



Intel[®] RealSense[™] D400 Series

Specification Update

Revision 009

November 2018

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Revision History

Document Number	Revision Number	Description	Revision Date
337125	001	Production Firmware 5.8.15 Release	February 2018
	002	Production Firmware 5.9.2 Release	March 2018
	003	Development Firmware 5.9.9 Release	April 2018
	004	Development Firmware 5.9.11 Release	May 2018
	005	Production Firmware 5.9.13 Release	June 2018
	006	Development Firmware 5.9.14	July 2018
	007	Development Firmware 5.10.3	August 2018
	008	Production Firmware 5.10.6	October 2018
	009	Development Firmware 5.10.13	November 2018

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1 Preface

This document is an update to the specification contained in the [Affected Documents](#) table below. This document is a compilation of device and documentation errata, specification clarifications and changes. It is intended for hardware systems manufactures and software developers of applications, systems or tools.

Information types defined in Nomenclature are consolidated into the specification updates and are no longer published in other documents.

This document may also contain information that was not previously published.

1.1 Affected Documents

Document Title	Location
Intel® RealSense™ D400 Series Product Family Datasheet	https://www.intel.com/content/www/us/en/support/articles/000026827.html

1.2 Nomenclature

Errata are design defects or errors. These may cause behavior to deviate from published specifications. Hardware and software designed to be used with any given stepping must assume that all errata documented for that stepping are present on all devices.

Specification Changes are modifications to the current published specifications. These changes will be incorporated in any new release of the specifications.

Specification Clarifications describe a specification in greater detail or further highlight a specification’s impact to a complex design situation. These clarifications will be incorporated in any new release of the specification.

Documentation Changes include typos, errors, or omissions from the current published specifications. These will be incorporated in any new release of the specification.



2 Summary Table of Changes

The following tables indicate the errata, specification changes, specification clarifications, or documentation changes which apply to the Product Name product. Intel may fix some of the errata in a future stepping of the component and account for the other outstanding issues through documentation or specification changes as noted.

2.1 Codes Used in Summary Tables

Status

- Doc: Document change or update will be implemented
- Open: In engineering assessment
- Plan Fix: This erratum may be fixed in a future firm of the product
- Fixed: This erratum has been previously fixed
- No Fix: There are no plans to fix this erratum

Table 2-1. Errata Summary Table

Number	Status	Errata
DSO-7194	Fixed in Windows 10* RS4	Windows driver [mksrv.sys] may crash with D400 series cameras in stress test condition
DSO-7755	Fixed in Development Firmware 5.9.9	Temporary stream hang observed on disabling Auto Exposure (AE) at 1280X720 resolution after any previous 90 FPS stream
DSO-7798	Fixed in Production Firmware 5.9.2	RGB at 60 FPS may not have the right exposure set when exposure is equal/less than -2
DSO-7849	Fixed in Development Firmware 5.9.9	ROI based depth streaming immediately after change of IR projector power may result in a stream hang
DSO-7854	Fixed in Production Firmware 5.9.13	Depth Stream hang when system resumes from Sleep (S3)
DSO-7976	Fixed in Production Firmware 5.9.2	D400 Series camera is not recognized after reboot on Linux
DSO-8007	Fixed in Windows Driver 5.160.1.5+	Firmware updates via DFU fails when firmware update limit is reached
DSO-8328	Fixed in Production Firmware 5.9.13	Metadata attribute "Trigger" indicating Depth to Color synchronization may not have correct value
DSO-8461	Not a RealSense bug (Requires Chrome* fix)	D400 Series Windows UWP driver does not work with Chrome browser
DSO-8467	Fixed in librealsense 2.10.1	Left Imager UYVY format displays green image

