Apacer

Thermal Throttling for PV22D-M280 1920GB - WT

Application Note

Nov 09, 2021

Version 1.0

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1. Introduction

Solid-state drives (SSDs) are a type of data storage device that use a non-volatile solid-state memory, such as a flash memory, to store data. As SSD performance demands increase, power requirements generally increase, while physical size requirements for SSDs generally stay the same or become smaller.

The increase in power requirements without a corresponding increase in physical size leads to challenges to dissipate more heat from SSDs and prevent failures due to overheating. To make things worse, SSDs used in industrial applications require higher ambient temperatures which further hinder heat dissipation. This can potentially put data stored on the SSD at the risk of being corrupted and hardware components in danger of being damaged.

To address the issue, this application note presents a thermal management technique that can monitor the temperature of the SSD equipped with a built-in thermal sensor via S.M.A.R.T. commands. This method can ensure the temperature of the device stays within temperature limits by drive throttling, i.e. reducing the speed of the drive when the device temperature reaches the threshold level, so as to prevent overheating, guarantee data reliability, and prolong product lifespan.

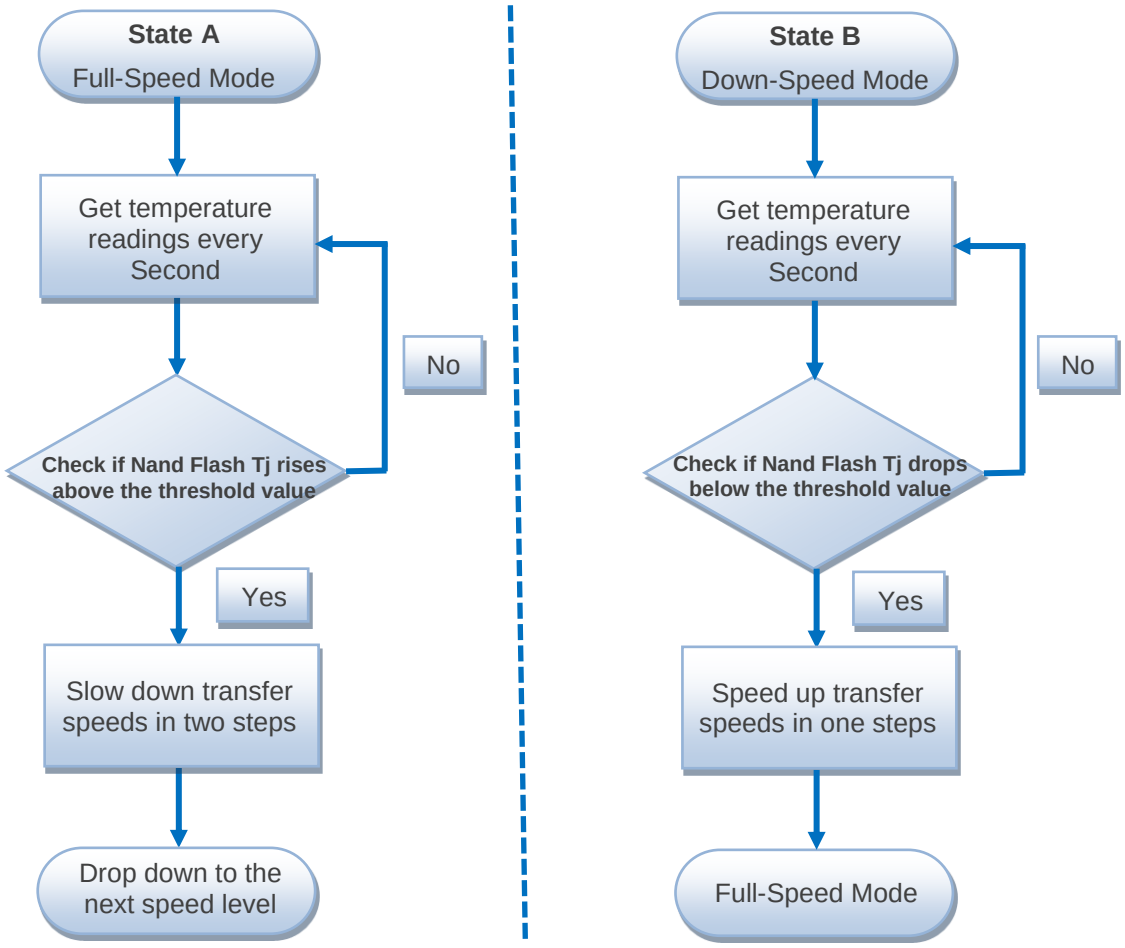
Note that the technique presented in this article can be applied to any thermal-sensor-equipped SSD which supports standard temperature (-40°C to 85°C).

2. Thermal Throttling Mechanism

Apacer's thermal sensor is designed to monitor the temperature of an SSD. When the SSD processes a large number of read/write operations continuously, its temperature may increase to a certain level which could lead to malfunction of the drive. To prevent hardware components from being damaged by overheating, the thermal throttling feature is implemented to control the temperature of the drive to not exceed its maximum threshold temperature by reducing its performance. That is, the drive will throttle itself back and run slower to generate less heat when it is running too hot.

