



# Serial ATA International Organization

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## Serial ATA Interoperability Program System Interoperability MS-DOS MOI

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# SATA-IO Logo Interoperability Program

## Revision History

Revision	Date	Comments
0.01	01/22/06	Initial release – all text in aqua is pending replacement
0.90	02/04/06	Added bootable CD, bootable floppy
1.0RC	02/20/06	Updated cd-rom boot instruction
1.0RC2	03/03/06	Updated references section and added a test measurement accuracy section
1.0	06/19/06	RC 30-day review complete, removed RC2, added front page disclaimer

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# INTRODUCTION

The test definitions themselves are intended to provide a high-level description of the motivation, resources, procedures, and methodologies specific to each test. Formally, each test description contains the following sections:

## **Purpose**

The purpose of the System Interoperability test is to ensure at a high level that when listed drives, cables and hosts are connected they actually operate.

## **References / Definitions:**

HDD – Hard disk drive, name given to a dos level block mode write / read device that uses the ATA command set. Examples would be a 3.5” ATA HDD and a 2.5” ATA HDD.

ODD – Optical Disk drive, name given to any dos level device that uses the ATAPI command set. Examples would be read only devices like CD-ROM and DVD-ROM and read / write type devices like CD-RW, DVD-RW, DVD+RW, CD-RW/DVD combo drives tested in read only mode.

USB Key – USB flash disk type device

## **Resource Requirements**

Host requirements: Hosts must provide the following:

- INT 13 BIOS services for ATA and ATAPI devices connected to their ports.
- For ATAPI devices, one of the following:
  - Provide a way to configure the SATA ports to be addressed in a legacy address (1Fx/3Fx, 17x/37x) and interrupt mode (edge triggered IRQ 14 and IRQ 15).
  - Bootable CD Hard Drive emulation mode
- Must support for one of the following:
  - Boot a floppy disk (slowest)
  - Boot a USB flash key
  - Boot a CD in Hard Drive emulation mode

## **Test Setup**

For HDD type devices, it shall be formatted with a 2GB (2047 MB under fdisk) FAT16/FAT32 file system and connected to SATA Port 0 (The first primary port) with no other SATA devices connected to the system. The BIOS must configure the SATA host controller to be in either Native SFF-8038 or Legacy addressing mode.

For ODD type devices, the System Interoperability data or boot media shall be required, the drive shall be connected to SATA Port 0 (The first primary port), with no other SATA devices connected to the system. If the data media is being used, the host BIOS must

configure the SATA host controller to be in Legacy Address mode. If the boot media is being used, either legacy or native addressing mode may be used, whichever the BIOS supports booting to.

### **Procedure**

The procedures consist of preparing the boot media and either drive preparation (for a HDD), or media preparation (for an ODD). See the individual test descriptions for details

### **Observable Results**

Once each test is started, intermediate test results are displayed, and log to a file: **file.log** located on the ram drive. Each test will pause on an error if the DOS environment variable EPAUSE is set to one (set EPAUSE 1). A summary of how many tests, how long and how much data has been transferred, when the test is complete.

### **Possible Problems**

If multiple bootable device/media combinations are available on the system at the same time, and it is easy to boot the wrong device, and have unexpected drive letter assignments.

If the host does not support either bootable hard drive emulation media or has a legacy mode, the ODD tests will be able to be run.

Some BIOS only support PIO type transfers, and so a reduced transfer rate and total amount of data transferred will be observed.

## REFERENCES

The following document is referenced in this text:

- [1] Serial ATA Revision 2.5, Revision 1.0, October 27, 2006
- [2] Serial ATA Interoperability Program Unified Test Document, Revision 1.0
- [3] Serial ATA Interoperability Policy Document, Revision 1.0

**Test Title:** System Interoperability HDD tests

**Purpose:** To test the interoperability between a HDD and the host system

**References:** See main reference section

**Resource Requirements:**

1. A serial ATA host that meets the previously described requirements
2. Serial ATA HDD Device Under Test with a 2GB FAT16/FAT32 File system starting with LBA 63
3. Serial ATA cable
4. MS-DOS bootable device (USB flash drive, Floppy or CD) loaded with the System Interoperability Test software
5. A writeable media (USB flash drive or floppy) to save the results to

**Last Modification:** 02/04/06

**Discussion:**

Depending on which type of bootable media you are using the default drive letter assignments will be slightly different.

