

Dell Latitude 5424 Rugged

Service Manual



Notes, cautions, and warnings

 **NOTE:** A NOTE indicates important information that helps you make better use of your product.

 **CAUTION:** A CAUTION indicates either potential damage to hardware or loss of data and tells you how to avoid the problem.

 **WARNING:** A WARNING indicates a potential for property damage, personal injury, or death.

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Working on your computer

Topics:

- Safety instructions
- Before working inside your computer
- Safety precautions
- Electrostatic discharge—ESD protection
- ESD field service kit
- Transporting sensitive components
- After working inside your computer

Safety instructions

Use the following safety guidelines to protect your computer from potential damage and to ensure your personal safety. Unless otherwise noted, each procedure included in this document assumes that you have read the safety information that shipped with your computer.

 **WARNING:** Before working inside your computer, read the safety information that is shipped with your computer. For more safety best practices, see the Regulatory Compliance home page at www.dell.com/regulatory_compliance.

 **WARNING:** Disconnect your computer from all power sources before opening the computer cover or panels. After you finish working inside the computer, replace all covers, panels, and screws before connecting your computer to an electrical outlet.

 **CAUTION:** To avoid damaging the computer, ensure that the work surface is flat, dry, and clean.

 **CAUTION:** To avoid damaging the components and cards, handle them by their edges, and avoid touching the pins and the contacts.

 **CAUTION:** You should only perform troubleshooting and repairs as authorized or directed by the Dell technical assistance team. Damage due to servicing that is not authorized by Dell is not covered by your warranty. See the safety instructions that is shipped with the product or at www.dell.com/regulatory_compliance.

 **CAUTION:** Before touching anything inside your computer, ground yourself by touching an unpainted metal surface, such as the metal at the back of the computer. While you work, periodically touch an unpainted metal surface to dissipate static electricity which could harm internal components.

 **CAUTION:** When you disconnect a cable, pull it by its connector or its pull tab, not the cable itself. Some cables have connectors with locking tabs or thumbscrews that you must disengage before disconnecting the cable. When disconnecting cables, keep them evenly aligned to avoid bending the connector pins. When connecting cables, ensure that the ports and the connectors are correctly oriented and aligned.

 **CAUTION:** Press and eject any installed card from the media-card reader.

 **CAUTION:** Exercise caution when handling Lithium-ion batteries in laptops. Swollen batteries should not be used and should be replaced and disposed properly.

 **NOTE:** The color of your computer and certain components may appear differently than shown in this document.

Before working inside your computer

1. Ensure that your work surface is flat and clean to prevent the computer cover from being scratched.
2. Turn off your computer.
3. If the computer is connected to a docking device (docked), undock it.
4. Disconnect all network cables from the computer (if available).

 **CAUTION: If your computer has an RJ45 port, disconnect the network cable by first unplugging the cable from your computer.**

5. Disconnect your computer and all attached devices from their electrical outlets.
6. Open the display.
7. Press and hold the power button for few seconds, to ground the system board.

 **CAUTION: To guard against electrical shock unplug your computer from the electrical outlet before performing Step # 8.**

 **CAUTION: To avoid electrostatic discharge, ground yourself by using a wrist grounding strap or by periodically touching an unpainted metal surface at the same time as touching a connector on the back of the computer.**

8. Remove any installed ExpressCards or Smart Cards from the appropriate slots.

Safety precautions

The safety precautions chapter details the primary steps to be taken before performing any disassembly instructions.

Observe the following safety precautions before you perform any installation or break/fix procedures involving disassembly or reassembly:

- Turn off the system and all attached peripherals.
- Disconnect the system and all attached peripherals from AC power.
- Disconnect all network cables, telephone, and telecommunications lines from the system.
- Use an ESD field service kit when working inside any notebook to avoid electrostatic discharge (ESD) damage.
- After removing any system component, carefully place the removed component on an anti-static mat.
- Wear shoes with non-conductive rubber soles to reduce the chance of getting electrocuted.

Standby power

Dell products with standby power must be unplugged before you open the case. Systems that incorporate standby power are essentially powered while turned off. The internal power enables the system to be remotely turned on (wake on LAN) and suspended into a sleep mode and has other advanced power management features.

Unplugging, pressing and holding the power button for 20 seconds should discharge residual power in the system board. Remove the battery from notebooks.

Bonding

Bonding is a method for connecting two or more grounding conductors to the same electrical potential. This is done through the use of a field service electrostatic discharge (ESD) kit. When connecting a bonding wire, ensure that it is connected to bare metal and never to a painted or non-metal surface. The wrist strap should be secure and in full contact with your skin, and ensure that you remove all jewelry such as watches, bracelets, or rings prior to bonding yourself and the equipment.

Electrostatic discharge—ESD protection

ESD is a major concern when you handle electronic components, especially sensitive components such as expansion cards, processors, memory DIMMs, and system boards. Very slight charges can damage circuits in ways that may not be obvious, such

as intermittent problems or a shortened product life span. As the industry pushes for lower power requirements and increased density, ESD protection is an increasing concern.

