

CloudSpeed Gen II

2.5" SATA SSD Product Line

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Revision History

Generic Firmware (ZRxx)

Date	Revision	Description
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

Channel Firmware (ZHxx)

Date	Revision	Description
February 2017	D	ZH07
June 2016	C	Legal Disclaimer updated and Western Digital branding
April 2016	B	ZH06
February 2016	A	ZH05 – Initial Release

Affected SKUs

Family	Part Number - SKU	Product Description	Firmware Code Name
Generic	SDLF1DAR-480G-1HA1	CloudSpeed Gen II Eco 2.5" 480GB (.6 DWPD)	ZR08RP41
	SDLF1DAR-960G-1HA1	CloudSpeed Gen II Eco 2.5" 960GB (.6 DWPD)	ZR08RP91
	SDLF1CRR-019T-1HA1	CloudSpeed Gen II Eco 2.5" 1.92TB (.6 DWPD)	ZR08RPA1
	SDLF1DAM-400G-1HA1	CloudSpeed Gen II Ultra 2.5" 400GB (1.8 DWPD)	ZR08RE41
	SDLF1DAM-800G-1HA1	CloudSpeed Gen II Ultra 2.5" 800GB (1.8 DWPD)	ZR08RE91
	SDLF1CRM-016T-1HA1	CloudSpeed Gen II Ultra 2.5" 1.60TB (1.8 DWPD)	ZR08REA1
Channel	SDLF1DAR-480G-1HA2	CloudSpeed Gen II Eco 2.5" 480GB (.6 DWPD)	ZR08RP41
	SDLF1DAR-960G-1HA2	CloudSpeed Gen II Eco 2.5" 960GB (.6 DWPD)	ZR08RP91
	SDLF1CRR-019T-1HA2	CloudSpeed Gen II Eco 2.5" 1.92TB (.6 DWPD)	ZR08RPA1
	SDLF1DAM-400G-1HA2	CloudSpeed Gen II Ultra 2.5" 400GB (1.8 DWPD)	ZR08RE41
	SDLF1DAM-800G-1HA2	CloudSpeed Gen II Ultra 2.5" 800GB (1.8 DWPD)	ZR08RE91
	SDLF1CRM-016T-1HA2	CloudSpeed Gen II Ultra 2.5" 1.60TB (1.8 DWPD)	ZR08REA1
Non-Secure	SDLF1DAR-480G-1JA2	CloudSpeed Gen II Eco 2.5" 480GB (.6 DWPD)	ZR08RP41
	SDLF1DAR-960G-1JA2	CloudSpeed Gen II Eco 2.5" 960GB (.6 DWPD)	ZR08RP91
	SDLF1CRR-019T-1JA2	CloudSpeed Gen II Eco 2.5" 1.92TB (.6 DWPD)	ZR08RPA1
	SDLF1DAM-400G-1JA2	CloudSpeed Gen II Ultra 2.5" 400GB (1.8 DWPD)	ZR08RE41
	SDLF1DAM-800G-1JA2	CloudSpeed Gen II Ultra 2.5" 800GB (1.8 DWPD)	ZR08RE91
	SDLF1CRM-016T-1JA2	CloudSpeed Gen II Ultra 2.5" 1.60TB (1.8 DWPD)	ZR08REA1



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.

Overview

This document describes the changes, known issues, and important notes for the 2.5" CloudSpeed Eco and Ultra Gen II SATA drives and firmware.

ZR08 Firmware

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

Note: This firmware releases 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.
 - o 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 where setting the Master Password incorrectly enabled Security on the device.
- 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

Generic Firmware (ZRxx)

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.
 - o 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.
- 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.

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- 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.
- 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

Channel Firmware (ZHxx)

ZH07 Firmware

The ZH07 firmware contains the following fixes for channel SKU's ending with SDLF1XXX-XXXX-1HA2:

- Corrected an issue where erase on super block with bad EBs end prematurely when there is a high rate of FRAME invoke activity.
- 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 Super Blocks consumption than generation.
- Corrected issue where stale reference to open Super Blocks in de-activated write stream causes read errors and FRAME invokes on certain pages of particular Super Blocks.
- Corrected issue where I/O latency is increased when drive is processing TRIM command.
- Corrected an issue where drive was sensitive to COMRESET during download command.
- Improved scheduling of recycle reads during write.
- Improved sequential read performance when data retention recycle was in progress.

ZH06 Firmware

The ZH06 firmware contains the following fixes for channel SKU's ending with SDLF1XXX-XXXX-1HA2:

- 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.
- Performance improvement that had shown excessive jitter during Random Writes.
- 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.
- Fixed an issue when running Extended DST that could cause Periodic DST to run while Extend DST was still running.
- Performance improvement: Fixed a performance issue seen when processing read commands at full performance, when the prior test involved heavy write activity.

ZH05 Firmware

This is the initial release of firmware ZH05 for channel SKU's ending with SDLF1XXX-XXXX-1HA2

- There are no known firmware issues that have been identify in ZH05

Known issues identified specifically when using an Interposer Card

Interposer Cards: LSISS 2530 and LSISS 2520

- Secure Erase – Enhanced
 - Interposers do not handle enhanced secure erase command properly
- Crypto Erase
 - Support is not available in interposers for Sanitize command

Interposer Card: LSISS 2530

- Block Erase
 - SCSI command fails.
- Note: Block Erase command does work with the LSISS 2520 card