WARNING: If you are using a ODD bootable media, you **MUST** also have an additional media (USB flash or floppy), if you wish to save the results.

Default drive letter assignments when using a floppy boot disk:

BOOTDRV=A:  
SRCDRV=D:  
RAMDRV=D:  
SATA HDD=C:  
ODD ROM drive = X: // Optional, only if one is attached to legacy port

Default drive letter assignments when using a USB boot disk

BOOTDRV=C:  
SRCDRV=E:  
RAMDRV=E:  
SATA\_HDD=D:  
ODD ROM drive = X: // Optional, only if one is attached to legacy port

Default drive letter assignments when using a bootable ODD disk drive, and floppy to save results

Floppy=a:  
BOOTDRV=C:  
SRCDRV=E:  
RAMDRV=E:

SATA\_HDD=D:  
ODD ROM drive = X: // Optional, only if one is attached to legacy port

Default drive letter assignments when using a bootable ODD disk, and USB key to save results

BOOTDRV=C:  
SRCDRV=F:  
RAMDRV=F:  
SATA\_HDD=D:  
USB key=E:  
ODD ROM drive = X: // Optional, only if the ODD is connected to a legacy port

### Test Setup:

1. Follow the test procedure to hook up the resources listed above.

### Test Procedure:

1. Connect the Serial ATA HDD Device under test to SATA Port 0 using a Serial ATA signal cable
2. Connect the Serial ATA HDD to a host system SATA power cable
3. Insert the MS-DOS bootable media into the Floppy drive, USB port. If using a ODD, must wait until power on.
4. Turn on the host system.
5. At the MS-DOS prompt, select the drive letter for the SATA HDD (see above for default drive letter)
6. At the MS-DOS prompt type: **run drive\_id** where drive\_id is a 20 character or less text identifier
7. After 9 to 10 minutes the test will complete with pass / fail results

### Observable Results:

1. Each iteration of the test is targeted to take about 60 seconds.
2. The results are logged to the screen and to the file file.log located on the RAMDRV (see above for the default drive letter) in the directory interop)

If the results are desired to be kept, they **MUST** be copied from the RAMDRIVE back to the USB flash or floppy disk.

### Measurement tolerance:

Data transferred: +- 0 bytes

Test duration: +- 1 seconds, with a minimum of 540 second execution time, equates to a +- 0.2% error

### Possible Problems:

If no ODD drive is attached (which is HIGHLY suggested unless the Bootable ODD option is being used), normal execution of the config.sys and autoexec.bat during normal boot will produce two error messages saying an ODD could not be found and the driver will not be loaded (oakcdrom.sys or mscdex.com)

**Test Title: System Interoperability ATAPI tests**

**Purpose:** To test the interoperability between an ATAPI drive and the host system

**References:** See main reference section

**Resource Requirements:**

1. A serial ATA host that meets the previously described requirements
2. Serial ATA ODD Device Under Test
3. Serial ATA cable
4. Serial ATA System Interoperability CD or DVD Media
5. MS-DOS bootable device (USB flash drive, Floppy or CD) loaded with the System Interoperability Test software
6. A writeable media (USB flash drive or floppy) to save the results to

**Last Modification:** 02/04/06

**Discussion:**

Depending on which type of bootable media you are using the default drive letter assignments will be slightly different.

WARNING: If you are using a ODD bootable media, you **MUST** also have an additional media (USB flash or floppy), if you wish to save the results.

