Technology Paper

Reducing Storage Energy Consumption by up to 75%

Introduction

While the challenging economic climate continues to exert downward pressure on enterprise IT investment, there is one key exception to this trend. According to research company Gartner, Inc., storage spending is growing almost three times faster than IT budgets as a whole. From 2007 to 2011, storage expenditures will increase more than 7 percent per year, compared with annual IT budget growth of only 2.5 percent, states John Monroe, Gartner vice president.

But this impressive growth in storage spending, fueled by relentless demand for more capacity and greater speed, comes at a time when companies of all sizes are striving to significantly cut IT energy costs. Notes John Monroe, a research vice president at Gartner, "The need for greater storage capacity will continue to expand in multiple directions and dimensions, but there will be an increasing scrutiny of all storage system purchases, with an eye to decreasing power consumption, footprint, and cost-per-GB in unprecedented ways."

Achieving the diverse goals of abundant capacity, high performance, low cost-per-GB and reduced power consumption poses a daunting task for any hard drive manufacturer. Seagate Technology is uniquely suited to meet this challenge, leveraging its industry-leading innovation and engineering expertise to create Seagate® PowerChoice™ technology. Simply put, PowerChoice technology drive power management delivers the lowest power usage ever offered in an enterprise-class hard drive.

Raising the Bar for Power Reduction

Recent years have seen power and cooling costs dramatically rise in the data center, spurring technology manufacturers to implement a variety of innovative power-savings features in their products. Seagate spearheaded the movement toward more energy-efficient hard drives with its PowerTrim™ technology, which has been utilized throughout Seagate enterprise-class hard drive families.

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Now Seagate has taken hard drive power management to the next level with its new PowerChoice technology (a proprietary implementation of T10 Approved Standard #T10/09-054, T13 Standard #T13/452-2008), delivering an unprecedented combination of energy efficiency and user flexibility.

First to market, Seagate has made significant contributions to the new cost-saving standard developed and published by the T10/T13 committees and currently offers PowerChoice technology on the Savvio® (starting with Savvio 10K.4), Constellation™ and Constellation ES enterprise-class hard drives.

While PowerTrim technology is an automatic power savings feature that is activated during very brief periods of command inactivity without impacting performance, PowerChoice technology complements PowerTrim technology by enabling even greater power reductions with four modes that cover idle periods greater than one second. The result? PowerChoice technology decreases drive power consumption by up to 54 percent in enterprise environments.

What's more, PowerChoice technology enables the host to tailor the drive's power savings settings for performance and power consumption via mode pages (SAS/FC) or Set Features commands (SATA). This configuration flexibility ensures that users can specify the optimal idle time thresholds for their particular storage applications. In addition to allowing host to control the drives, with PowerChoice technology enable/disable and timer mode page settings, the host can take full control of the PowerChoice technology capabilities via the Start/Stop Unit (SSU) command (SAS/FC) or Set Feature commands (SATA), thereby disabling drives timer-based controls and allowing host-directed power transitions to occur immediately.

Benefits of PowerChoice Technology

Purpose-built for enterprise environments, PowerChoice technology made its debut in the new Constellation family of nearline enterprise hard drives. These high-capacity, 7200-RPM drives (2.5-inch Constellation and 3.5-inch Constellation ES drives, in both SAS and SATA interfaces) are optimized for Tier 2/nearline applications, wh ich demand enormous capacity and enterprise-class reliability under the less rigorous workloads that characterize nearline environments.

For environments where hard drives are idle more frequently and for longer periods, the benefits of the Constellation family of drives are particularly compelling. (PowerChoice technology is now available in Seagate Savvio 10K mission-critical drives as well.) As can be seen in the table below, the drive's power savings significantly increase as idle time grows. It is important to note that such power savings are achieved while ensuring the drive can still promptly respond to commands, thus preventing any degradation of system performance.

PowerChoice™ Technology Profile: Constellation™ 2.5-Inch Drive Power Savings and Response Time

	Power (W)	Power Savings[1] (%)	Recovery Time (sec)	Default Timer to Entry
Idle	2.82	0	0	n/a
Idle_A	2.82	0	0	1 sec.
Idle_B	2.18	23	0.5	10 min.
Idle_C	1.82	35	1	30 min.
Standby_Z	1.29	54	8	60 min.