Summary Table of Changes

Number	Status	Errata
DSO-8538	Fixed in Development Firmware 5.9.11	Color correction parameters are not updated correctly
DSO-8565	No Fix (expected as per current design)	Infrared speckles on color image from D415 and D435 cameras
DSO-8665	Open	Camera "Frames did not arrive error" after improper camera shutdown
DSO-6804 DSO-8681	No Fix	D400 Series cameras intermittently enumerated as USB2 device on unplug/plug
DSO-9006	Fixed in Development Firmware 5.9.11	Frame rate does not change when manual exposure value is changed
DSO-9074	Closed. This is USB2 Bandwidth related	Simultaneous streaming Depth, Imager and Color may result in data stream hang when camera is connected through USB2
DSO-9094	Fixed in Development Firmware 5.9.11	Specific controls values missing in frames metadata
DSO-9153	Fixed in Development Firmware 5.9.11	D400 series camera fails to be recognized on system reboot when connected through USB3
DSO-9224	Fixed in Production Firmware 5.9.13	IR Projector pattern flicker when streaming through USB2 connection
DSO-9228	Fixed in Production Firmware 5.9.13	D400 series camera disconnects on resume from system sleep when connected through USB2
DSO-9240	Fixed in Production Firmware 5.9.13	D400 Series camera fails to be recognized on system reboot when connected through USB2
DSO-9478	Fixed in Production Firmware 5.10.6	Image Flicker when Auto Exposure (AE) is enabled
DSO-9501	Open	Camera is not functional after HLK Sensor test when connected through USB2
DSO-9546	Fixed in Development Firmware 5.9.14	IR projector pattern flicker when streaming at 1280X720, 4 FPS and connected through USB2
DSO-9556	Fixed in Development Firmware 5.10.3	Camera stuck after streaming start-stop at Low FPS for few times
DSO-9645	Fixed in Development Firmware 5.10.3	Darker depth frame when changing depth exposure from [165760- 165780] and connected through USB2
DSO-10002	Fixed in Development Firmware 5.10.3	Calibration tables may get corrupted during power on and off cycles
DSO-10011	No Fix	Auto Exposure (AE) for Color is not optimized for bright sunlight
DSO-10428	Open	IR Image is black in Auto Exposure (AE) mode with sudden exposure to light
DSO-10431	Open	IR image may flicker in outdoor sunlight when using Auto Exposure (AE) with default set point
DSO-10503	Open	Low fill rate in outdoor environment using Auto Exposure (AE)
DSO-10603	Open	Unable to set the Depth Exposure Time < 70 usec through USB2

Summary Table of Changes

Table 2-2. Specification Changes

Number	Specification Changes
	Development Firmware v5.10.13 adds support for Intel® RealSense™ D435i camera.

Number	Specification Changes
	Firmware v5.9.2+ adds USB 2.0 support for Intel® RealSense™ D410, D415 and D435 cameras. The USB2.0 is supported for OS Linux and Windows*10 with Intel® RealSense™ SDK 2.10.4+ To ensure the best of quality of service, connection to a dedicated USB2 root port is desired.

Table 2-3. Specification Clarifications

No.	Specification Clarifications
	<p>Firmware releases are classified as "Production" and "Development" Firmware.</p> <p>Production Firmware – Firmware version recommended for Production builds integrating Intel® RealSense™D400 Series, Remote product update and Software development.</p> <p>Development Firmware – Firmware version recommended for software developers and may contain features that have not been fully validated by Intel. The development firmware is not recommended for production builds or remote product update.</p>

Table 2-4. Documentation Changes

No.	Documentation Changes
	None for this revision of this specification update.

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3 Errata

DSO-7194	Windows driver [mksrv.sys] may crash with D400 Series camera in stress testing
Problem:	Windows driver crashes in start-stop streaming iterations. It may take hundreds of start-stop streaming iterations for failure to occur.
Implication:	D400 Series camera fails to be recognized in Windows Device Manager
Workaround:	None. To be fixed in a future Microsoft* Windows 10* release
Status:	Refer the <i>Summary Tables of Changes</i>