Default drive letter assignments when using a floppy boot disk (system must support legacy addressing mode):

BOOTDRV=A:  
SRCDRV=C:  
RAMDRV=C:  
ODD ROM drive = X:

Default drive letter assignments when using a USB boot disk (system must support legacy addressing mode)

BOOTDRV=C:  
SRCDRV=D:  
RAMDRV=D:  
ODD ROM drive = X:

Default drive letter assignments when using a bootable ODD disk drive, and floppy to save results

Floppy=a:  
BOOTDRV=C:  
SRCDRV=D:  
RAMDRV=D:

ODD ROM drive = X: // Optional, only if the ODD is attached to a legacy port

Be sure to use C: as the test drive

Default drive letter assignments when using a bootable ODD disk, and USB key to save results

BOOTDRV=C:

SRCDRV=E:

RAMDRV=E:

USB key=D:

ODD ROM drive = X: // Optional, only if the ODD is attached to a legacy port

Be sure to use drive C: to run the tests on

### Test Setup:

1. If using Floppy or USB bootable media, configure the SATA Host to be in Legacy Addressing mode
2. Follow the test procedure to hook up the resources listed above.

### Test Procedure:

1. Connect the Serial ATA ATAPI Device under test to SATA Port 0 using a Serial ATA signal cable
2. Connect the Serial ATA ATAPI to a host system SATA power cable
3. Insert the MS-DOS bootable USB flash drive into an appropriate USB port
4. Turn on the host system.
5. At the MS-DOS prompt, select the drive letter for the SATA ATAPI drive (usually X: or C:)
6. At the MS-DOS prompt type: **run drive\_id cd** where drive\_id is a 20 character or less text identifier and cd says to run the cd tests
7. After 9 to 10 minutes the test will complete with pass / fail results

**Observable Results:** The results are logged to the screen and to the file **file.log** located on in the directory **interop** on the ramdrive (see above for the default drive letter )

If the results are desired to be kept, they **MUST** be copied from the RAMDRIVE back to a floppy or USB flash drive.

### Measurement tolerance:

Data transferred: +- 0 bytes

Test duration: +- 1 seconds, with a minimum of 540 second execution time, equates to a +- 0.2% error

**Possible Problems:**

If the host system is not configured in Legacy mode the DOS CD-ROM driver will not load. If legacy mode is not offered, then try using a bootable ODD test procedure.

## Appendix A: Configuration of USB flash disk

### How to create and configure a USB flash disk to be bootable and contain the System Interoperability tests

Creating and configuring a USB flash disk to run the System Interoperability tests consists of the following high level operations:

1. Make the USB flash disk bootable
2. Load the required MS-DOS tools
3. Load the System Interoperability Tests

#### How to make the USB flash disk bootable:

To make your USB flash disk bootable, you will need the following:

1. PC system capable of booting USB devices, with NO HDD or ATAPI devices attached to the system
2. DOS bootable floppy (command.com, io.sys, etc) with the format, fdisk and programs

Procedure:

1. Insert the USB flash disk into an appropriate USB slot
2. Insert the MS-DOS bootable floppy into the floppy drive
3. While booting the system, enter the BIOS configuration menu and validate the boot order as floppy drives before USB devices
4. Save and exit the BIOS setup and continue the DOS boot
5. If the USB drive is already formatted, skip the next two steps
6. At the DOS prompt type **fdisk**
7. Select the USB and create a primary partition
8. Make sure the partition is marked active
9. Exit **fdisk** and reboot if requested
10. Execute either: **format c: /s** or a **sys c:**
11. Remove the bootable floppy
12. Reboot the system using the USB flash disk

#### Loading the required MS-DOS tools:

To use your USB flash disk bootable, you will need to

1. Boot your system with a bootable USB flash disk
2. Insert a your Windows 98se recovery disk that contains the required files
3. Copy the following files from the floppy into c:\bin:
  - a. Himem.sys
  - b. Ramdrive.sys
  - c. Oakcdrom.sys
  - d. Mscdex.exe
  - e. Chkdsk.com
  - f. Format.com

- g. Fdisk.exe
- h. Sys.com
- 4. Copy the following additional NON MS-DOS utilities into c:\bin
  - a. Pkunzip.exe

**Loading the System Interoperability Tests:**

Download comp.zip and interop\_MMDDYY.zip file from the SATA-IO members only Logo website (where MMDDYY is the digits for the Monday Day and Year of the test release).