1 Power savings estimates and recovery times are preliminary; figures based on Seagate® Constellation SAS 2.5-inch hard drive

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Clearly, the power savings of PowerChoice technology-equipped hard drives are substantial. For example, a 1U rack filled with twenty-four 500GB Constellation drives that have entered PowerChoice technology C mode delivers 12TB of storage, yet consumes 43W or slightly more power than a single 40W light bulb!

How PowerChoice Technology Works

Each individual power condition builds on the capabilities of the previous higher power condition in order to save incrementally more power. The specific energy-saving steps implemented for each power condition are as follows:

Idle_A

- Disables most of the servo system, reduces processor and channel power consumption
- Disks rotating at full speed (7200 RPM)

Idle_B

- Disables most of the servo system, reduces processor and channel power consumption
- Heads are unloaded to drive ramp.
- Disks rotating at full speed (7200 RPM)

Idle_C/Standby_Y (SAS Only)

- Disables most of the servo system, reduces processor and channel power consumption
- Heads are unloaded to drive ramp.
- Drive speed reduced to a lower RPM (reduced RPM)

Standby_Z

- Heads are unloaded to drive ramp.
- Drive motor is spun down.
- Drive still responds to non-media access host commands.

As noted earlier, flexibility is a key feature of PowerChoice technology, enabling commands from the host side to customize power condition settings and direct a drive into or out of power conditions as required. Two different options are available for the user to modify PowerChoice technology settings, depending on the interface used:

SAS

- Host-definable timers via mode pages
- Immediate host-commanded power transitions via Start/Stop Unit (SSU) command

SATA

- Host-definable timers via Set Features commands
- Immediate host-commanded power transitions via Set Features commands

Conclusion

With ever-tightening IT budgets and growing concerns over both the fiscal and environmental costs of escalating power use, the need for more energy-efficient storage in the enterprise has never been more urgent. Seagate has responded with the Constellation and Savvio 10K families of enterprise-class hard drives featuring PowerChoice technology, and in so doing has rewritten the rules for high-capacity storage in the data center.

Not only do these drives boast remarkably low operating power needs, the enhanced power options enabled by PowerChoice technology reduce energy costs even further during slow or idle periods. As a result, these models deliver the highest power-reduction savings ever offered in an enterprise-class drive. What's more, PowerChoice technology's flexible, user-manageable options enable these power savings without sacrificing performance, data integrity or reliability.

Featuring the world's first 2.5-inch, 7200-RPM nearline hard drive, the industry's first 10K-RPM, 600GB drive and a range of 3.5-inch drives that offer capacities up to 2TB, the Constellation and Savvio 10K families are made even more compelling by the inclusion of PowerChoice technology. With its blend of significant power savings and easy user configurability, PowerChoice technology has raised the bar for energy-efficient enterprise storage.

Appendix–Implementation Guide

The following details simplify integration of the PowerChoice™ technology feature set for deployment in enterprise system architectures. As already mentioned, the Seagate® PowerChoice technology feature is available on SAS, FC and SATA interfaces. The following information details the implementation guidelines for SAS and SATA interfaces.

Serial Attached SCSI (SAS) Command Implementation

The following details provide the needed information required to determine what features the drive supports, how to enable/disable and modify the power condition timers, interpret sense code responses, access log pages detailing PowerChoice technology-related activity, and how the host can initiate direct control of PowerChoice technology savings via the Start/Stop Unit (SSU) command.

The SAS implementation allows the host to control staggered spinup for each device to recover from Standby_Y or Standby_Z using the SAS Notify (Enable Spinup) primitive. When Standby_Y or Standby_Z are utilized, the drive requires two events to occur before transitioning to the active state. The sequence of events required to enter the active state from a Standby_Y condition are a media access request from the host followed by receipt of the Notify (Enable Spinup) primitive. The drive waits indefinitely after receipt of a media access command for the Notify (Enable Spinup) primitive.

Determining Capabilities Supported by PowerChoice Technology

PowerChoice technology capabilities are reported via the Vital Product Data (VPD) page 8Ah. This page reports the power conditions supported by PowerChoice technology:

Byte \ Bit	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Page Code (8Ah)							
2	Reserved							
3	Page Length (OEh)							
4	Reserved						STANDBY_Y	STANDBY_Z
5	Reserved					IDLE_C	IDLE_B	IDLE_A
6 - 7	STOPPED CONDITION RECOVERY TIME							
8 - 9	STANDBY Z CONDITION RECOVERY TIME							
10 - 11	STANDBY Y CONDITION RECOVERY TIME							
12 - 13	IDLE A CONDITION RECOVERY TIME							
14 - 15	IDLE B CONDITION RECOVERY TIME							
16 - 17	IDLE C CONDITION RECOVERY TIME							

Notes.

