

# Ultrastar DC SA620 SATA SSD

## Firmware Release Note



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**Revision Date:** October, 2018

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One MB is equal to one million bytes, one GB is equal to one billion bytes and one TB equals 1,000GB (one trillion bytes) when referring to storage capacity. Accessible capacity will vary from the stated capacity due to formatting and partitioning of the drive, the computer's operating system, and other factors.

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## Revision History

### Generic Firmware (ZRxx)

Date	Revision	Description
October 2018	N	ZR11
na	na	ZR10 not released
January 2018	M	ZR09/BLR-0080
November 2017	L	ZR09
July 2017	K	ZR08 – Combines ZRxx and ZHxx firmware families
October 2016	J	ZR07
September 2016	H	ZR06
June 2016	G	Legal Disclaimer updated and Western Digital branding
May 2016	F	ZR04
December 2015	E	ZR03
October 2015	D	ZR02
August 2015	C	ZR01
July 2015	B	ZP01
May 2015	A	Z30C

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## Affected SKUs

Family	Part Number - SKU	Product Description	Firmware Code Name
Generic	SDLF1DAR-480G-1HA1	Ultrastar DC SA620 480GB (0.6 DWPD)	ZR11RP41
	SDLF1DAR-960G-1HA1	Ultrastar DC SA620 960GB (0.6 DWPD)	ZR11RP91
	SDLF1CRR-019T-1HA1	Ultrastar DC SA620 1.92TB (0.6 DWPD)	ZR11RPA1
	SDLF1DAM-400G-1HA1	Ultrastar DC SA620 400GB (1.8 DWPD)	ZR11RE41
	SDLF1DAM-800G-1HA1	Ultrastar DC SA620 800GB (1.8 DWPD)	ZR11RE91
	SDLF1CRM-016T-1HA1	Ultrastar DC SA620 1.6TB (1.8 DWPD)	ZR11REA1
Channel	SDLF1DAR-480G-1HA2	Ultrastar DC SA620 480GB (0.6 DWPD)	ZR11RP41
	SDLF1DAR-960G-1HA2	Ultrastar DC SA620 960GB (0.6 DWPD)	ZR11RP91
	SDLF1CRR-019T-1HA2	Ultrastar DC SA620 1.92TB (0.6 DWPD)	ZR11RPA1
	SDLF1DAM-400G-1HA2	Ultrastar DC SA620 400GB (1.8 DWPD)	ZR11RE41
	SDLF1DAM-800G-1HA2	Ultrastar DC SA620 800GB (1.8 DWPD)	ZR11RE91
	SDLF1CRM-016T-1HA2	Ultrastar DC SA620 1.6TB (1.8 DWPD)	ZR11REA1
Non-Secure	SDLF1DAR-480G-1JA2	Ultrastar DC SA620 480GB (0.6 DWPD)	ZR11RP41
	SDLF1DAR-960G-1JA2	Ultrastar DC SA620 960GB (0.6 DWPD)	ZR11RP91
	SDLF1CRR-019T-1JA2	Ultrastar DC SA620 1.92TB (0.6 DWPD)	ZR11RPA1
	SDLF1DAM-400G-1JA2	Ultrastar DC SA620 400GB (1.8 DWPD)	ZR11RE41
	SDLF1DAM-800G-1JA2	Ultrastar DC SA620 800GB (1.8 DWPD)	ZR11RE91
	SDLF1CRM-016T-1JA2	Ultrastar DC SA620 1.6TB (1.8 DWPD)	ZR11REA1



### ESD Caution – Handling

Static electricity may be discharged through this disk subsystem. In extreme cases, this may temporarily interrupt the operation or damage components. To prevent this, make sure you are working in an ESD-safe environment. For example, before handling the disk subsystem, touch a grounded device, such as a



computer case.

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## Overview

This document describes the changes, known issues, and important notes for the 2.5" Ultrastar DC SA620 SATA SSD drives and firmware.