Due to the increased density of semiconductors used in recent Dell products, the sensitivity to static damage is now higher than in previous Dell products. For this reason, some previously approved methods of handling parts are no longer applicable.

Two recognized types of ESD damage are catastrophic and intermittent failures.

- **Catastrophic** – Catastrophic failures represent approximately 20 percent of ESD-related failures. The damage causes an immediate and complete loss of device functionality. An example of catastrophic failure is a memory DIMM that has received a static shock and immediately generates a "No POST/No Video" symptom with a beep code emitted for missing or nonfunctional memory.
- **Intermittent** – Intermittent failures represent approximately 80 percent of ESD-related failures. The high rate of intermittent failures means that most of the time when damage occurs, it is not immediately recognizable. The DIMM receives a static shock, but the tracing is merely weakened and does not immediately produce outward symptoms related to the damage. The weakened trace may take weeks or months to melt, and in the meantime may cause degradation of memory integrity, intermittent memory errors, etc.

The more difficult type of damage to recognize and troubleshoot is the intermittent (also called latent or "walking wounded") failure.

Perform the following steps to prevent ESD damage:

- Use a wired ESD wrist strap that is properly grounded. The use of wireless anti-static straps is no longer allowed; they do not provide adequate protection. Touching the chassis before handling parts does not ensure adequate ESD protection on parts with increased sensitivity to ESD damage.
- Handle all static-sensitive components in a static-safe area. If possible, use anti-static floor pads and workbench pads.
- When unpacking a static-sensitive component from its shipping carton, do not remove the component from the anti-static packing material until you are ready to install the component. Before unwrapping the anti-static packaging, ensure that you discharge static electricity from your body.
- Before transporting a static-sensitive component, place it in an anti-static container or packaging.

ESD field service kit

The unmonitored Field Service kit is the most commonly used service kit. Each Field Service kit includes three main components: anti-static mat, wrist strap, and bonding wire.

Components of an ESD field service kit

The components of an ESD field service kit are:

- **Anti-Static Mat** – The anti-static mat is dissipative and parts can be placed on it during service procedures. When using an anti-static mat, your wrist strap should be snug and the bonding wire should be connected to the mat and to any bare metal on the system being worked on. Once deployed properly, service parts can be removed from the ESD bag and placed directly on the mat. ESD-sensitive items are safe in your hand, on the ESD mat, in the system, or inside a bag.
- **Wrist Strap and Bonding Wire** – The wrist strap and bonding wire can be either directly connected between your wrist and bare metal on the hardware if the ESD mat is not required, or connected to the anti-static mat to protect hardware that is temporarily placed on the mat. The physical connection of the wrist strap and bonding wire between your skin, the ESD mat, and the hardware is known as bonding. Use only Field Service kits with a wrist strap, mat, and bonding wire. Never use wireless wrist straps. Always be aware that the internal wires of a wrist strap are prone to damage from normal wear and tear, and must be checked regularly with a wrist strap tester in order to avoid accidental ESD hardware damage. It is recommended to test the wrist strap and bonding wire at least once per week.
- **ESD Wrist Strap Tester** – The wires inside of an ESD strap are prone to damage over time. When using an unmonitored kit, it is a best practice to regularly test the strap prior to each service call, and at a minimum, test once per week. A wrist strap tester is the best method for doing this test. If you do not have your own wrist strap tester, check with your regional office to find out if they have one. To perform the test, plug the wrist-strap's bonding-wire into the tester while it is strapped to your wrist and push the button to test. A green LED is lit if the test is successful; a red LED is lit and an alarm sounds if the test fails.
- **Insulator Elements** – It is critical to keep ESD sensitive devices, such as plastic heat sink casings, away from internal parts that are insulators and often highly charged.
- **Working Environment** – Before deploying the ESD Field Service kit, assess the situation at the customer location. For example, deploying the kit for a server environment is different than for a desktop or portable environment. Servers are typically installed in a rack within a data center; desktops or portables are typically placed on office desks or cubicles. Always look for a large open flat work area that is free of clutter and large enough to deploy the ESD kit with additional space to accommodate the type of system that is being repaired. The workspace should also be free of insulators that can cause an

ESD event. On the work area, insulators such as Styrofoam and other plastics should always be moved at least 12 inches or 30 centimeters away from sensitive parts before physically handling any hardware components

- **ESD Packaging** – All ESD-sensitive devices must be shipped and received in static-safe packaging. Metal, static-shielded bags are preferred. However, you should always return the damaged part using the same ESD bag and packaging that the new part arrived in. The ESD bag should be folded over and taped shut and all the same foam packing material should be used in the original box that the new part arrived in. ESD-sensitive devices should be removed from packaging only at an ESD-protected work surface, and parts should never be placed on top of the ESD bag because only the inside of the bag is shielded. Always place parts in your hand, on the ESD mat, in the system, or inside an anti-static bag.
- **Transporting Sensitive Components** – When transporting ESD sensitive components such as replacement parts or parts to be returned to Dell, it is critical to place these parts in anti-static bags for safe transport.