Byte 4 bits 0 – 1 reports support for Standby power conditions.
Byte 5 bits 0 – 2 reports support for Idle power conditions.
Bytes 6 – 7 reports the typical power on time in 1ms increments.
Bytes 8 – 17 reports the typical recovery time in 1ms increments for the associated power condition.
A bit value of 1 in bytes 4 or 5 indicates support for the associated power condition.
A value of 0 for the associated power condition indicates that support does not exist.

Determining or Modifying PowerChoice Technology Settings

Analyzing PowerChoice technology settings and changing settings is done via the SCSI Mode Sense and Mode Select commands. The Mode Sense command is used to report the current PowerChoice technology settings by accessing mode page 1Ah:

Byte \ Bit	7	6	5	4	3	2	1	0
0	PS	SPF(0b)		Page Code (1Ah)				
1	Page Length							
2	Reserved							STANDBY_Y
3	Reserved				IDLE_C	IDLE_B	IDLE_A	STANDBY_Z
4 - 7	IDLE_A CONDITION TIMER							
8 - 11	STANDBY_Z CONDITION TIMER							
12 - 15	IDLE_B CONDITION TIMER							
16 - 19	IDLE_C CONDITION TIMER							
20 - 23	STANDBY_Y CONDITION TIMER							
24 - 39	RESERVED							

Notes.

The behavior of PS and SPF bits is defined by the SPC-4 standard.
Byte 2 bit 0 and byte 3 bits 0 – 3 indicate whether the associated power condition is enabled or disabled.
A bit equal to 1 indicates that the associated power condition is enabled.
A bit equal to 0 indicates that the associated power condition is disabled.

Idle_C and Standby_Y are mutually exclusive; only one may be enabled at a time. Both power conditions place the drive in a state where the heads parked on the ramp while the spindle speed is reduced to a lower RPM. The difference being how the drive returns to the active power state. If the Idle_C power condition is enabled, the drive returns to the active state upon receipt of any media access command. If the Standby_Y power condition is enabled, the drive requires two events to return to the active state; first receipt of a media access command, which must be followed by receipt of a Notify (Enable Spinup) primitive. Use of Standby_Y allows the host to stagger spin-up of drives within an enclosure. The drive waits indefinitely for receipt of the Notify (Enable Spinup) primitive. This behavior is equivalent to issuing a SCSI Start command or initial drive spinup from a powered off state.

Bytes 4 – 23 define the time in 100ms increments that the drive waits after the command queue is empty before transitioning to the associated power condition. The Default mode page reports the minimum timer value; each power condition timer can be set to with a Mode Select command. Each minimum timer value is established at the time of manufacture prior to shipment.

The host system can set any of the power condition timers to a value greater than the default by using the Mode Select command. New values for the timers can be set individually or at the same time. Attempts to set the timer values less than the default results in an error being reported by the drive per the standard reporting method defined by the SPC-4 standard.

The drive enters each power condition as the associated timer expires. If multiple timers expire at the same time, the drive enters the power condition with the greatest amount of power savings.

Host Control of Power Conditions

To allow unlimited flexibility in controlling the drive's PowerChoice technology feature, the Start/Stop Unit (SSU) SCSI command can be used. This allows the host system to take full control of PowerChoice technology, initiating direct power transition or allowing the drive's automated timer controls to execute. Various combinations of the SSU command are available and provide the host with the following capabilities:

- Cause transition to the active condition
- Cause transition to an Idle power condition
- Cause transition to a Standby power condition
- Force an Idle power condition timer to expire
- Force a Standby power condition timer to expire
- Initialize and start all enabled Idle power condition timers
- Initialize and start all enabled Standby power condition timers

The host uses the SSU command Power Condition and Power Condition Modifier fields to control PowerChoice technology's capabilities listed above. The SSU command is defined as follows:

Byte \ Bit	7	6	5	4	3	2	1	0
0	OPERATION CODE (1Bh)							
1	Reserved							IMMED
2	Reserved							
3	Reserved				POWER CONDITION MODIFIER			
4	POWER CONDITION				Reserved	N FLUSH	LOEJ	START
5	CONTROL							

Notes.