DSO-7755	Temporary stream hang observed on disabling Auto Exposure (AE) at 1280x720 resolution after any previous 90 FPS stream:
Problem:	Play any 90 FPS depth or left or right imager stream → stop → play 1280x720 resolution → disable Auto Exposure (AE) → the stream gets stuck for few seconds.
Implication:	Depth or left and right Imager streams are stuck for a few seconds
Workaround:	None
Status:	Refer the <i>Summary Tables of Changes</i>

DSO-7798	RGB at 60 FPS may not have the right exposure set when exposure is equal/less than -2
Problem:	Manual exposure with value equal or less than -2 may not result in right exposure.
Implication:	Depth module D415 and Depth cameras D415 and D435 with RGB sensor are affected by this issue
Workaround:	None
Status:	Refer the <i>Summary Tables of Changes</i>

DSO-7849	ROI based depth streaming immediately after change of IR projector power may result in a stream hang
Problem:	Frames do not arrive after ROI (Region of Interest) is selected to start streaming immediately after a change is made to the IR projector power.
Implication:	No depth streaming
Workaround:	Stop and Start stream again will resolve issue.
Status:	Refer the <i>Summary Tables of Changes</i>

DSO-7854	Depth Stream hang when system resumes from Sleep (S3)
Problem:	System resume from S3 does not resume depth streaming and requires application restart.

Errata

Implication:	Currently seen on Windows* only.
Workaround:	None
Status:	Refer the <i>Summary Tables of Changes</i>

DSO-7976	D400-series camera is not recognized after reboot on Linux
Problem:	Device does not appear in the device manager (lsusb)
Implication:	The frequency of the problem occurrence depends on specific Kernel version. It occurs more frequently on 4.4.0.x kernel versions and less frequently with 4.10.x kernel versions. Not seen on Windows*
Workaround:	physical-unplug-plug a camera
Status:	Refer the <i>Summary Tables of Changes</i>

DSO-8067	Firmware updates via DFU Service fails when firmware update limit is reached
Problem:	D400-series firmware update engine will allow a return to a previous version or baseline version of firmware up to 20 times unless a higher version of firmware. DFU service as part of Windows Driver package updates camera firmware when camera connected has a firmware version different than expected. The DFU service fails to function when firmware update limit of 20 is reached.
Implication:	When the firmware update limit is reached, firmware update fails even if higher firmware version. DFU service is in Windows driver package only.
Workaround:	Ensure firmware is updated to higher version before firmware update limit or avoid reaching firmware update limit
Status:	Refer the <i>Summary Tables of Changes</i>

DSO-8328	Metadata attribute "Trigger" indicating Depth to Color synchronization may not have correct value
Problem:	Trigger is a metadata field and its value indicates whether the depth and color streams are synced (1) or not (0). The value in this metadata field indicating synchronization may have the wrong value.
Implication:	D400-series cameras, D415 and D435 with color sensor
Workaround:	None
Status:	Refer the <i>Summary Tables of Changes</i>

DSO-8461	D400-Series Windows driver does not work with Chrome browser
Problem:	When Windows driver is installed on a Windows*10 system, chrome browser does not recognize D400-Series camera in chrome://settings/content/camera
Implication:	D400-series camera is recognized without Windows driver installed.
Workaround:	None
Status:	Refer the <i>Summary Tables of Changes</i>

DSO-8467	Left Imager UYVY format displays green image
Problem:	Streaming color out of left imager in UYVY format displays a green image
Implication:	RealSense Viewer displays a green image when UYVY format is selected for left imager stream
Workaround:	Select alternate format
Status:	Refer the <i>Summary Tables of Changes</i>

DSO-8538	Color correction parameters are not updated correctly
Problem:	Color correction parameters update to default values
Implication:	This issue affects color from left imager in cameras D400, D410 & D415
Workaround:	None
Status:	Refer the <i>Summary Tables of Changes</i>

DSO-8565	Infrared speckles on color image from D415 and D435 cameras
Problem:	Infrared speckles are seen on color image from D415 and D435 cameras when laser power is at maximum or closer to maximum value
Implication:	Infrared speckles reduces with distance and ambient lighting
Workaround:	Lower laser power to a value that satisfies usage.
Status:	Refer the <i>Summary Tables of Changes</i>