ESD protection summary

It is recommended that all field service technicians use the traditional wired ESD grounding wrist strap and protective anti-static mat at all times when servicing Dell products. In addition, it is critical that technicians keep sensitive parts separate from all insulator parts while performing service and that they use anti-static bags for transporting sensitive components.

Transporting sensitive components

When transporting ESD sensitive components such as replacement parts or parts to be returned to Dell, it is critical to place these parts in anti-static bags for safe transport.

After working inside your computer

After you complete any replacement procedure, ensure that you connect external devices, cards, and cables before turning on your computer.

 **CAUTION: To avoid damage to the computer, use only the battery designed for this particular Dell computer. Do not use batteries designed for other Dell computers.**

1. Connect any external devices, such as a port replicator or media base, and replace any cards, such as an ExpressCard.
2. Connect any telephone or network cables to your computer.

 **CAUTION: To connect a network cable, first plug the cable into the network device and then plug it into the computer.**

3. Connect your computer and all attached devices to their electrical outlets.
4. Turn on your computer.

Technology and components

This chapter details the technology and components available in the system.

Topics:

- Using your computer
- AC-DC Adapters
- Battery
- Processors
- Memory features
- Graphics options
- Corning Gorilla Glass
- Pen Usage
- Optical Disk Drive
- Media Card Readers
- UEFI BIOS
- Systems management - From on-premises to the cloud
- Trusted Platform Module
- Fingerprint Reader
- USB features
- USB Powershare
- USB Type-C
- Ethernet
- HDMI 2.0

Using your computer

Open the LCD Lid



1. Press LCD latch located on the bottom chassis.
2. Lift the LCD lid at an convenient viewing angle.

NOTE: Laptops are designed to allow LCD lid movement to a maximum of 180°, however lid should not be opened more than 140°, if the rear I/O ports are in use or when docked.

Stealth mode

Latitude rugged products come equipped with a stealth mode feature. Stealth mode allows you to turn off the display, all the LED lights, internal speakers, the fan and all wireless radios with a single key combination.

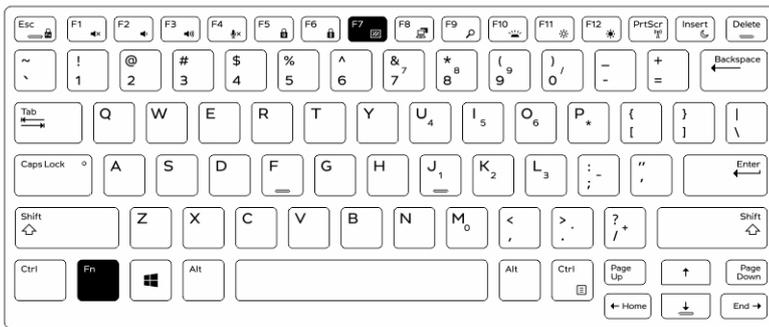
NOTE: This mode is aimed at using the computer in covert operations. When the stealth mode is enabled, the computer remains functional but does not emit any light or sound.

Turning stealth mode on/off

1. Press the Fn+F7 key combination (Fn key not needed if Fn lock is enabled) to turn on stealth mode.

NOTE: Stealth mode is a secondary function of the F7 key. The key can be used to perform other functions on the computer when not used with the Fn key to enable stealth mode.

2. All the lights and sounds are turned off.
3. Press the Fn+F7 key combination again to turn off the stealth mode.



Disabling stealth mode in the system setup (BIOS)

1. Power off the computer.
2. Power on the computer and at the Dell logo, tap the F2 key repeatedly to bring up the **System Setup** menu.
3. Expand and open the **System Configuration** menu.
4. Select **Stealth Mode Control**.

NOTE: Stealth mode is enabled by default.

5. To disable stealth mode uncheck the **Enable Stealth Mode** option.
6. Click **Apply changes** and click **Exit**.

Using the backlit keyboard

The Latitude rugged series comes equipped with a backlit keyboard that can be customized. The following colors are enabled:

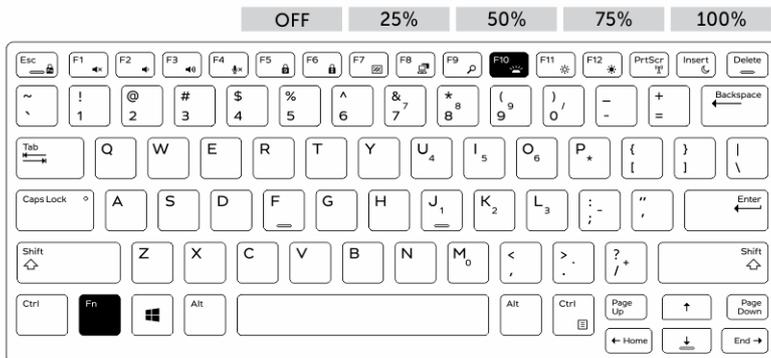
1. White
2. Red
3. Green
4. Blue

Alternatively, the system can be configured with two additional custom colors in the System Setup (BIOS).

