C H A P T E R   1 0

IDE and ATAPI

This chapter presents the PC 98 requirements and recommendations for ATA (AT Attachment), ATAPI (ATA Packet Interface) controllers and peripherals. ATA is more commonly known as IDE (Integrated Device Electronics).

The IDE interface is one of the most widely used in the PC world. Originally intended only for hard drives, IDE support is being extended to additional device types and performance features.

The use of IDE in a PC 98 system is optional. If IDE is used, however, all components must comply with the requirements defined in this chapter.

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IDE Controller Requirements

This section summarizes the specifications and standards for Windows-compatible IDE controllers.

1. Controller complies with ATA-2 specification
Required

Recommended: ATA-3 compliance.

All IDE adapters (and peripherals) must meet the hardware and software design requirements listed in the current version of the *AT Attachment 2* specification.

2. Bootable IDE controller supports El Torito No Emulation mode
Required

A bootable IDE storage controller must support the No Emulation mode defined in *El Torito—Bootable CD-ROM Format Specification, Version 1.0,* by IBM and Phoenix, or an equivalent method that supports the Windows NT CD-ROM installation process.

3. System BIOS and option ROMs support Int 13h Extensions
Required

The Int 13h Extensions ensure correct support for high-capacity drives, consistent drive-letter mapping between real mode and protected mode, and other capabilities for both Windows and Windows NT. Support for the fixed-disk access subset of Int 13h Extensions must be provided in the system BIOS and in any option ROMs for storage devices that include BIOS support.

The Int 13h Extensions are defined in the Windows NT 5.0 DDK and in the "Layered Block Device Drivers" section of the Windows 98 DDK.

4. Controller and peripherals support media status notification
Required

For CD-ROM and DVD-ROM, manufacturers must comply with all provisions defined in the Media Status Event Notification subsection of SFF 8090 (Mt. Fuji specification). This specification is available from the SFF Committee and from ftp://fission.dt.wdc.com/pub/standards/SFF/specs/.

For ATAPI floppy drives, manufacturers must implement media status notification as defined in SFF 8070.

For other ATA and ATAPI devices, *Media Status Notification Support Specification, Version 1.03* or higher, by Microsoft Corporation, defines the protocol to use for communicating about the current state of removable media. This specification is available at http://www.microsoft.com/hwdev/specs/.

For other ATAPI devices such as tape drives, media status notification is not required, but if it is implemented, the support must comply with SFF 8090.

Important: For CD-ROM and DVD-ROM devices, do not use *Media Status Notification Support Specification, Version 1.03* or earlier, as the guideline for implementing status notification on optical storage devices. This specification does not apply to optical storage devices because it does not contain packet-based support.

5. Dual IDE adapters use single FIFO with asynchronous access or dual FIFOs and channels
Required

PCI dual IDE adapters must be designed so that either channel might be used at any time; that is, the operating system does not have to serialize access between the primary and secondary channel at any time. This means either that the two channels are totally independent or that anything shared, such as a programmed I/O (PIO) read pre-fetch buffer, is protected by a hardware arbitrator.

A design implementing a single first in/first out (FIFO) that uses a hardware solution to synchronize access to both channels meets this requirement if the design does not require that a request on one channel be completed before another can be started.

Section 5.0 of the *Compaq, Intel, Phoenix BIOS Boot Specification* defines the implementation for dual asynchronous channels.

Dual-channel controllers that require special software to serialize channel I/O for a single prefetch FIFO do not meet these requirements. Such designs require serial access to one of four devices, defeating the primary advantage of asynchronous dual-channel controllers. Furthermore, such devices are non-standard and require custom driver support.

The introduction of non-standard IDE hardware is strongly discouraged because it negatively impacts traditional compatibility of the IDE interface. Notice, however, that dual-channel controllers which do not require special software to serialize channel I/O do meet these requirements.

6. System BIOS and devices support LBA
Required

To enable support for IDE disk drives that are larger than 528 MB, the system BIOS must use a logical block addressing (LBA) scheme that is compatible with the BIOS/CMOS and IDE register set constraints. The system BIOS must also be able to enable and disable block mode, and must be able to disable 32-bit mode.

Although ATAPI was defined to be transparent to the BIOS, the BIOS must recognize the presence of ATAPI devices using the signature defined in SFF 8020i. In some cases, without such support, the BIOS might fail to configure the adapter if it does not see a device.

