Power Management Description Cleanup

Document 94-064r1

At the 29 Sep 93 SFF / ATA WG meetings in Milpitas, CA, I was talked into rewriting the Power Management command sections of the ATA specification. Later I joined the group of people helping Steve Finch edit the ATA-2 document. I prepared the following command descriptions in the proposed ATA-2 command description format for the Nov 93 ATA WG meeting in Colorado Springs. Here is revision 1 of the command descriptions prepared for the 14 Mar 94 ATA Extensions WG meeting in Newport Beach, CA.

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What I present here are the many sections of the ATA-2 document that describe the Power Management Feature Set. A Feature Set is a set of commands or functions that comprise an optional ATA feature (another Feature Set is Read/Set/Write Multiple).

First, here is the ATA-2 section that describes the command description format.

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z.z Command Description Format

Each command description in this document includes the following information: Type, Protocol, Inputs, Outputs, Prerequisites, Description, and Errors.

TYPE

Type defines command category this command belongs to.

PROTOCOL

Type defines the command protocol this command uses.

INPUTS

Inputs define the Command Block registers used to pass command parameters to the drive.

OUTPUTS

Outputs define the information returned by this command in the Command Block registers.

PREREQUISITES

Prerequisites define any required prerequisite commands or state that must exist before this command can be executed.
DESCRIPTION

Description is a detailed description of the command's processing.

ERRORS

Errors define the error conditions that may be signaled by this command.

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Second, here are the sections that introduce the Power Management Feature Set.

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x.x. Power Management Feature Set

The Power Management Feature Set permits a host to modify the behavior of a drive in a manner which reduces the power required to operate. The Power Management Feature Set provides a set of commands and a timer that enable a drive to implement low power consumption modes. A drive that implements the Power Management feature shall implement the following minimum set functions:

1) A Standby timer
2) Idle command
3) Idle Immediate command
4) Sleep command
5) Standby command
6) Standby Immediate command

Additional vendor unique commands and functions are allowed.

x.x.1 Power modes

The lowest power consumption when the drive is powered on occurs in Sleep Mode. When in Sleep Mode, the drive requires a reset to be activated. The time to respond could be as long as 30 seconds.

In Standby Mode the drive interface is capable of accepting commands, but as the media is not immediately accessible, it could take the drive as long as 30 seconds to respond.

In Idle Mode the drive is capable of responding immediately to media access requests. A drive in Idle Mode may take longer to complete the execution of a command because it may have to activate some circuitry.

In Active mode the drive is capable of responding immediately to media access requests, and commands complete execution in the shortest possible time. During the execution of a media access command a drive shall be in Active mode.

x.x.2 Commands

The Check Power Mode command allows a host to determine if a drive is currently in, going to or leaving Standby mode.
The Idle and Idle Immediate commands move a drive to Idle mode immediately from the Active or Standby modes. The Idle command also sets the Standby Timer count and enables or disables the Standby Timer.

The Sleep command moves a drive to Sleep mode. The drive's interface becomes inactive at the completion of the Sleep command. A reset is required to move a drive out of Sleep mode. When a drive exits Sleep mode it may enter Active, Idle or Standby mode. The mode selected by the drive is based on the type of reset received and on vendor unique implementation.

The Standby and Standby Immediate commands move a drive to Standby mode immediately from the Active or Idle modes.

x.x.3 Standby timer

The Standby timer provides a method for the drive to automatically enter Standby mode from either Active or Idle mode following a host programmed period of inactivity. If the Standby timer is enabled and if the drive is in the Active or Idle mode, the drive waits for the specified time period and if no command is received, the drive automatically enters the Standby mode.

If the Standby Timer is disabled, the drive will not automatically enter Standby mode.

x.x.4 Active to Idle mode transition

The transition from Active to Idle mode is vendor specified. A drive may immediately enter Idle mode at the completion of a media access command or there may be a vendor specified delay before Idle mode is entered. It is possible that the Standby timer may be enable for a time period that is less than the normal automatic Active to Idle mode time period. In this case, the drive may move directly from Active to Standby mode.

x.x.5 Status

In the Active, Idle and Standby modes, the drive shall have Ready status and shall be ready to accept any command.

In Sleep mode, the drive's interface is not active. A host shall not attempt to read the drive's status or issue commands to the drive.

x.x.6 Power Mode transitions

Figure 7 shows the minimum set of mode transitions that shall be implemented.
Path 1: An Idle command, Idle Immediate command or vendor unique implementation moves the drive to Idle mode.

Path 2: An Idle command or Idle Immediate command moves the drive to Idle mode.

Path 3: A Standby command, Standby Immediate or Standby timer expiration moves the drive to Standby mode.

Path 4: A Media access command moves the drive to Active mode.

Path 5: A Sleep command moves the drive to Sleep mode.

Path 6: A reset, either hardware or software, moves the drive to Active, Idle or Standby as specify by the drive vendor.

Figure ?. Power Management Modes

Third, here are the command description sections.

8.4. CHECK POWER MODE

TYPE

Optional - Power Management Feature Set.

PROTOCOL

Non-data command.
INPUTS
None.

OUTPUTS
The Sector Count register is set to 0 (00h) if the drive is going to, in or leaving Standby mode. The Sector Count register is set to 255 (FFh) if the drive is in Active or Idle mode.