Turning the keyboard backlight on/off or adjusting brightness

To turn the backlight on/off or adjust the backlight brightness settings:

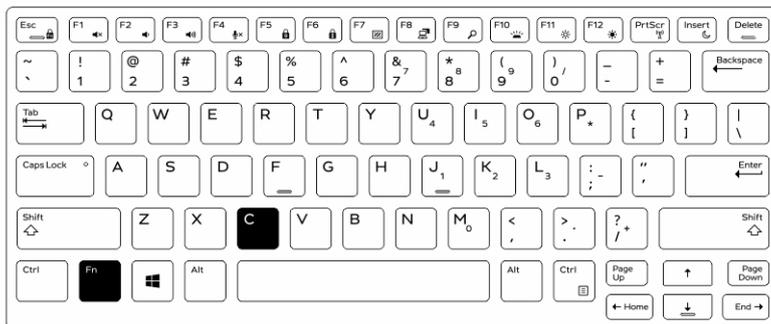
1. To initialize the keyboard backlight switch, press Fn+F10 (the Fn key is not needed if function key Fn lock is enabled).
2. The first use of the preceding key combination turns on the backlight to its lowest setting.
3. Repeated pressing of the key combinations cycles the brightness settings through 25 percent, 50 percent, 75 percent and 100 percent.
4. Cycle through the key combination to either adjust the brightness or turn off the keyboard backlight.



Changing the keyboard backlight color

To change the keyboard backlight color:

1. To cycle through the available backlight colors press Fn+C keys .
2. White, Red, Green and Blue are active by default; up to two custom colors can be added to the cycle in the System Setup (BIOS).



Customizing the backlit keyboard in System Setup (BIOS)

1. Turn off the computer.
2. Turn on the computer and when the Dell logo appears, press the F2 key repeatedly to bring up the System Setup menu.
3. Under **System Configuration** menu, select **RGB Keyboard Backlight**.
You can enable/disable the standard colors (White, Red, Green and Blue).
4. To set a custom RGB value, use the input boxes on the right side of the screen.
5. Click **Apply changes** and click **Exit** to close System Setup.

Function Fn key lock features

NOTE: The keyboard has Function key Fn lock capability. When activated, the secondary functions on the top row of keys become default and will not require use of the Fn key.

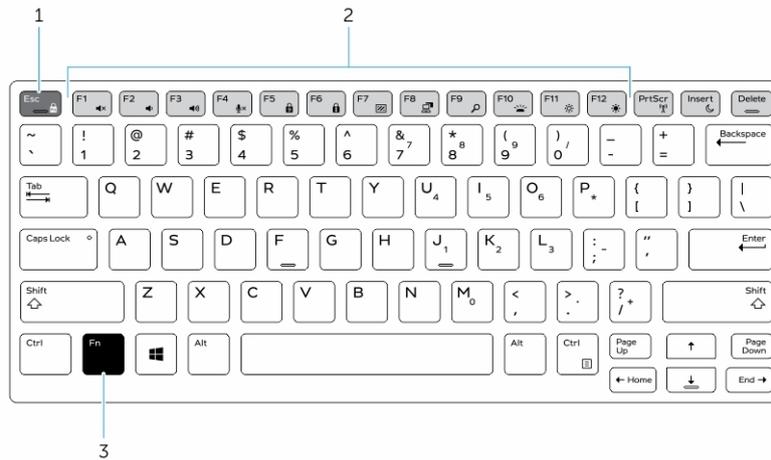


Figure 1. Fn key callouts

1. Fn lock key
2. Affected Fn keys
3. Fn key

NOTE: Fn lock affects only the above keys (F1 to F12). Secondary functions will not require the Fn key to be pressed while enabled.

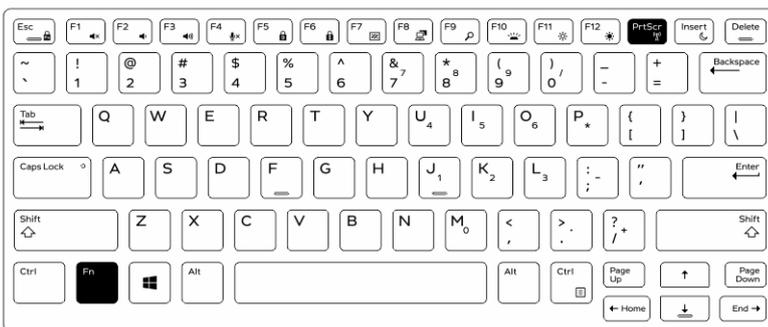
Enabling the Function (Fn) lock

1. Press the Fn+Esc keys.

NOTE: Other secondary function keys on the top row are not affected and requires the use of the Fn key.
2. Press the Fn+Esc keys again to deactivate the function lock feature. The function keys return to the default actions.

Enabling and disabling the wireless (WiFi) feature

1. To enable wireless Networking, press Fn + PrtScr.
2. Press Fn + PrtScr again to disable wireless Networking.



Hot key definition

Fn behavior: Primary behavior is media key; Secondary behavior is F1-F12 key.