DSO-8665	Camera "Frames did not arrive error" after improper camera shutdown
Problem:	If the camera is improperly shutdown while streaming like in power failure or computer reset, trying to re-start camera again after power up shows "Frames did not arrive error"
Implication:	Camera cannot be restored without a physical unplug-plug or a camera hardware reset
Workaround:	Camera hardware reset to restore camera after power up
Status:	Refer the <i>Summary Tables of Changes</i>

DSO-6804 DSO-8681	D400 Series camera intermittently enumerated as USB2 device on unplug/plug
Problem:	D400-Series camera intermittently enumerates as a USB 2.0 high speed device when the camera is plugged to a USB 3.1 Gen1 port.
Implication:	The issue is seen on Windows* and Linux*. The issue is not applicable when Host to Camera connection is Type-C (Host) to Type-C (Camera)
Workaround:	Plug in to Host (USB Type A) after camera connection (Type C) or alternately physical unplug-plug a camera with different insertion speeds. Issue more likely to occur on slow plug insertion into USB 3.1 Gen1 port.

Errata

Status:	Refer the <i>Summary Tables of Changes</i>
DSO-9006	Frame rate does not change when manual exposure value is changed
Problem:	Frame rate (FPS) may need to change based on the exposure value and in some cases the FPS may not change as expected.
Implication:	Issue observed with camera D430 and D435
Workaround:	None
Status:	Refer the <i>Summary Tables of Changes</i>

DSO-9074	Simultaneous streaming Depth, Imager and Color may result in data stream hang when camera is connected through USB2
Problem:	One or two streams hangs may hang when simultaneously streaming Depth, Imager and Color data when camera is connected through USB2
Implication:	The issue is not observed when 1 or 2 data streams are simultaneously streaming. The issue is observed on Windows* and Linux*
Workaround:	None
Status:	Refer the <i>Summary Tables of Changes</i>

DSO-9094	Specific controls values missing in frames metadata
Problem:	Frames arrive without controls values in Metadata
Implication:	Missing metadata for valid frames. Issue observed in Linux*
Workaround:	None
Status:	Refer the <i>Summary Tables of Changes</i>

DSO-9153	D400-series camera fails to be recognized on system reboot when connected through USB3
Problem:	D400-Series camera may fail to be recognized on system reboot when connected through USB3
Implication:	The issue is observed on Windows*. Camera not recognized in Windows Device Manager
Workaround:	Disconnect — connect camera after system reboot
Status:	Refer the <i>Summary Tables of Changes</i>

DSO-9224	IR Projector pattern flicker when streaming through USB2 connection
Problem:	IR Projector pattern flicker maybe observed when camera is streaming through a USB2 connection
Implication:	The flicker may be observed after streaming for some time (~3 minutes) independent of resolution and frame rate. It is observed in D400-series cameras with IR projectors and on Windows* and Linux*

Workaround:	None
Status:	Refer the <i>Summary Tables of Changes</i>

DSO-9228	D400-series camera disconnects on resume from system sleep when connected through USB2
Problem:	D400-series camera may disconnect on resume from system sleep when connected through USB2.
Implication:	Application such as Intel® RealSense Viewer streaming before entering system sleep fail to function on resume from sleep as the camera may fail to be recognized. The issue is only observed on Linux* OS
Workaround:	None
Status:	Refer the <i>Summary Tables of Changes</i>

DSO-9240	D400-Series camera fails to be recognized on system reboot when connected through USB2
Problem:	D400-Series camera may fail to be recognized on system reboot when connected through USB2
Implication:	The issue is observed on Windows* and Linux*
Workaround:	Disconnect — connect camera after system reboot.
Status:	Refer the <i>Summary Tables of Changes</i>