7. Controller and peripherals support PCI IDE bus mastering
Required

The programming register set for PCI IDE bus master DMA is defined in SFF 8038i. IDE drives must comply with SFF 8038i to ensure fully featured hardware and Windows-compatible device driver support.

With ATAPI CD-ROM, PIO demands placed on the system CPU can have a negative impact on performance and application processing, especially for multimedia. Bus master DMA IDE adapters, which leverage local bus data rates, can provide higher data rates and the ability to offload the system CPU from I/O transfers.

Other factors that encourage the adoption of bus master DMA include the increased disk media transfer rates, plus demands made by multitasking operating systems and multichannel/multidevice IDE configurations.

Controllers and peripherals must also support Ultra DMA/33 (also known as Ultra-ATA) as defined in the "ATAPI Peripheral General Requirements" section later in this chapter.

8. Controller and peripheral connections include Pin 1 cable designation with keyed and shrouded connectors
Required

Pin 1 orientation must be designated by one edge of the keyed ribbon cable and also on the keyed connector of the IDE or ATAPI controller and peripheral device. Designation of the keyed connector must be clearly indicated on or near the connector.

ATAPI Peripheral General Requirements

This section defines the requirements for all ATAPI devices. Specific requirements for IDE floppy drives, hard drives, CD-ROM, and DVD devices are defined in the "Storage and Related Peripherals" chapter in Part 4 of this guide.

9. Peripherals comply with SFF 8020i, Version 2.5 or higher
Required

This specification defines standard hardware and software design guidelines for ATAPI devices. See also the "System BIOS and option ROMs support Int 13h Extensions" requirement earlier in this chapter.

10. BIOS enumeration of all ATAPI devices complies with SFF 8020i, Version 2.5 or higher
Required

ATAPI specification SFF 8020i, Version 2.5 or higher, defines the enumeration process for all ATAPI devices.

11. Devices support ATAPI RESET command
Recommended

This item ensures that the ATAPI RESET command is processed by the peripheral, even if the firmware state cannot be determined. Reset the controller by going into a power-on state (requests cleared, signature present), except leave any nondefault mode values in their current state and leave the DRV bit unchanged. For more information, see Section 6.2 of SFF 8020i, Version 2.5 or higher.

12. IDE/ATAPI controllers and devices support Ultra DMA/33
Required

Ultra DMA/33 is required to avoid the bottleneck created by the current 16.6-Mb/s limit on disk transfer. Ultra DMA/33 also provides error checking for improved robustness over previous IDE implementations. This is a requirement for all IDE/ATAPI controllers and devices.

PCI chip sets must implement DMA as defined in SFF 8020i and must implement Ultra DMA/33 as defined in the specification submitted by Quantum Corporation for inclusion in the ATA-4 specification (proposed as ATA-4 1153 DR11).

Plug and Play for IDE Controllers and Peripherals

This section summarizes the Plug and Play requirements for IDE controllers and peripherals.

13. Operating system recognizes the boot drive in a multiple-drive system
Required

The implementation of boot-drive determination in multiple-drive systems is defined in Section 5.0 of the *Compaq, Intel, Phoenix BIOS Boot Specification*. This is the format that both Windows and Windows NT operating systems use for determining the boot drive as new bootable devices are introduced for PCs. The system designer can use an equivalent method for boot-drive determination, but the method must ensure that the Windows and Windows NT operating systems recognize the boot drive.

14. Each device has a Plug and Play device ID
Required

For a system-board device, there must be a Plug and Play device-specific ID.

Each IDE controller or peripheral device must provide device IDs in the manner required for the bus it uses, as defined in the related chapter for the specific bus in Part 3 of this guide.

For example, an add-on PCI IDE device must comply with PCI 2.1 and also must provide a Subsystem ID and Subsystem Vendor ID as defined in the "PCI" chapter in Part 3 of this guide. PCI IDE controllers integrated into core logic on the system board do not have to provide Subsystem IDs and Subsystem Vendor IDs, but must meet other PCI 2.1 requirements.

15. Dynamic resource configuration supported for all devices
Required

All devices must be capable of being automatically disabled by the system. Also, disabling the device must result in freeing all its resources for use by other devices.

Changing or adding a controller to the system must not require changing jumpers or switches on either the controller or the system board.

16. Resource configuration meets bus requirements
Required

Plug and Play resource-configuration requirements are defined by the bus used by the IDE/ATAPI controllers and peripheral devices, as defined in the related chapter for the specific bus in Part 3 of this guide.