- Fn Lock only switches primary and secondary behavior on F1-F12.
- F7 is stealth –unique for rugged and semi rugged platforms. It turns off LCD, all wireless, all alerts, indicator lights, sound, fan, etc

Table 1. Keyboard shortcuts

Hot keys	Function	Description
Fn+ESC	Fn Lock	Allows the user to toggle between locked and unlocked Fn keys.
Fn+F1	Audio Volume Mute	Temporarily mutes/unmutes the audio. The audio level before muting is returned after unmuting.
Fn+F2	Audio Volume Down/Decrease	Decreases the audio volume until minimum/off is reached.
Fn+F3	Audio Volume Up/Increase	Increases the audio volume until maximum is reached.
Fn+F4	Microphone Mute	Silences the on-board microphone so it cannot record audio. There is an LED on the F4 function key that notifies the user of the state of this feature: <ul style="list-style-type: none"> • LED off = microphone capable of recording audio • LED on = microphone muted and unable to record audio
Fn+F5	Num lock	Allows the user to toggle between locked and unlocked NumLock
Fn+F6	Scroll lock	Used as Scroll Lock key.
Fn+F7	Stealth Mode	Allows the user to toggle to and from Stealth Mode
Fn+F8	LCD and Projector display	Determines video output to LCD and external Video devices when attached and displays present.
Fn+F9	Search	Mimics the Windows key + F keystroke to open Windows Search dialog box.
Fn+F10	KB Illumination/Backlight	Determines the Keyboard Illumination/Backlight brightness level. The hot key cycles through the following brightness states when pressed: Disabled, Dim, Bright. For more detail, see Keyboard Illumination/Backlight section.
Fn+F11	Brightness Decrease	Decreases the stepping of LCD brightness for each press until minimum is reached. For details, see the LCD Brightness section.
Fn+F12	Brightness Increase	Increases the stepping of LCD brightness for each press until maximum is reached. For details, see the LCD Brightness section.
Fn+PrintScreen	Radio On/Off	Toggles all the wireless radios on and off. For example, WLAN, WWAN, and Bluetooth.

Table 1. Keyboard shortcuts (continued)

Hot keys	Function	Description
Fn+Insert	Sleep	Puts the system into the ACPI S3 State and does not wake the system.

Traditional programming functions like Scroll Lock are assigned to alpha keys with un-printed legends.

- **Fn+S** = Scroll Lock
- **Fn+B** = Pause
- **Fn+Ctrl+B** = Break
- **Fn+R** = Sys-Req

 **NOTE:** For non-backlit keyboards F10 has no function and icon on function key is purged.

AC-DC Adapters



There are a two types of AC adapters offered for this platform:

- 90W 3-Pin
- 130W 3-Pin
- When you disconnect the AC adapter cable from the computer, grasp the connector, not the cable itself, and then pull firmly but gently to avoid damaging the cable.
- The AC adapter works with electrical outlets worldwide. However, power connectors and power strips vary among countries. Using an incompatible cable or improperly connecting the cable to the power strip or electrical outlet may cause fire or equipment damage.

How to check the status of AC Adapter in BIOS?

1. Restart / Power on your computer.
2. At the first text on the screen or when the Dell logo appears, tap <F2> until the message **Entering Setup** appears.
3. Under **General > Battery Information**, you will see **AC Adapter** listed.
4. The **status** shows the **wattage** of the AC adapter connected. Any errors detected with the AC adapter or the DC-In connector will be displayed here.

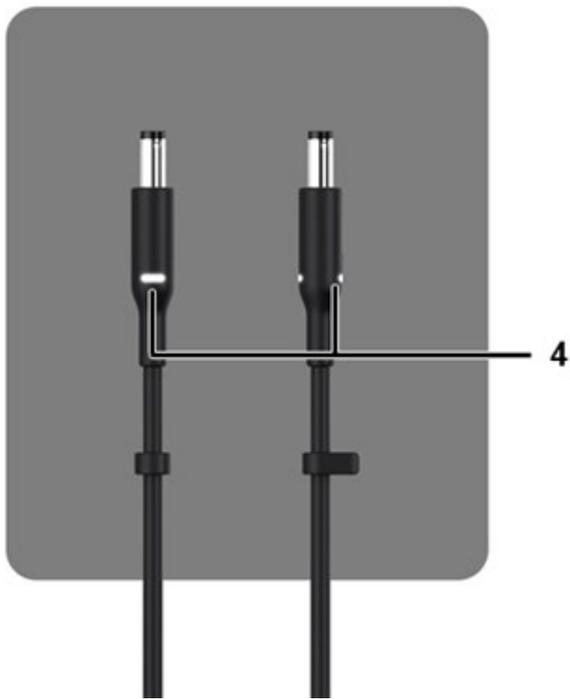
90W



130W



LED and Cable



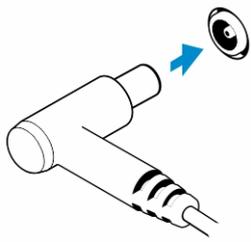


Table 2. Adapter Features

Features	
1	Body shape creates a smooth base for cable wrapping.
2	Cable lock on cord for securing cable wrap.
3	90° strain relief directs the cable out the side of the adapter.
4	Adapter LED is implemented in two spots on opposite sides of the plug head. The LED illumination will be white.