The behavior of all bits in the SSU command is defined by the SPC-4 standard except for the Power Condition and Power Condition Modifier fields.

Definitions of the Power Condition and Power Condition Modifier fields are described in the table below:

Power Condition Value	Power Condition Modifier Value	Description
0h	0h	Process the START and LOEF bits.
1h	0h	Cause the drive to transition to the active power condition
2h	0h	Cause the drive to transition to the Idle A power condition
	1h	Cause the drive to transition to the Idle B power condition
	2h	Cause the drive to transition to the Idle C power condition
3h	0h	Cause the drive to transition to the Standby Z power condition
	1h	Cause the drive to transition to the Standby Y power condition
7h	0h	Initialize and start all of the idle and Standby timers that are enabled
Ah	0h	Force the Idle A power condition timer to expire
	1h	Force the Idle B power condition timer to expire
	2h	Force the Idle C power condition timer to expire
Bh	0h	Force the Standby Z power condition timer to expire
	1h	Force the Standby Y power condition timer to expire

Receipt of any SSU command with a non-zero value in the Power Condition field results in all power condition timers to be disabled. The timers remain disabled until the receipt of an SSU command to initialize and start all timers or upon receipt of a logical unit reset.

Receipt of any SSU command with the Power Condition field set to a 2h or 3h causes the drive to immediately transition to the specified power condition. If the requested power condition results in greater power savings, the drive transitions directly to that power condition. If the request causes the drive to transition to a power condition which increases power used, then the drive transitions to the Active Condition first followed by a transition to the requested power condition.

Receipt of any SSU command with the Power Condition field set to Ah or Bh: may cause the drive to transition to a greater power saving condition. If the drive is in Idle_C and the SSU command requests the Idle_B power condition timer to expire, the drive remains in the Idle_C Power Condition.

Determining the Current Power State of the Drive

To allow the host to determine whether the drive is in a power condition, a SCSI Request Sense command can be issued. Receipt of a Request Sense command does not change the current power state of the drive. If the drive is currently in a power condition, the reported sense code is as shown:

Sense Key	ASCQ	Description
5Eh	00h	LOW POWER CONDITION ON
5Eh	01h	IDLE CONDITION ACTIVIATED BY TIMER
5Eh	02h	STANDBY CONDITION ACTIVIATED BY TIMER
5Eh	03h	IDLE CONDITION ACTIVIATED BY COMMAND
5Eh	04h	STANDBY CONDITION ACTIVIATED BY COMMAND
5Eh	05h	IDLE B CONDITION ACTIVIATED BY TIMER
5Eh	06h	IDLE B CONDITION ACTIVATED BY
5Eh	07h	IDLE C CONDITION ACTIVATED BY TIMER
5Eh	08h	IDLE C CONDITION ACTIVATED BY COMMAND
5Eh	09h	STANDBY Y CONDITION ACTIVATED BY TIMER
5Eh	0Ah	STANDBY Y CONDITION ACTIVATED BY

In addition to indicating the drive's current power condition, the sense code also indicates the method used by the drive to enter the current power condition. As already discussed, the drive may enter a given power condition via expiration of the defined mode page timers or as a result of receiving an SSU command from the host.

Power Condition Transitions Log Page

Log page 1Ah provides a counter to record each time the drive transitions into a particular target condition. The following table defines the parameter codes associated with each power condition transition:

Parameter Code	Description
0000h	Accumulated Transitions to Active
0001h	Accumulated Transitions to Idle_a
0002h	Accumulated Transitions to Idle_b
0003h	Accumulated Transitions to Idle_c
0008h	Accumulated Transitions to Standby_z
0009h	Accumulated Transitions to Standby_y

The payload response received when issuing a Log Select command to the drive requesting all parameter codes defined in the above table would be as shown in the table on the following page.