17. ISA address ranges 3F7h and 377h are not claimed by IDE controllers
Required

Although IDE controllers might use these addresses, 3F7h and 377h also contain registers used by the FDC. To prevent resource conflicts, these addresses must not be claimed as device-register resources.

Power Management for IDE Devices

This section summarizes the specific IDE power management requirements. Power management requirements for peripherals that use IDE are defined in the related device-class chapters in Part 4 of this guide.

18. Device supports ATA STANDBY command
Required

The IDE drive must implement the ATA STANDBY command according to the ATA standard to ensure that the drives are able to spin up properly after a STANDBY command. This command is defined in the ATA-2 specification and in SFF 8020i.

It is recommended that the hard disk drive spin-up and be able to complete a Read operation within 6 seconds of applying power and within 5 seconds of leaving ATA STANDBY mode and transitioning to ATA ACTIVE, as specified in the *Storage Device Class Power Management Reference Specification, Version 1.0* or higher.

19. Bus and device meet PC 98 power management requirements
Required

The IDE channel must comply with the *Storage Device Class Power Management Reference Specification, Version 1.0* or higher. Additional power management requirements are specified based on industry-defined standards for the bus used by the controller (such as PCI) and for the device. For more information, see the related chapter for the specific bus in Part 3 of this guide.

IDE and ATAPI References

The following represents some of the references, services, and tools available to help build hardware that is optimized to work with Windows operating systems.

AT Attachment 2 [X3T9.2 948D] and other ATA specifications
ATA Packet Interface for CD-ROM, SFF 8020i
Other SFF Committee publications
  ftp://fission.dt.wdc.com/pub/standards/SFF/specs/

Compaq, Intel, Phoenix BIOS Boot Specification, Version 1.01
  http://www.ptltd.com/techs/specs.html

El Torito—Bootable CD-ROM Format Specification, Version 1.0
Compaq, Intel, Phoenix BIOS Boot Specification, Version 1.01
  http://www.ptltd.com/techs/specs.html

IDE and SCSI specifications
  SFF Committee publications
  FaxAccess: (408) 741-1600 (fax-back)
  Fax: (408) 867-2115

  Global Engineering Documents
  Phone: (800) 854-7179 (US)
          (613) 237-4250 (Canada)
          (303) 792-2181 (Outside North America)
  Fax: (303) 397-2740
  ftp://ftp.symbios.com/pub/standards/io/

Media Status Notification Support Specification, Version 1.03
SMART IOCTL API Specification, Version 1.1
  http://www.microsoft.com/hwdev/specs/

PCI Local Bus Specification, Revision 2.1 (PCI 2.1)
  PCI SIG
  Phone: (800) 433-5177
  http://www.pcisig.com

Storage Device Class Power Management Reference Specification, Version 1.0
  http://www.microsoft.com/hwdev/onnow.htm

Ultra DMA/33 specification
  http://www.quantum.com

Windows DDK and Windows NT DDK
  MSDN Professional membership

Checklist for IDE and ATAPI

If a recommended feature is implemented, it must meet the PC 98 requirements for that feature as defined in this document.

1. Controller complies with ATA-2 specification
Required

2. Bootable IDE controller supports El Torito No Emulation mode
Required

3. System BIOS and option ROMs support Int 13h Extensions
Required

4. Controller and peripherals support media status notification
Required

5. Dual IDE adapters use single FIFO with asynchronous access or dual FIFOs and channels
Required

6. System BIOS and devices support LBA
Required

7. Controller and peripherals support PCI IDE bus mastering
Required

8. Controller and peripheral connections include Pin 1 cable designation with keyed and shrouded connectors
Required

9. Peripherals comply with SFF 8020i, Version 2.5 or higher
Required

10. BIOS enumeration of all ATAPI devices complies with SFF 8020i, Version 2.5 or higher
Required

11. Devices support ATAPI RESET command
Recommended

12. IDE/ATAPI controllers and devices support Ultra DMA/33
Required

13. Operating system recognizes the boot drive in a multiple-drive system
Required

14. Each device has a Plug and Play device ID
Required

15. Dynamic resource configuration supported for all devices
Required

16. Resource configuration meets bus requirements
Required

17. ISA address ranges 3F7h and 377h are not claimed by IDE controllers
Required

18. Device supports ATA STANDBY command
Required

19. Bus and device meet PC 98 power management requirements
Required