Large integer (8-byte) support for scripting

Basic large integer arithmetic and comparison operations are supported for scripting. Large integer values are used as parameters for some SCSI commands. Also large integer values might be necessary while making and parsing device parameters and other binary data.

4.21. Large CDB (greater than 16 bytes) and bidirectional data transfer support

Application supports large CDB with length greater than 16 bytes and bidirectional data transfer. The length of large CDB is limited by 256 bytes. The operating system platform and HBA device/driver must support storage request block in order to utilize this feature. Windows 8 operating system platform and later support storage request block. Support of storage request block for HBA is reflected in the list of properties. If Request type property has non-zero value the HBA supports large CDB and bidirectional data transfer. This feature is supported for all command execution modes: manual, service procedure, and scripting.

4.22. Task management function support

The following task management functions are supported.

- SCSI Bus Reset. Resets the SCSI bus for adapter that is selected in the hardware configuration tree. SCSI bus is selected by number in case when adapter supports multiple buses.
- Device Bus Reset. Resets the SCSI bus the selected device is connected to.
- Target Device Reset. Resets the SCSI target for the selected device.
- Logical Unit Reset. Resets the logical unit for the selected device.

4.23. Control byte fields support

The script can set Link, Flag, NACA, and Vendor Specific fields in Control byte in CDB for all commands. The script can dynamically disable and enable Control byte setting in order to pass arbitrary values for Control byte in raw and custom CDBs.

4.24. Unicode file encoding support

Unicode file encoding is supported for script device log, and test files. User can change file encoding settings in program options dialog box. One can save files in ANSI, Unicode, UTF-8, and UTF-16LE encodings.

4.25. Interactive tools

The product includes the set of interactive tools:

- Hex-to-decimal converter. The dialog box allows the user to quickly convert hexadecimal and decimal numeric values in both directions.
- Binary data editor. The Binary Editor dialog box provides the means for editing binary data files. The dialog box title includes name of the file and indication of the changed data (asterisk character). The dialog box is modeless. It is possible to open multiple binary editor dialog boxes and to edit multiple files in parallel.
- Disk block editor. The Disk Block Editor interactive tool allows the user to edit the logical blocks for selected disk device. The tool is implemented as child window with navigation controls on the top edge of the window and binary editor in the main part of the window. The binary editor allows the user to view the current content of the read logical block and to change the logical block data. The changed bytes are highlighted by red color. It is possible to open multiple separate windows for single disk device. Each window allows the user to edit either different or the same logical block.
- Changer management. The Changer Management interactive tool allows the user to manage elements for selected media changer device. The Changer Management window contains the list of elements of selected type (medium transport, storage, import/export, and data transfer). The list includes the columns for all supported fields of element status descriptor. The control bar is located at the top edge of the window. The control bar allows the user to select the element type and to refresh the element list. Also the bar reflects the total number of elements of selected type. It is possible to open multiple separate windows for single media changer device. Each window allows the user to manage the elements of either the same or the different type.

The interactive tools are located in Tools menu.