PREREQUISITES
None.

DESCRIPTION
If the drive is in, going to, or recovering from the Standby Mode the drive shall set BSY, set the Sector Count register to 0 (00h), clear BSY, and assert INTRQ.

If the drive is in Active or Idle Mode, the drive shall set BSY, set the Sector Count register to 255 (FFh), clear BSY, and assert INTRQ.

ERRORS
Command Abort - The drive does not support the Power Management command set.

8.11. IDLE

TYPE
Optional - Power Management Feature Set.

PROTOCOL
Non-data command.

INPUTS
The value in the Sector Count register when the IDLE command is issued shall determine the time period programmed into the Standby Timer. See Table ??.

<table>
<thead>
<tr>
<th>Sector Count Register contents</th>
<th>Corresponding Timeout Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 (00h)</td>
<td>Timeout Disabled</td>
</tr>
<tr>
<td>1 - 240 (01h-F0h)</td>
<td>(value * 5) seconds</td>
</tr>
<tr>
<td>241 - 251 (F1h-FBh)</td>
<td>((value - 240) * 30) minutes</td>
</tr>
<tr>
<td>252 (FCh)</td>
<td>21 minutes</td>
</tr>
<tr>
<td>253 (FDh)</td>
<td>Vendor unique period between 8 and 12 hours</td>
</tr>
<tr>
<td>254 (FEh)</td>
<td>Reserved</td>
</tr>
<tr>
<td>255 (FFh)</td>
<td>21 minutes 15 seconds</td>
</tr>
</tbody>
</table>

Table ?? - Automatic Standby Timer Periods
This command causes the drive to set BSY, enter the Idle Mode, clear BSY, and assert INTRQ. INTRQ is asserted even though the drive may not have fully transitioned to Idle Mode.

If the Sector Count register is non-zero then the Standby Timer shall be enabled. The value in the Sector Count register shall be used to determine the time programmed into the Standby Timer.

If the Sector Count register is zero then the Standby Timer is disabled.

Command Abort - The drive does not support the Power Management command set.
8.25. SLEEP

TYPE

Optional - Power Management Feature Set.

PROTOCOL

Non-data command.

INPUTS

None.

OUTPUTS

None.

PREREQUISITES

None.

DESCRIPTION

This command is the only way to cause the drive to enter Sleep Mode.

This command causes the drive to set BSY, prepare to enter Sleep mode, clear BSY and assert INTRQ. The host shall read the Status register in order to clear the interrupt and allow the drive to enter Sleep mode. In Sleep mode the interface becomes inactive. The host shall not attempt to access the Command Block registers while the drive is in Sleep mode.

Because some host systems may not read the Status register and clear the interrupt, a drive may automatically deassert INTRQ and enter Sleep mode after a vendor specified time period of not less than 2 seconds.

The only way to recover from Sleep Mode is with a software reset or a hardware reset.

A drive shall not power on in Sleep Mode nor remain in Sleep Mode following a reset sequence.

ERRORS

Command Abort – The drive does not support the Power Management command set.

8.26. STANDBY

TYPE

Optional - Power Management Feature Set.
PROTOCOL

Non-data command.

INPUTS

The value in the Sector Count register when the STANDBY command is issued shall determine the time period programmed into the Standby Timer. See Table ??.

<table>
<thead>
<tr>
<th>Sector Count Register contents</th>
<th>Corresponding Timeout Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>0    (00h)</td>
<td>Timeout Disabled</td>
</tr>
<tr>
<td>1 - 240 (01h-F0h)</td>
<td>(value * 5) seconds</td>
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<tr>
<td>241 - 251 (F1h-FBh)</td>
<td>((value - 240) * 30) minutes</td>
</tr>
<tr>
<td>252  (FCh)</td>
<td>21 minutes</td>
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<tr>
<td>253  (FDh)</td>
<td>Vendor unique period between 8 and 12 hours</td>
</tr>
<tr>
<td>254  (FEh)</td>
<td>Reserved</td>
</tr>
<tr>
<td>255  (FFh)</td>
<td>21 minutes 15 seconds</td>
</tr>
</tbody>
</table>

Table ?? - Automatic Standby Timer Periods

OUTPUTS

None.

PREREQUISITES

None.

DESCRIPTION

This command causes the drive to set BSY, enter the Standby Mode, clear BSY, and assert INTRQ. INTRQ is asserted even though the drive may not have fully transitioned to Standby Mode.

If the Sector Count register is non-zero then the Standby Timer shall be enabled. The value in the Sector Count register shall be used to determine the time programmed into the Standby Timer.

If the Sector Count register is zero then the Standby Timer is disabled.

ERRORS

Command Abort - The drive does not support the Power Management command set.

8.27. STANDBY IMMEDIATE

TYPE

Optional - Power Management Feature Set.
Non-data command.

INPUTS

None.

OUTPUTS

None.

PREREQUISITES

None.

DESCRIPTION

This command causes the drive to set BSY, enter the Standby Mode, clear BSY, and assert INTRQ. INTRQ is asserted even though the drive may not have fully transitioned to Standby Mode.

ERRORS

Command Abort - The drive does not support the Power Management command set.