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Byte \ Bit	7	6	5	4	3	2	1	0
0	DS	SPF (0b)	Page Code (1Ah)					
1	Subpage Code (00h)							
2	(MSB)	Page Length (30h)						
3	(LSB)							
4	(MSB)	PARAMETER CODE (0000h)						
5	Accumulated transitions to active state							(LSB)
6	DU	Obsolete	TSD	ETC	TMC		FMT & LINKING	
7	Parameter Length (04h)							
8	(MSB)	Accumulated Transitions to Active						
11	(4 byte binary number)							(LSB)
12	(MSB)	Parameter Code (0001h)						
13	Accumulated transitions to Idle_A state							(LSB)
14	DU	Obsolete	TSD	ETC	TMC		FMT & LINKING	
15	Parameter Length (04h)							
16	(MSB)	Accumulated Transitions to Idle_A						
19	(4 byte binary number)							(LSB)
20	(MSB)	Parameter Code (0002h)						
21	Accumulated Transitions to Idle_B State							(LSB)
22	(DU)	Obsolete	TSD	ETC	TMC		FMT & LINKING	
23	Parameter Length (04h)							
24	(MSB)	Accumulated Transitions to Idle_B						
27	(4 byte binary number)							(LSB)
28	(MSB)	Parameter Code (0003h)						
29	Accumulated Transitions to Idle_C State							(LSB)
30	(DU)	Obsolete	TSD	ETC	TMC		FMT & LINKING	
31	Parameter Length (04h)							
32	(MSB)	Accumulated Transitions to Idle_C						
35	(4 byte binary number)							(LSB)
36	(MSB)	Parameter Code (0008h)						
37	Accumulated Transitions to Standby_Z State							(LSB)
38	(DU)	Obsolete	TSD	ETC	TMC		FMT & LINKING	
39	Parameter Length (04h)							
40	(MSB)	Accumulated Transitions to Standby_Z						
43	(4 byte binary number)							(LSB)
44	(MSB)	Parameter Code (0009h)						
45	Accumulated Transitions to Standby_Y State							(LSB)
46	DU	Obsolete	TSD	ETC	TMC		FMT & LINKING	
47	Parameter Length (04h)							
48	(MSB)	Accumulated Transitions to Standby_Y						
51	(4 byte binary number)							(LSB)

A count is defined as a transition from one power condition to a target power condition. A request to transition to a power condition that the drive is presently in does not increment the counter for that power condition. All counters are saturating counters and do not reset or roll over.

Start/Stop Cycle Counter Log Page

Log page 0Eh has been extended to include two additional items, drive "Specified Load-Unload Count Over Device Lifetime" (parameter code 0005h) and "Accumulated Load-Unload Cycles" (parameter code 0006h). The specified count is a fixed value and provides the user a means to determine the drive's load-unload cycle capability. The accumulated load-unload counter provides real-time determination of how many load-unload cycles the drive has completed. The accumulated count includes all load-unload cycles resulting from the drive being powered on and off or the result of a transition to a power condition. All counters are saturating counters and do not reset or roll over.

A load-unload cycle is defined as an operational cycle with the heads unloaded from the medium, continues while the heads are loaded on to the spinning medium and ends when the heads are unloaded from the medium.

The payload response received when issuing a Log Select command to the drive requesting parameter codes 0005h and 0006h returns in the following:

Byte \ Bit	7	6	5	4	3	2	1	0
0	DS	SPF(0b)	Page Code (0Eh)					
1	SUBPAGE CODE (00h)							
2	(MSB)	PAGE LENGTH (0052h)						
3	(LSB)							
4 : 39	Bytes previously defined (See SCSI Command Manual)							
40	(MSB)	PARAMETER CODE (0005h)						
41	Specified load-unload count over device lifetime							(LSB)
42	DU	Obsolete	TSD	ETC	TMC		FMT&LINKING	
43	PARAMETER LENGTH (04h)							
44	(MSB)	SPECIFIED LOAD-UNLOAD COUNT OVER DEVICE LIFETIME						
47	(4 byte binary number)							(LSB)
48	(MSB)	PARAMETER CODE (0006h)						
49	Accumulated load-unload cycles							(LSB)
50	DU	Obsolete	TSD	ETC	TMC		FMT&LINKING	
51	PARAMETER LENGTH (04h)							
52	(MSB)	ACCUMULATED LOAD-UNLOAD CYCLES						
55	Accumulated load-unload cycles							(LSB)

SCSI Command Interaction While in a Power Condition

Limited command capability is available if the drive is in a power condition. Following are the commands that the drive executes and returns status for without causing a transition to the Active power state:

- Test Unit Ready
- Request Sense
- Report LUNs
- Start/Stop Unit

Note. Use of the Start/Stop Unit (SSU) command may result in a transition to the Active state or a power condition as defined by the SSU commands Power Condition and Power Condition Modifier fields.

