



# **Intel® RealSense™ D400 Series**

**Specification Update**

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***Revision 006***

***July 2018***

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## Revision History

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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

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# 1 Preface

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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	<a href="https://www.intel.com/content/www/us/en/support/articles/000026827.html">https://www.intel.com/content/www/us/en/support/articles/000026827.html</a>

## 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.

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## 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	Open	Windows driver [mskssrv.sys] may crash with D400 series cameras in stress test condition
<del>DSO-7755</del>	<del>Fixed in Development Firmware 5.9.9</del>	<del>Temporary stream hang observed on disabling Auto Exposure (AE) at 1280X720 resolution after any previous 90 FPS stream</del>
<del>DSO-7798</del>	<del>Fixed in Production Firmware 5.9.2</del>	<del>RGB at 60 FPS may not have the right exposure set when exposure is equal/less than -2</del>
<del>DSO-7849</del>	<del>Fixed in Development Firmware 5.9.9</del>	<del>ROI-based depth streaming immediately after change of IR projector power may result in a stream hang</del>
<del>DSO-7854</del>	<del>Fixed in Production Firmware 5.9.13</del>	<del>Depth Stream hang when system resumes from Sleep (S3)</del>
<del>DSO-7976</del>	<del>Fixed in Production Firmware 5.9.2</del>	<del>D400 Series camera is not recognized after reboot on Linux</del>
<del>DSO-8007</del>	<del>Fixed in Windows Driver 5.160.1.5+</del>	<del>Firmware updates via DFU fails when firmware update limit is reached</del>
<del>DSO-8328</del>	<del>Fixed in Production Firmware 5.9.13</del>	<del>Metadata attribute "Trigger" indicating Depth to Color synchronization may not have correct value</del>
DSO-8461	No Fix (Requires Chrome* fix)	D400 Series Windows UWP driver does not work with Chrome browser
<del>DSO-8467</del>	<del>Fixed in librealsense 2.10.1</del>	<del>Left Imager UYVY format displays green image</del>
<del>DSO-8538</del>	<del>Fixed in Development Firmware 5.9.11</del>	<del>Color correction parameters are not updated correctly</del>

## Summary Table of Changes

Number	Status	Errata
<del>DSO-8565</del>	No Fix (expected as per current design)	<del>Infrared speckles on color image from D415 and D435 cameras</del>
DSO-8665	Open	Camera "Frames did not arrive error" after improper camera shutdown
<del>DSO-6804</del> DSO-8681	Open	D400 Series cameras intermittently enumerated as USB2 device on unplug/plug
<del>DSO-9006</del>	Fixed in Development Firmware 5.9.11	<del>Frame rate does not change when manual exposure value is changed</del>
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
<del>DSO-9094</del>	Fixed in Development Firmware 5.9.11	<del>Specific controls values missing in frames metadata</del>
<del>DSO-9153</del>	Fixed in Development Firmware 5.9.11	<del>D400 series camera fails to be recognized on system reboot when connected through USB3</del>
<del>DSO-9224</del>	Fixed in Production Firmware 5.9.13	<del>IR Projector pattern flicker when streaming through USB2 connection</del>
<del>DSO-9228</del>	Fixed in Production Firmware 5.9.13	<del>D400 series camera disconnects on resume from system sleep when connected through USB2</del>
<del>DSO-9240</del>	Fixed in Production Firmware 5.9.13	<del>D400 Series camera fails to be recognized on system reboot when connected through USB2</del>
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	Open	Camera stuck after streaming start-stop at Low FPS for few times
DSO-9645	Open	Darker depth frame when changing depth exposure from [165760 - 165780] and connected through USB2

**Table 2-2. Specification Changes**

Number	Specification Changes
	Development Firmware v5.9.14 adds hardware sync feature support for multi-camera configuration. This is currently supported for Intel® RealSense™ Depth Camera D415. For details on multi camera hardware synchronization, please refer to "Multiple Camera Whitepaper" at <a href="https://realsense.intel.com/intel-realsense-downloads/#whitepaper">https://realsense.intel.com/intel-realsense-downloads/#whitepaper</a> . Intel® RealSense™ Depth Camera D435 will have hardware sync. feature enabled in future version of firmware.