To load the System Interoperability tests, perform the following tasks to configured / bootable USB flash disk drive:

- 1. mkdir c:\interop
- 2. copy comp.zip c:\interop        REM – Do NOT unarchive – files are very large
- 3. Unarchive Interop\_MMDDYY.zip into c:\interop
- 4. copy c:\interop\config.sys c:\
- 5. copy c:\interop\autoexec.bat c:\

## **Appendix B: Configuration of floppy disk**

### **How to create and configure a floppy disk to be bootable and contain the System Interoperability tests**

NOTE: Booting a floppy disk is MUCH slower and so usage of a USB key is highly suggested

Creating and configuring a floppy disk to run the System Interoperability tests consists of the following high level operations:

1. Make the floppy disk bootable
2. Load the required MS-DOS tools
3. Load the System Interoperability Tests

#### **How to make the floppy disk bootable:**

To make your floppy disk bootable, you will need to do ONE of the following:

1. A utility to make a bootable floppy disk (follow utilities instruction)
2. A windows 98se system (Generate a windows recovery floppy, and remove all the program except the ones listed below)

#### **Loading the required MS-DOS tools:**

To use your bootable floppy, you will need to

1. Copy over the following files from a Windows 98se recovery disk into the `\bin` directory:
  - b. Himem.sys
  - c. Ramdrive.sys
  - d. Oakcdrom.sys
  - e. Mscdex.exe
  - f. Chkdsk.com
  - g. Format.com
  - h. Fdisk.exe
  - i. Sys.com
2. Copy the following additional NON MS-DOS utilities into `c:\bin`
  - j. Pkunzip.exe

#### **Loading the System Interoperability Tests:**

Download `comp.zip` and `interop_MMDDYY.zip` file from the SATA-IO members only Logo website (where MMDDYY is the digits for the Monday Day and Year of the test release).

To load the System Interoperability tests, perform the following tasks to configured / bootable USB flash disk drive:

1. `mkdir c:\interop`
2. `copy comp.zip c:\interop`      REM – Do NOT unarchive – files are very large

3. Unarchive Interop\_MMDDYY.zip into c:\interop
4. copy c:\interop\config.sys c:\
5. copy c:\interop\autoexec.bat c:\

## Appendix C: Configuration of Bootable CD

### How to create and configure a CD to be bootable and contain the System Interoperability tests

This procedure is FAIRLY complex and should ONLY be done if no other option is available.

WARNING: You must copy the files to a USB flash disk to the order described or the test data will not reside on the desired location on the CD.

Creating and configuring a Bootable CD to run the System Interoperability tests consists of the following high level operations:

1. Configuring a USB flash disk to be the RIGHT size
2. Making a the USB flash disk bootable
3. Loading the required MS-DOS utilities
4. Loading the System Interoperability tests onto the USB flash disk
5. Loading filler data to take up space so that the test and data are on the outside diameter of the CD
6. Loading the System Interoperability test data onto the USB flash disk
7. Using a system that contains a CD burning utility that can make Hard Drive Emulation bootable CDs

#### Configure a USB flash disk to be the right size and bootable

To make your USB flash disk bootable, you will need the following:

1. A 1 GB flash disk capable of booting in the system (Anything less than 700MB will not be able to hold a CD image, and anything more than 1GB will be wasted)
2. PC system capable of booting USB devices, with NO HDD or ATAPI devices attached to the system
3. DOS bootable floppy (command.com, io.sys, etc) with the format, fdisk and programs
4. A system with CD burning software that is capable to generate a bootable CD (I use Nero).