PowerChoice Technology Interaction With Background Drive Activities

The drive performs various background activities to update log pages and S.M.A.R.T. information as well as maintaining the integrity of the data written to the media. With this in mind, PowerChoice technology works in unison with background activities. If any background activity is active when a power condition timer expires, entry into the power condition is held off until the required background activity is completed. During this wait period, all power condition timers are suspended. If the transition to a target power condition is the result of an SSU command from the host, then the transition is held off until the background activity is completed.

If the drive is in the process of completing a BMS (Background Media Scan) cycle, then the drive responds to the SSU command with a sense code of 052C0005 (Illegal Power Condition Request). The host can monitor the progress of the current BMS cycle by issuing a Log Select command to return log page 15h (Background Scan Results) and evaluate the “Background Medium Scan Progress” field.

SATA Set Features Command

Extended Power Conditions—PowerChoice™ Technology

Utilizing the load/unload architecture, a programmable power management interface is provided to tailor systems for reduced power consumption and performance requirements.

The table below lists the supported power conditions available in PowerChoice™ technology. Power conditions are ordered from highest power consumption (and shortest recovery time) to lowest power consumption (and longest recovery time) as follows: Idle_A power ≥ Idle_B power ≥ Idle_C power ≥ Standby_Z power. The further you go down in the table, the more power savings is actualized. For example, Idle_B results in greater power savings than the Idle_A power condition. Standby results in the greatest power savings.

Power Condition Name	Power Condition ID	Description
Idle_A	81h	Reduced electronics
Idle_B	82h	Heads unloaded; disks spinning at full RPM
Idle_C	83h	Heads unloaded; disks spinning at reduced RPM
Standby_Z	00h	Heads unloaded; motor stopped (disks not spinning)

Each power condition has a set of current, saved and default settings. Default settings are not modifiable. Default and saved settings persist across power-on resets. The current settings do not persist across power-on resets. At the time of manufacture, the default, saved and current settings in the Power Conditions log match.

PowerChoice technology is invoked using one of two methods:

- Automatic power transitions which are triggered by expiration of individual power condition timers. These timer values may be customized and enabled using the Extended Power Conditions (EPC) feature set using the standardized Set Features command interface.
- Immediate host-commanded power transitions may be initiated using an EPC Set Features "Go to Power Condition" subcommand to enter any supported power condition. Legacy power commands Standby Immediate and Idle Immediate also provide a method to directly transition the drive into supported power conditions.

PowerChoice technology exits power saving states under the following conditions:

- Any command which requires the drive to enter the PM0: Active state (media access)
- Power-on reset

PowerChoice technology provides the following reporting methods for tracking purposes:

- Check Power Mode Command
  - Reports the current power state of the drive
- Identify Device Command
  - EPC Feature sets supported flag
  - EPC Feature enabled flag is set if at least one Idle power condition timer is enabled

Power Condition Log reports the following for each power condition:

- Nominal recovery time from the power condition to active
- If the power condition is Supported, Changeable and Savable
- Default enabled state, and timer value
- Saved enabled state, and timer value
- Current enabled state, and timer value

S.M.A.R.T. Read Data reports:

- Attribute 192 – Emergency Retract Count
- Attribute 193 – Load/Unload Cycle Count

PowerChoice Technology Manufacturer Default Power Condition Timer Values

Default Power Condition timer values have been established to assure product reliability and data integrity. A minimum timer value threshold of two minutes ensures the appropriate amount of background drive maintenance activities occur. Attempting to set a timer value less than the specified minimum timer value threshold results in an aborted EPC "Set Power Condition Timer" subcommand.

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Power Condition Name	Manufacturer Default Timer Values
Idle_A	2 min
Idle_B	4 min
Idle_C	10 min
Stanby_Z	15 min

Setting power condition timer values less than the manufacturer specified defaults or issuing the EPC "Go to Power Condition" subcommand at a rate exceeding the default timers may limit this product's reliability and data integrity.

For More Information

If you have additional questions on PowerChoice™ technology implementation, contact your Seagate technical representative.

Supported Extended Power Condition Feature Subcommands

EPC Subcommand	Description
00h	Restore Power Condition Settings
01h	Go to Power Condition
02h	Set Power Condition Timer
03h	Set Power Condition State

PowerChoice™ Technology-Supported Extended Power Condition Identifiers

Power Condition Identifiers	Power Condition Name
00h	Standby_Z
01..80h	Reserved
81h	Idle_A
82h	Idle_B
83h	Idle_C
84..FEh	Reserved
FFh	All EPC Power Conditions

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