### ZR11 Firmware

The ZR11 firmware contains the following fixes for all Ultrastar DC SA620 SATA SSD SKUs.

- Corrected an issue where units shipped with incorrect values in Log Page 4.
- Corrected an issue where a SMART Log Page 6 counter was not correctly incremented when Drive Selftest was run.
- Corrected an issue where Drive Selftest in captive mode could freeze when run on higher capacity drives.
- Corrected an issue where L2P Partition Out of Range issue during data retention recycling, had the risk to put the drive in a format corrupt state.

### ZR10 Firmware: (not released)

### ZR09 Firmware

The ZR09 firmware contains the following fixes:

**Note:** An update to the ZR09 binary image has been released. It includes an updated bootloader that is required to support previously communicated (PCN-001090-EXT and PCN-002039-EXT) Micron 20nm DDR component change. The filenames of binary images with the updated bootloader will be in the format **ZR09Rxx1\_w\_boot\_BLR-0078\_QR.dob**.

- Revised setting to support second source DDR parts.
- Corrected an error in the POR handler that resulted in the drive failing to send a Register Device to Host FIS and causing the drive to be being taken off line
- Corrected an error on the POR handler that caused the drive to start decoding host primitives before it was fully ready to do so, causing it to not respond after speed negotiations completed.
- Corrected the management of the "firmware string justification" field in the Identify Device command, ensuring that it was always set to the correct value.
- Corrected an issue where settings that prevented track timeouts under certain circumstances were being incorrectly cleared.
- Corrected a timing issue with the resetting of control bits that could result in incorrect operation of the sequencer.
- Modified the sequencer initialization sequence to only enable the sequencer after the configuration has completed.
- Added steps in recycle read operations to reduce BER and so reduce frequency that read retries are required.
- Added SMART attribute 199, UDMA CRC Error count, to the list of those that are reported.

### ZR08 Firmware

The ZR08 firmware contains the following fixes for all CloudSpeed Gen II SKUs.

**Note:** This firmware release merges the previously separate Generic (ZRxx) and Channel (ZHxx) firmware lines. As a result of this merger there is an additional step required the first time a Channel device is upgrade from ZH07 and earlier to ZR08. Once a device has been upgraded to ZR08, the additional step is no longer required to switch between revisions.

To upgrade from Generic ZR07 and earlier firmware revisions:

1. Download ZR08 onto the unit (this is the normal firmware download procedure.)

To upgrade from Channel ZH07 and earlier firmware revisions:

1. Download ZH08 intermediate firmware onto the unit.
2. Download ZR08 onto the unit.

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- If the unit is later downgraded to ZH07 it can be upgraded again directly, without having to download the intermediate firmware ZH08 again.
- Corrected an issue where IO issued to a drive in a critical window after DST completes could result in the drive reporting DST still in progress, leading to a host reporting DST timeout.
- Added settings to support second source DDR parts.
- Corrected an issue where the SECURITY COUNT EXPIRED bit is not cleared after a hard reset.
- Increased the internal TRIM command timeout to 60s.
- Corrected an issue where setting the Master Password incorrectly enabled Security.
- Corrected an issue where after a hard reset, a drive with Security Set Password enabled was not locked.
- Corrected an issue with the directory table that incorrectly made the invalid log page 13h visible.
- Corrected an issue where a drive could enter a format corrupt state due to hitting an internal timeout during a very extended read recover operation.
- On 480GB model, optimized the recycle ratio calculation to improve performance stability.
- Corrected an issue where the drive was incorrectly setting the max head number used in CHS mode.
- Corrected an issue where the hard error count was being incorrectly incremented when data was recovered from DDR.
- Corrected an issue where running DST on a fully unmapped device was significantly longer than a fully written device.
- Corrected an issue where Security Enabled bit was different in the Identify Device page compared to the Security page

## ZR07 Firmware

The ZR07 firmware contains the following fixes:

- Corrected an issue where the number of free blocks could get to a critical level due to host write pattern.
  - The cause was due to the recycle rate was slower than required leading to higher rate of SB consumption than generated.