#### Procedure

1. Insert the USB flash disk into an appropriate USB slot
2. Insert the MS-DOS bootable floppy into the floppy drive
3. While booting the system, enter the BIOS configuration menu and validate the boot order as floppy drives before USB devices
4. Save and exit the BIOS setup and continue the DOS boot
5. Execute **fdisk**,
  - a. N – Do not choose drive support (use FAT16, not FAT32)
  - b. Delete partition

- c. Delete the primary partition (partition 1, type in volume name, Y)
  - d. Create a partition
  - e. Create a primary partition
  - f. N – Do NOT create a partition to span the entire disk
  - g. **598** – Create a partition that is 598MB in size
  - h. ESC
  - i. ESC
  - j. Reboot
6. format c: /s

### **Loading the required MS-DOS tools:**

To use your USB flash disk bootable, you will need to

- 1. Boot your system with a bootable USB flash disk
- 2. Insert a your Windows 98se recovery disk that contains the required files
- 3. Copy the following files from the floppy into c:\bin:
  - k. Himem.sys
  - l. Ramdrive.sys
  - m. Oakcdrom.sys
  - n. Mscdex.exe
  - o. Chkdsk.com
  - p. Format.com
  - q. Fdisk.exe
  - r. Sys.com
- 4. Copy the following additional NON MS-DOS utilities into c:\bin
  - a. Pkunzip.exe

### **Loading the System Interoperability Tests:**

To load the System Interoperability tests, perform the following tasks to configured / bootable USB flash disk drive:

- 1. Download comp.zip and interop\_MMDDYY.zip file from the SATA-IO members only Logo website (where MMDDYY is the digits for the Month Day and Year of the test release).
- 2. mkdir c:\interop
- 3. copy comp.zip c:\interop
- 4. Unarchive Interop\_MMDDYY.zip into c:\interop
- 5. Unarchive comp.zip c:\
- 6. copy c:\interop\config.sys c:\
- 7. copy c:\interop\autoexec.bat c:\

## **Loading filler data**

The filler data is loaded to take up space on the CD so that the rest of the test data and tests reside on the OD (Outside Diameter) of the CD where the maximum media transfer rate occurs.

To load the “filler data”, perform the following tasks

1. Download the cd\_image\_MMDDYY.zip file from the SATA-IO members only Logo website (where MMDDYY is the digits for the Month, Day and Year of the image release).
2. Uncompress the boot\_image archive and either burn a CD using that image or use a image access utility to extract the files from the image archive.
3. make a directory dir\_100 on the USB flash disk, and copy the first 5 files from the dir\_100 directory in the image (ZERO1001.BIN through ZERO1005) into the dir\_100 directory on the USB flash disk (This takes up 500MB of space)
4. Copy dir\_10 through dir\_70 to the USB flash disk (7 directories)
5. Copy dir\_1 to the USB flash disk

## **Loading the System Interoperability Test data:**

To load the System Interoperability data tests, extract the following files from \interop\comp.zip

1. [cd to the \ directory on the USB flash disk](#)
2. pkunzip \interop\comp.zip md5sum.md5
3. pkunzip \interop\comp.zip comp2048.bin
4. pkunzip \interop\comp.zip comp64k.bin
5. pkunzip \interop\comp.zip comp256k.bin
6. pkunzip \interop\comp.zip comp1mb.bin
7. pkunzip \interop\comp.zip comp16mb.bin
8. Using a system that contains a CD burning utility that can make Hard Drive Emulation bootable CDs

## **Burning the bootable CD:**

Requires access to the files from “filler” data CD. Make sure you have a copy of the filler data on the HDD.

Access to the

1. In your burning software select making a bootable ISO.
2. Select the 598MB USB key as the boot image
3. There should be about 100MB left for the data portion of the CD
4. At the top level of the data portion of the CD, add the following directories and files:

- a. dir\_10 through dir\_70 from the cd\_boot\_image filler data (takes up 70 more MB)
  - b. md5sum.md5
  - c. comp2048.bin
  - d. comp64k.bin
  - e. comp256k.bin
  - f. comp1mb.bin
  - g. comp16mb.bin
5. Commence with burning the CD.