In the following sections, a flow chart will be demonstrated to explicate the procedure of thermal throttling, followed by the test results of Apacer PV22D-M280.

2.1 Thermal Throttling Flow Chart



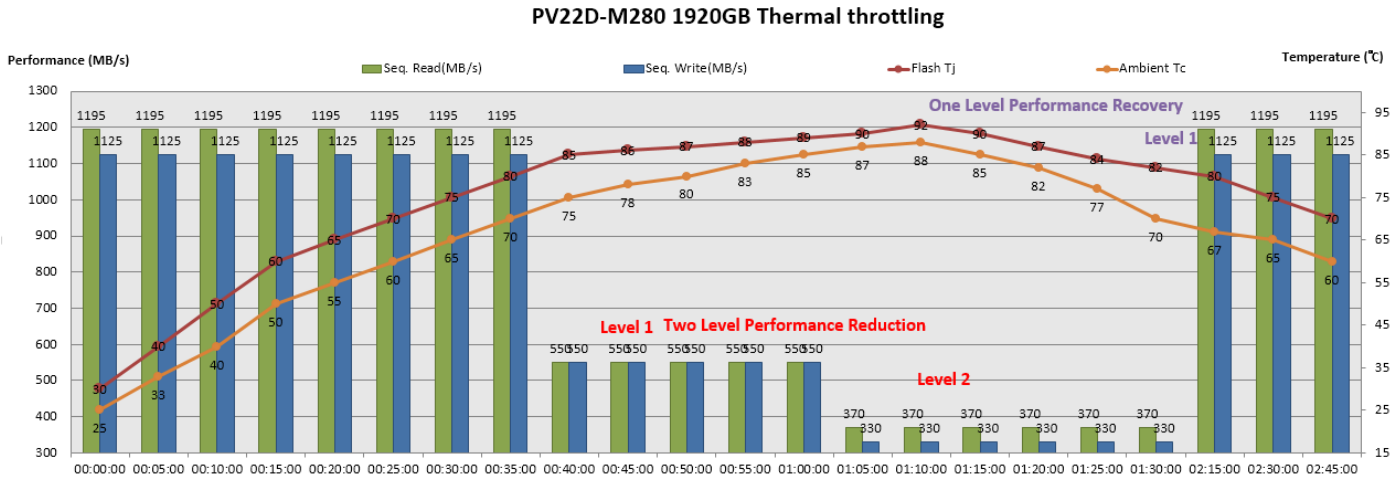
2.2 Test Results

Item	Description
Testing Product	PV22D-M280
Product Capacity	1920 GB
Operating Temperature	25°C to 88°C
Operating System	Windows 10
***Air Flow**	115CFM

** Note: Fan dimension: 120X120X38mm, Fan distance: 10 cm.*

Apacer PV22D-M280 is accessed at full speed in initial phase of the test according to the flow chart.

When the temperature exceeds the threshold value, the drive starts to throttle by decreasing in performance, thereby allowing the device to cool down. It measures the temperature level again and,



if it is greater than or equal to the previous reading, it goes one step further, reducing the performance by one more level until it reaches a low steady state: 370 MB/s in sequential read and 330 MB/s in sequential write in this case.

With the temperature dropping to 80°C, the drive recovers to its maximum performance level in one step with sequential read and write speeds of 1195 MB/s and 1125 MB/s respectively, same as the transfer speeds recorded at the beginning of the test.

Apacer PV22D-M280 test results are summarized in the below table, including the following four milestones:

- Drive throttles when temperature rises above the maximum threshold value of 90°C.
- Two-level performance reduction.
- Drive stops throttling when temperature drops below the minimum threshold value of 80°C.
- One-level performance recovery.

Temperature (°C)	Level	Read (MB/s)	Write (MB/s)
	(Threshold value)	1195	1125
Two-Level Performance Reduction			
85	1	550	550
90	2	370	330
80	(Threshold value)	-	-
One-Level Performance Recovery			
80	1	1195	1125

3. Conclusion

SSDs are considerably fast and can perform tasks within a matter of seconds, but the downside to the solid-state storage is that it cannot maintain top speed without overheating. Thermal sensor is therefore required to be placed on a circuit board to monitor the temperature of the drive.

When the temperature exceeds the maximum threshold level, thermal throttling will be triggered to reduce performance to prevent hardware components from being damaged. Performance is only permitted to drop to the extent necessary for recovering a stable temperature to cool down the device's temperature. Once the temperature decreases to the minimum threshold value, transfer speeds will rise back to its optimum performance level. This protective mechanism can ensure Apacer SATA SSD operates within temperature limits to keep user data and the device safe as well as extend product longevity.

Revision History

Revision	Description	Date
1.0	Official release	11/09/2021

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