Battery

Dell Latitude Rugged use the following 3-cell battery options:

- 3-cell 51 Whr (ExpressCharge)
- 3-cell 51 Whr (Long-Life Cycle, includes 3 year limited warranty)

The battery is located on the bottom of the system and is hot swap capable. This design is unlike any other Dell predecessors laptops, where system needs to be powered off when the battery is removed, without the need to remove the bottom cover.

(i) NOTE: Battery is categorized as a CRU (Customer Replaceable Unit) on this platform.

(i) NOTE: Battery typically requires about 2 hours to fully charge.

Battery Specifications

What is ExpressCharge ?

For a system advertised as having the ExpressCharge feature, the battery typically will have greater than 80% charge after about an hour of charging with the system off and fully charged in about 2 hours with the system off.

Enabling Expresscharge requires that both the system and the battery that is used on the system be ExpressCharge capable. If any of the above requirements is missing, ExpressCharge will not be enabled.

What is BATTMAN?

BATTMAN is a computer controlled battery manager intended for typical rechargeable batteries. It has the following capabilities:

- Monitors self-discharge
- Measures internal resistance
- Automatically performs repeated discharge/charge cycles to break in new batteries
- Keeps a log of all operations performed, which can be imported
- Connects via parallel port to any PC running Microsoft Windows
- Operating software, complete with source code, is available to download

Processors

This laptop is shipped with the following Intel 6th generation i5 SkyLake or 7th and 8th Generation KabyLake processors:

- Intel Core i3, 7130U KabyLake processor
- Intel Core i5, 8350U KabyLake or 6300U SkyLake processors
- Intel Core i7, 8650U KabyLake processor series

NOTE: The clock speed and performance varies depending on the workload and other variables.

Skylake processor

Intel Skylake is the successor to the Intel Broadwell processor. It is a micro-architecture redesign using an already existing process technology and it will be branded as Intel 6th Gen Core. Like Broadwell, Skylake is available in four variants with suffixes SKL-Y, SKL-H, and SKL-U.

The Skylake also includes Core i7, i5, i3, Pentium and Celeron processors.

Skylake vs Broadwell roadmap

The following illustration is a roadmap comparison between the Skylake processor vs the Broadwell processor:

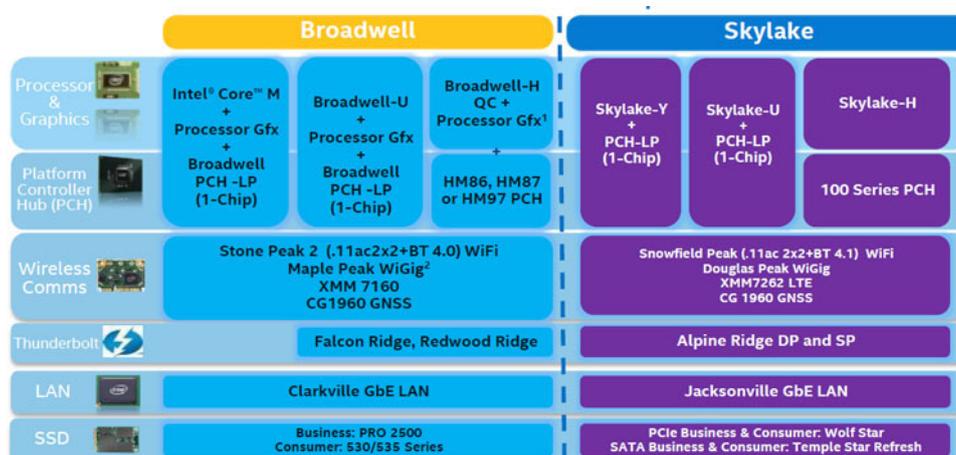


Figure 2. Skylake vs Broadwell roadmap

Processor performance features

The following table illustrates the performance available on each Skylake suffix.

Table 3. Performance features

Feature	Feature description	SKL-Y	SKL-U	SKL-H
General Features	Cores	Dual Core	Dual Core	Dual Core
	CPU/Memory/Graphic Overclocking	No	No	Yes
	Intel Extreme Tuning Utility	No	No	Yes
	Intel Hyper-Threading Technology	Yes	Yes	Yes
	Intel Smart Cache Technology with last level cache (LLC) sharing between Processor and GFx cores	Yes	Yes	Yes

Table 3. Performance features (continued)