## Appendix D: Creating a formatted HDD

To create a formatted HDD for System Interoperability testing, you will need the following:

1. A PC system with the HDD connected to Primary SATA port 0
2. DOS bootable floppy (command.com, io.sys, etc) with format and fdisk

### Procedure

1. Insert the MS-DOS bootable floppy into the floppy drive
2. Execute **fdisk**,
  - a. Y –Choose large drive support (uses FAT32, not FAT16)
  - b. 1 - Create a partition
  - c. 1 - Create a primary partition
  - d. N – Do NOT create a partition to span the entire disk
  - e. **2047** – Create a partition that is 2047 MB in size
  - f. ESC
  - g. ESC
  - h. Reboot
3. format c: /s

## Appendix E: Inside the System Interoperability tests

### Source of the files:

The System Interoperability tests consist of source binary files that are created from the SATA-IO composite pattern that has been reverse scrambled and reverse encoded so that it matches the SATA-IO composite 2K Dword (8,192 bytes) pattern out on the SATA-IO bus, if the pattern is not split between data FIS on a non-8K alignment. The size of the source binary files was varied to strike a balance between guaranteed being 8K aligned and increased data throughput that is gained with larger file sizes. In addition the smaller file sizes have a high likelihood of being cached, and thus achieving higher burst transfer rates, whereas the larger files increase the devices media access interactions.

Current file sizes are: 8KB, 64KB, 256KB, 1MB, and 16MB

### Error detection and validation:

The System Interoperability tests use the industry standard MD5 128-bit checksum generator that has proven to be very capable at detecting single bit errors (even in very large files). There are a number of MD5 checksum tools available in the public domain and for a large number of different platforms. The current test uses the tool `md5dos.exe` to perform these checks.

The MD5 signatures for each of the data files has already been generated and is stored in the file `comp.lst`

For the HDD test, each of the source binary files is copied to the HDD, and then copied using the copy command 39 more times generationally, so that only the last file needs to be validated to verify all 40 copies were correct. The last copy is verified with its stored md5 signature.

For the ATAPI test, only read tests are performed, and each of the source binary files is read and validated using the md5 signature tool multiple times

If an error is detected, the test will pause (controlled by EPAUSE environment variable).

Each test is re-executed until the time allocated is consumed.

### Script control:

Each test is performed / controlled by the DOS batch file `run.bat`. In addition to the internal copy command, the script also uses the following utilities and batch files:

1. `md5dos.exe` – Used to compute the md5 signatures for the data files
2. `aset.exe` – Gather start / end times to run the test for a specific amount of time

3. **delta.bat** – Script to compute the elapse time between the start time and the end time and detect if it has been greater than 9 minutes (540 seconds)
4. **copyfile.bat** – Used when testing HDDs to do the 40 generational copies
5. **copy\_cd.bat** – Used when testing ATAPI drives to compute multiple MD5 signatures

**Support files:**

6. **comp2048.bin** – 8KB binary SATA-IO comp data file
7. **comp64k.bin** – 64KB binary SATA-IO comp data file (comp2048.bin repeated 8 times)
8. **comp256k.bin** – 256KB binary SATA-IO comp data file (comp2048.bin repeated 32 times)
9. **comp1mb.bin** – 1MB binary SATA-IO comp data file (comp2048.bin repeated 128 times)
10. **comp16mb.bin** – 16MB binary SATA-IO comp data file (comp2048.bin repeated 2048 times)
11. **comp.lst** – md5 signature file used to validate all of the above SATA-IO comp data files
12. **comp\_cd.lst** – md5 signature file used to validate one loop of the ATAPI test
13. **comp2048.lst** – md5 signature for just the file comp2048.bin
14. **comp64k.lst** – md5 signature for just the file comp64k.bin
15. **comp256k.lst** – md5 signature for just the file comp256k.bin
16. **comp1mb.lst** – md5 signature for just the file comp1mb.bin
17. **comp16mb.lst** – md5 signature for just the file comp16mb.bin

All of these files are distributed in the file: **Interop\_mmddy.zip** mm is the month, dd is the day and yy is the last two digits of the year of the release.