## ZR06 Firmware

The ZR06 firmware contains the following fixes:

- Corrected an issue where erase on super block with bad EBs end prematurely when there is a high rate of FRAME invoke activity.
- Corrected issue where stale reference to open super block in de-activated write stream causes read errors and FRAME invokes on certain pages of particular Super block
  - This could happen during periods to heavy random writes or during Data Integrity recycling.
- Corrected issue where I/O latency is increased when drive is processing TRIM command.

## ZR04 Firmware

The ZR04 firmware contains the following fixes:

- Fixed a firmware download issue when using scli.
- Performance improvements for Random Write IOPs.
- Fixed an issue that allowed firmware for a 0.6 DWPD product to be loaded on-top of a 1.8 DWPD product, causing the SSD to no longer function.
- Fixed an issue where the firmware was not being initialized properly, leading to security-set-password failing sporadically.
- Fixed performance degradation that could be seen after the drive had been left setting idle for an extended period of time. Issue was due to unnecessary recycling.
- Added SATA NCQ Send and Receive log (log address 13h).
- Fixed an issue when running Extended DST that could cause Periodic DST to run while Extend DST was still running.

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- Reduced short DST time to 2 minutes.
- FLUSH CACHE command, while DST-Short is in progress resulting in a drive hang condition.
- Fixed an issue where Long DST was not getting completed if a drive is power cycled.
- Resolved an issue if a MPECC error occurs during a Write, the data was not marked as bad. FTL incorrectly returns this MPECC corrupted data as good data on a Read request.
- Added 2 decimal points to SMART Attribute SSD Life Left.
- Performance improvement: Fixed a performance issue seen when processing read commands at full performance, when the prior test involved heavy write activity.

### Known issues unresolved in this release

- 480GB capacity only: Greater than a 30% drop in performance can be seen during Data Retention recycling.
  - **Failure Scenario:** After extended active (Power-On with No I/O) Idle time (> 100 hours), followed by a power-cycle, may result in reduced SW/SR/RR transient performance drop for ~15-20 minutes after the aforementioned power cycle.
 

**Root Cause:** The 480G architecture has a limited super-device structure by design and this prevents further optimizations between the data integrity algorithm and post-extended idle-time performance metrics

**Change Description:** SD does not intend to make further post-idle time performance improvements on the 480G capacity since the data integrity algorithm takes precedence over temporary transient performance penalties

**Likelihood:** Low

**Severity:** Low
- 400GB/480GB capacity only: Program Failure: Seen only during SanDisk specific fault-insertion.
  - **Failure Scenario:** This test case purposely injects multiple consecutive L2P Program Failure log blocks in a row. Also, at this scenario requires the failing die's erase blocks to be part of the Open Log Super Block List. This combinatorial requirement makes this failure mode exceptionally rare.
 

**Root Cause:** Present firmware handles the very rare scenario of (3) consecutive Program failures in a row coupled with the above additional qualifiers. The firmware does not handle cases above 3 program failures and will likely result in a format-corrupt drive.

**Change Description:** SanDisk intends to provide additional design-margin and will target the next quarterly release for this rare scenario fix.

**Likelihood:** Low

**Severity:** High

### ZR03 Firmware

The ZR03 firmware contains the following fixes:

- Fixed an issue to defer the internal communication messaging between SATA and FTL CPU until initialization completes.
- Improved data retention background task to reduce unnecessary data -recycling.
- Fixed an issue where data retention created significantly more metadata to be processed leading to long initialization times (200+ seconds). Implemented a fix to reduce this to 25 seconds.
- Issues still unresolved

### Known issues unresolved in this release

- WHQL storage assessment test failed.



