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.

===

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.

===

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.

==

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

==

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 ? shows the minimum set of mode transitions that shall be
implemented.

```
                                  ---------------------+
                                                       |
        +--------1-------- ACTIVE -------3---------+    |
        |                                     |    |
        | +------4------->        <------4-------+ |    |
        | |                                     | |    |
        | |                                     | |    |
        | |                                     | |   ||
        | |                                     | |    |
```
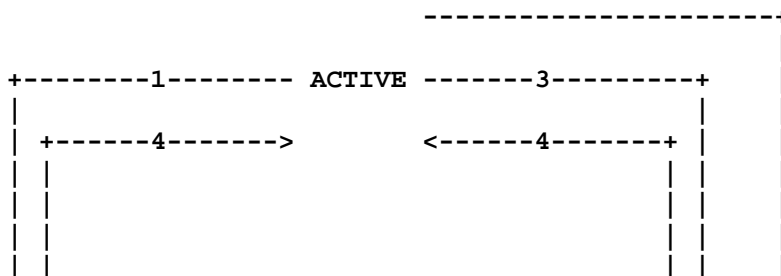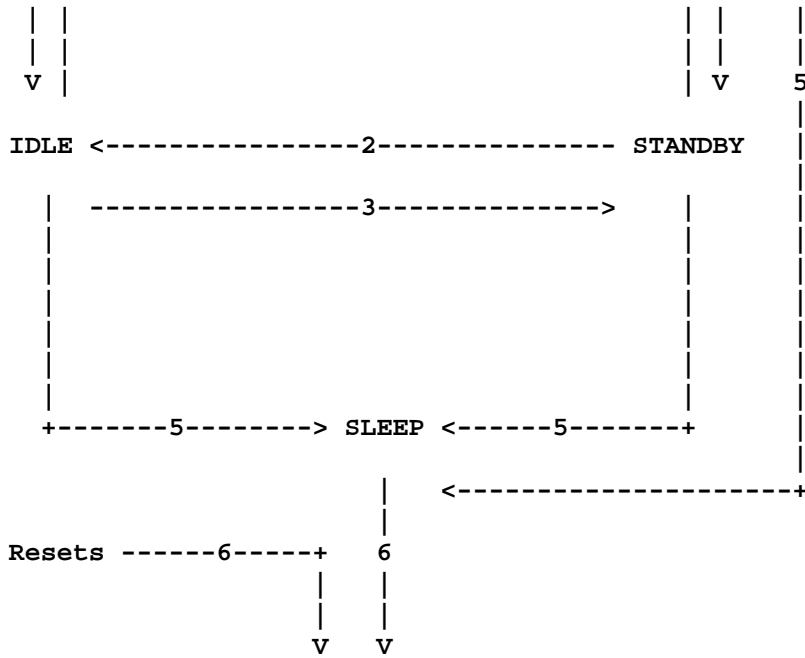
```
      | |                                    | |       |
      | |                                    | |       |
      V |                                    | V       5
                                                       |
      IDLE <----------------2--------------- STANDBY   |
                                                       |
      |   ----------------3------------->   |          |
      |                                      |          |
      |                                      |          |
      |                                      |          |
      |                                      |          |
      |                                      |          |
      |                                      |          |
      +--------5--------> SLEEP <------5-------+         |
                                                        |
                 |      <--------------------+          |
                 |                                      |
     Resets ------6-----+    6                          
                 |      |
                 |      |
                 V      V

                   (see Path 6)


     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 ??.

```
+---------------------+-----------------------------+
| Sector Count        | Corresponding               |
| Register contents   | Timeout Period              |
+---------------------+-----------------------------+
|    0      (00h)      | Timeout Disabled            |
|    1 - 240 (01h-F0h) | (value * 5) seconds         |
|  241 - 251 (F1h-FBh) | ((value - 240) * 30) minutes |
|  252      (FCh)      | 21 minutes                  |
|  253      (FDh)      | Vendor unique period between |
|                     | 8 and 12 hours              |
|  254      (FEh)      | Reserved                    |
|  255      (FFh)      | 21 minutes 15 seconds       |
+---------------------+-----------------------------+
   Table ?? - Automatic Standby Timer Periods
```

OUTPUTS

None.

PREREQUISITES

None.

DESCRIPTION

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.

ERRORS

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

8.12. IDLE IMMEDIATE

TYPE

Optional - Power Management Feature Set.

PROTOCOL

Non-data command.

INPUTS

None.

OUTPUTS

None.

PREREQUISITES

None.

DESCRIPTION

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.

ERRORS

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 ??.

```
+--------------------+-----------------------------+
| Sector Count       | Corresponding               |
| Register contents  | Timeout Period              |
+--------------------+-----------------------------+
|    0      (00h)    | Timeout Disabled            |
|   1 - 240 (01h-F0h)| (value * 5) seconds         |
| 241 - 251 (F1h-FBh)| ((value - 240) * 30) minutes|
| 252       (FCh)    | 21 minutes                  |
| 253       (FDh)    | Vendor unique period between|
|                    | 8 and 12 hours              |
| 254       (FEh)    | Reserved                    |
| 255       (FFh)    | 21 minutes 15 seconds       |
+--------------------+-----------------------------+
    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.

PROTOCOL

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.