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><b>Production Firmware</b> – Firmware version recommended for Production builds integrating Intel® RealSense™D400 Series, Remote product update and Software development.</p> <p><b>Development Firmware</b> – 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

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

<b>DSO-7755</b>	<b><del>Temporary stream hang observed on disabling Auto Exposure (AE) at 1280X720 resolution after any previous 90 FPS stream.</del></b>
<b>Problem:</b>	<del>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.</del>
<b>Implication:</b>	<del>Depth or left and right Imager streams are stuck for a few seconds</del>
<b>Workaround:</b>	<del>None</del>
<b>Status:</b>	<del>Refer the <i>Summary Tables of Changes</i></del>

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

<b>DSO-7849</b>	<b><del>ROI based depth streaming immediately after change of IR projector power may result in a stream hang</del></b>
<b>Problem:</b>	<del>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.</del>
<b>Implication:</b>	<del>No depth streaming</del>
<b>Workaround:</b>	<del>Stop and Start stream again will resolve issue.</del>
<b>Status:</b>	<del>Refer the <i>Summary Tables of Changes</i></del>

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

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

<b>DSO-7976</b>	<b>D400-series-camera-is-not-recognized-after-reboot-on-Linux</b>
<b>Problem:</b>	Device does not appear in the device manager (lsusb)
<b>Implication:</b>	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*
<b>Workaround:</b>	physical-unplug-plug-a-camera
<b>Status:</b>	Refer the <i>Summary Tables of Changes</i>

<b>DSO-8007</b>	<b>Firmware-updates-via-DFU-Service-fails-when-firmware-update-limit-is-reached</b>
<b>Problem:</b>	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.
<b>Implication:</b>	When the firmware update limit is reached, firmware update fails even if higher firmware version. DFU service is in Windows driver package only.
<b>Workaround:</b>	Ensure firmware is updated to higher version before firmware update limit or avoid reaching firmware update limit
<b>Status:</b>	Refer the <i>Summary Tables of Changes</i>

<b>DSO-8328</b>	<b>Metadata-attribute-“Trigger”-indicating-Depth-to-Color-synchronization-may-not-have-correct-value</b>
<b>Problem:</b>	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.
<b>Implication:</b>	D400-series cameras, D415 and D435 with color sensor
<b>Workaround:</b>	None
<b>Status:</b>	Refer the <i>Summary Tables of Changes</i>

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

## Errata

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

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

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

<b>DSO-8665</b>	<b>Camera "Frames did not arrive error" after improper camera shutdown</b>
<b>Problem:</b>	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"
<b>Implication:</b>	Camera cannot be restored without a physical unplug-plug or a camera hardware reset
<b>Workaround:</b>	Camera hardware reset to restore camera after power up
<b>Status:</b>	Refer the <i>Summary Tables of Changes</i>

<b>DSO-6804 DSO-8681</b>	<b>D400 Series camera intermittently enumerated as USB2 device on unplug/plug</b>
<b>Problem:</b>	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.
<b>Implication:</b>	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)
<b>Workaround:</b>	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.

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

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

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

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

<b>DSO-9224</b>	<b><del>IR-Projector pattern flicker when streaming through USB2 connection</del></b>
<b>Problem:</b>	IR-Projector pattern flicker maybe observed when camera is streaming through a USB2 connection
<b>Implication:</b>	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*

## Errata

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

<b>DSO-9228</b>	<b><del>D400-series camera disconnects on resume from system sleep when connected through USB2</del></b>
<b>Problem:</b>	D400-series camera may disconnect on resume from system sleep when connected through USB2.
<b>Implication:</b>	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
<b>Workaround:</b>	None
<b>Status:</b>	Refer the <i>Summary Tables of Changes</i>

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

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

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

<b>DSO-9556</b>	<b>Camera stuck after streaming start-stop at Low FPS for few times</b>
<b>Problem:</b>	Camera depth streams at low frame rates may be stuck after start-stop streaming a few times
<b>Implication:</b>	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.
<b>Workaround:</b>	None
<b>Status:</b>	Refer the <i>Summary Tables of Changes</i>

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

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