## ZR02 Firmware

The ZR02 firmware contains the following fixes:

- Fixed an issue when a drive has both TRIM active during PFAIL and writes to the same LBAs in the TRIM region, can cause the drive to go Read only.
- Fixed an issue where a drive failed for a HLBA mismatch on a Read/Modify/Write command.
- Corrected an issue found during our internal regression testing where a drive failed our SMART Attribute PersistenceCount test.
- Fixed an issue where the SMART Read Log did not ABORT on retrieving SMART log 04h, 30h, and E0h with an invalid page count.
- Fixed an issue when the drive is in the sanitize operation, the SMART DST command should be aborted by the drive.
- Fixed an issue where in QoS latency testing showed some cases of >30ms max latency.
- Fixed an issue where the NOP command was reporting a 50/00 status and should have been reporting a 51/04 status.
- Port firmware enhancements for improving unaligned command performance.
- Corrected an issue that could cause a 50% dip in performance during sequential writes.
- Fixed the bootloader so that the clocks and DDR are initialized during a soft start which is used during code download.

## ZR01 Firmware

The ZR01 firmware contains the following fixes:

- Fixed an issue where a drive fell off the bus when performing a sequential write when a write interrupt was performed.
- Fixed an issue where a drive failed when testing corrupted LBA's and did not report the correct status and error.
- Fixed an issue where a Trim Operation while the drive is in background operation mode hangs the drive.
- Created a vendor unique command for enabling/disabling DLOG feature over SATA interface.
- When a Sanitize operation is occurring in the background the drive may incorrectly accept and process other commands such as SMART DST.

## ZP01 Firmware

The ZP01 firmware contains the following fixes:

- Data Validation Error seen while running FIO IOStress Test with "8k-4kAlign-QD1-RANDOM-R0".
- NAND error retries may be unsuccessful which may lead to uncorrectable data.
- Drive may not be fully compliant with Sanitize feature sets.
- Command Time Out issue seen using an Intel HBA at QD16 which manifested as a long latency in performance testing.
- Slight degradation observed in IO consistency.
- Drive failure seen on a Write Command Timeout when testing a larger number of write commands.
- Drive failure seen using internal powerstate test.
- Drive issued a read command timeout on the LBA after being marked pseudo by Write Uncorrectable.
- Command Time Out seen in Oakgate while testing mixed workloads. The fix is currently in test for the next release.
- Drive failed operating shock 1000G/1 ms.
- Fixed an issue where large max latencies were causing a decrease in IOPS consistency.
- Resolved an issue where 50ms latency outliers were encountered on low QD.
- Fixed an issue where a drive failed for CRC Limit error and showed aborted commands.
- Fixed an issue where a drive failed MAT reporting a miscompare error during a full sequential read.
- Fixed an issue where a drive with LBA's set out of range passed the max LBA makes the drive go format corrupt or gets into read only mode.
- Drive went format corrupt during write-interrupt test.
- Drive times out after issuing heavy NCQ commands.
- Fixed an issue where a drive failed for CRC\_LIM. The drive was running 64K sequential write at the time of failure. The failure is caused by running out of spare super blocks to write.

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- Fixed an issue where a drive doesn't respond to the host after encountering a flash ,media error during a READ FPDMAQ command with more than 100h sector count.
- Reduced SPI recycle time.

## **Z30C Firmware**

The Z30C firmware contains the following fixes:

- Improved command timeout handling.
- Improved max read and write latencies and all measurements at QD32 below 15ms.
- Fixed an issue where we saw a data miscompare after a write was interrupted by a power cycle.
- Added PFAIL detection during L2P writes.
- Fixed an issue to properly handle flash program failures during a power failure.
- Resolved an issue where the read thresholds were incorrectly adjusted during a secure erase.

**Note:** The drive needs a secure erase after it is updated to Z30C

1. Download Z30C
2. Secure Erase the drive