DSO-9478	Image Flicker when Auto-Exposure (AE) is enabled
Problem:	Image flicker may be observed under certain light conditions when Auto-Exposure (AE) is enabled
Implication:	Image flicker seen on imager output streams may impact the depth stream
Workaround:	None
Status:	Refer the <i>Summary Tables of Changes</i>

DSO-9501	Camera is not functional after HLK Sensor test when connected through USB2
Problem:	Camera is not functional after HLK Sensor test when connected through USB2 (Windows HLK)
Implication:	The issue is observed on production units and not seen on pre-production samples.
Workaround:	None
Status:	Refer the <i>Summary Tables of Changes</i>

Errata

DSO-9546	IR projector pattern flicker when streaming at 1280X720, 4 FPS and connected through USB2
Problem:	IR projector pattern flicker may be observed when streaming at resolution 1280X720, 4 FPS and camera connected to a USB2 connection
Implication:	The issue is observed on Windows* and Linux*
Workaround:	None
Status:	Refer the <i>Summary Tables of Changes</i>

DSO-9556	Camera stuck after streaming start stop at Low FPS for few times
Problem:	Camera depth streams at low frame rates may be stuck after start stop streaming a few times
Implication:	The issue is observed for both, USB3 and USB2 camera connection and at 6FPS. Re-plugging the camera is required to be able to communicate with the camera again.
Workaround:	None
Status:	Refer the <i>Summary Tables of Changes</i>

DSO-9645	Darker depth frame when changing depth exposure from [165760-165780] and connected through USB2
Problem:	Darker (holes) depth frames are observed when depth exposure is changed between 165760 and 165780 range of values
Implication:	When streaming depth / IR configuration with resolutions [480x270/640x480] and [6/15/30/60] fps and camera connected through USB2
Workaround:	None
Status:	Refer the <i>Summary Tables of Changes</i>

DSO-10002	Calibration tables may get corrupted during power on and off cycles
Problem:	Power on/off cycles may cause calibration table to get corrupted
Implication:	Invalid depth stream
Workaround:	None
Status:	Refer the <i>Summary Tables of Changes</i>

DSO-10011	Auto Exposure (AE) for Color is not optimized for bright sunlight
Problem:	Auto Exposure for Color is not optimized for bright sunlight.
Implication:	Depth Cameras D415 and D435 support color through dedicated RGB sensor and are impacted by this issue. The cameras cannot be used for color in bright sunlight for use cases that require good AE-based region of interest (ROI)
Workaround:	Not to use Depth Cameras D415 and D435 for color under direct bright sunlight

Status:	Refer the <i>Summary Tables of Changes</i>
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DSO-10428	IR Image is black in Auto Exposure (AE) mode with sudden exposure to light
Problem:	When switching from no light to full outdoor sunlight in AE mode, IR image turns black
Implication:	The failure is observed with Depth Camera D415
Workaround:	None
Status:	Refer the <i>Summary Tables of Changes</i>

DSO-10431	IR image may flicker in outdoor sunlight when using Auto Exposure (AE) with default set point
Problem:	IR image flickers in outdoor sunlight when using Auto Exposure with default AE set-point (1536) and higher
Implication:	The failure is observed with Depth Camera D435
Workaround:	Change AE set-point to a value lower than default.
Status:	Refer the <i>Summary Tables of Changes</i>

DSO-10503	Low fill rate in outdoor environment using Auto Exposure (AE)
Problem:	In outdoor light condition (at shaded area), the fill rate might be lower compared to older firmware versions.
Implication:	The failure is observed with Depth Camera D435
Workaround:	None
Status:	Refer the <i>Summary Tables of Changes</i>

DSO-10603	Unable to set the Depth Exposure Time < 70 usec through USB2
Problem:	When connected through USB2, setting Depth Exposure Time less than 70 usec will result in artifacts and over-exposed frames.
Implication:	The failure is observed with Depth Camera D400 series
Workaround:	When connected through USB2, do not set Depth Exposure Time less than 70 usec
Status:	Refer the <i>Summary Tables of Changes</i>