Feature	Feature description	SKL-Y	SKL-U	SKL-H
	Intel Smart Sound Technology	Yes	Yes	Yes
	Intel Turbo Boost Technology 2.0	Yes	Yes	Yes
	Last Level Cache (LLC)	Up to 4M	Up to 4M	Up to 4M
	Voltage Optimizer	Yes	TBD	TBD
Display	3 Independent Display Support	Yes	Yes	Yes
	HDMI 2.0 Display @60Hz	3840x2160	3840x2160	3840x2160
	DP/eDP Display @60Hz	3840x2160	4096x2304	4096x2304
	eDP 1.3, support for MPO, NV12	Yes	Yes	Yes
Media	Intel Built-In Visuals	Yes	Yes	Yes
Compute	OpenCL 2.0	Yes	No	yes
Platform Hardware	14nm process	Yes	Yes	Yes
	16PCIe Graphic lanes (configurable as 1x16 or 2x8 or 1x8+2x4)	No	No	Yes
	PCIe Gen3.0 support	No	No	Yes
	Switchable graphics (muxless solution)	No	Yes	Yes
Memory	Memory Type	DDR4	DDR4	DDR4
	Connector / Memory Down	Memory down	SODIMM	SODIMM
	Speed	2133MT/s for DDR4	2133MT/s for DDR4	2133MT/s for DDR4
	Max Capacity	32 GB	32 GB	32 GB
OS Support	Windows 11 (64-bit)	Yes	Yes	Yes
	Windows 10 (64-bit)	Yes	Yes	Yes
	Windows 7 (64-bit / 32bit)	Yes	Yes	Yes
	Windows 8.1 (64-bit)	Yes	Yes	Yes
	Linux (kernel and associated modules)	Yes	Yes	Yes
	Chrome	Yes	Yes	No
	Android	No	No	No

General comparison with Broadwell processor

	Broadwell Platform Features	Skylake Platform Features
Performance	Improved CPU & Graphics performance (upto 50%) with significant power reduction (upto 40% lower SOC power) and longer battery life ¹	Improved CPU & Graphics performance (upto 50%) with significant power reduction (upto 60% lower SOC power) and longer battery life ¹
Thermals	H: 47W ² , U: 28W ² , U: 15W ² , Y: 4.5W ² TDP Configurable TDP ³ , Low Power Mode ³	H: 45W ² and 35W, U: 28W ² , U: 15W ² , Y: 4.5W ² TDP Configurable TDP ³ , Low Power Mode ³
Graphics	Gen8, DX11.1, Open CL 1.2/2.0 ⁴ , Open GL 4.x, PCIe3.0	Gen9 LP, DX11.3, DX12, Open CL 1.2/2.0 ⁴ , Open GL 4.3/4.4, PCIe3.0
Media	Faster AVC and MPEG-2 with full HW encode; VP8 Encode (GPU), VP8 Decode, VP9 Decode (GPU), HEVC Decode; Intel [®] Quick Sync Video; 3 simultaneous Displays,	VP8 Encode, VP8 Decode, VP9 Decode (GPU), VP9 Encode (GPU), HEVC 8b Decode; HEVC 8b Encode, VDENC, SFC Intel [®] Quick Sync Video; 3 simultaneous Displays
Audio	Intel [®] Smart Sound Technology ⁵	Enhanced Intel [®] Smart Sound Technology, GMM HW accelerated Speech, Enhanced Audio Pre and Post Processing, Enhanced Intel [®] Wake on Voice
2D Camera Imaging	Discrete ISP in camera module	Integrated ISP ^{6,7} , supporting upto 16MP, 4K@30fps, 1080p@60fps
RealSense 3D Cameras	Intel [®] RealSense F200 (UF Camera)	Intel [®] RealSense R200 (WF camera) ⁸ , Intel [®] RealSense F200 (UF Camera)
I/O & Storage	USB 3.0 ⁹ , Thunderbolt™ Technology ⁹	PCIe Gen3.0 (U and Y), eMMC5.0 ⁴ , SDXC3.0, USB OTG ¹⁰ , CSI2 MIPI, USB 3.0 ⁹ , Thunderbolt™ Technology ⁹
Touch and Sensing	Discrete Touch, Discrete Sensor Hub controllers on platform	Integrated Touch ¹¹ processing, Intel [®] Integrated Sensor Solution
Wireless	High Bandwidth 802.11 ac, WiGig ⁴ , Cat4 LTE, Intel [®] Wireless Display 5.0 ⁴ , GNSS, NFC	High Bandwidth 802.11 ac, WiGig ⁴ , Cat6 LTE, Intel [®] Wireless Display 6.0 ⁴ Wireless Charging, GNSS, NFC
Security	McAfee YAP, Boot Guard, Intel [®] PTT 2.0 ³ , Intel [®] IPT ³ , Intel [®] BIOS Guard v2.0 ³ , Anti-malware Boost (Beacon Pass 2.0) ⁷	McAfee YAP w/ Intel [®] SGX, IPT with MFA Boot Guard, Intel [®] PTT 3.0 ³ , Intel [®] IPT ³ , Intel [®] BIOS Guard v2.0 ³
Enterprise/SMB	Intel [®] vPro™ Technology w/ AMT 10.0, Intel [®] Small Business Advantage 3.0, Intel [®] vPro™ w/ Windows® 8.1 InstantGo™, Intel [®] Pro WiDi 5.1	Intel [®] vPro™ Technology w/ AMT 11.0, Small Business Advantage SBA Next Intel [®] Pro WiDi 6.0, Secure LBS

Figure 3. Comparison with Broadwell processor

Kaby Lake — 7th and 8th Generation Intel Core processors

The 7th and 8th Gen Intel Core processor (Kaby Lake) family is the successor of Sky Lake R. It's main features include:

- Intel 14nm Manufacturing Process Technology
- Intel Turbo Boost Technology
- Intel Hyper Threading Technology
- Intel Built-in Visuals
 - Intel HD graphics - exceptional videos, editing smallest details in the videos
 - Intel Quick Sync Video - excellent video conferencing capability, quick video editing and authoring
 - Intel Clear Video HD - visual quality and color fidelity enhancements for HD playback and immersing web browsing
- Integrated memory controller
- Intel Smart Cache
- Optional Intel vPro technology (on i5/i7) with Active Management Technology 11.6
- Intel Rapid Storage Technology

Table 4. Kaby lake specifications

Processor number	Base Clock Speed	Cache	No. of cores/ No. of threads	Power	Memory type	Graphics
Intel Dual Core i3-7130U	2.7 GHz	3 MB	2/4	15 W	DDR4-2400	Intel HD graphics 620
Intel Quad Core i5-8350U	1.7 GHz	6 MB	4/8	15 W	DDR4-2400	Intel UHD graphics 620
Intel Quad-Core i7-8650U	1.9 GHz	8 MB	4/8	15 W	DDR4-2400	Intel UHD graphics 620

Memory features

This laptop supports 4–32 GB DDR4 SDRAM memory, up to 2400 MHz on KabyLake processors and 2133 MHz on SkyLake processors.

DDR4

DDR4 (Double Data Rate fourth generation) memory is a higher-speed successor to the DDR2 and DDR3 technologies and allows up to 512 GB in capacity, compared to the DDR3's maximum of 128 GB per DIMM. DDR4 synchronous dynamic random-access memory is keyed differently from both SDRAM and DDR to prevent the user from installing the wrong type of memory into the system.

DDR4 needs 20 percent less or just 1.2 volts, compared to DDR3 which requires 1.5 volts of electrical power to operate. DDR4 also supports a new, deep power-down mode that allows the host device to go into standby without needing to refresh its memory. Deep power-down mode is expected to reduce standby power consumption by 40 to 50 percent.

DDR4 Details

There are subtle differences between DDR3 and DDR4 memory modules, as listed below:

Key notch difference

The key notch on a DDR4 module is in a different location from the key notch on a DDR3 module. Both notches are on the insertion edge but the notch location on the DDR4 is slightly different, to prevent the module from being installed into an incompatible board or platform.

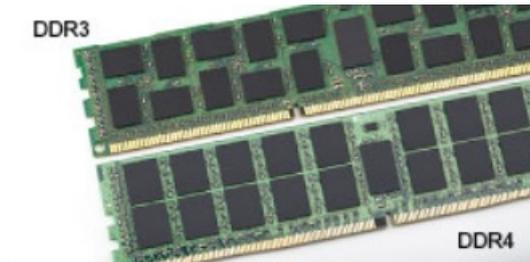


Figure 4. Notch difference

Increased thickness

DDR4 modules are slightly thicker than DDR3, to accommodate more signal layers.

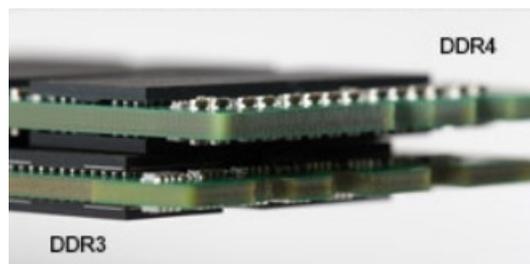


Figure 5. Thickness difference

Curved edge

DDR4 modules feature a curved edge to help with insertion and alleviate stress on the PCB during memory installation.

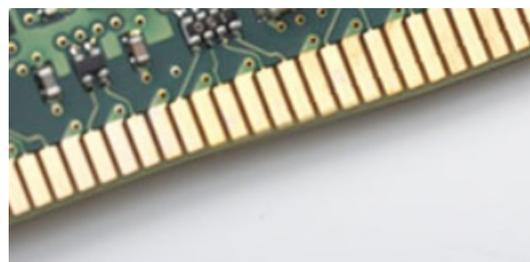


Figure 6. Curved edge

Memory Errors

Memory errors on the system display the new 2 - Amber, 3 - White failure code. If all memory fails, the LCD does not turn on. Troubleshoot for possible memory failure by trying known good memory modules in the memory connectors on the bottom of the system or under the keyboard, as in some portable systems.

Graphics options

Graphics Specifications

Table 5. Graphics specifications

Controller	Type	CPU Dependency	Graphics memory type	Capacity	External display support	Maximum resolution
Intel HD 620 Graphics	UMA	Intel Core i3 - 7130U	Integrated	Shared system memory	HDMI 2.0	4096×2304 @60 Hz
Intel UHD 620 Graphics	UMA	Intel Core i5 - 8350U	Integrated	Shared system memory	HDMI 2.0	4096×2304 @60 Hz
Intel HD 520 Graphics	UMA	Intel Core i5-6300U	Integrated	Shared system memory	HDMI 2.0	4096×2304 @60 Hz
AMD Radeon 540	Discrete	Intel Core i5 - 8350U Intel Core i7 - 8650U	Discrete	Dedicated, 2 GB DDR5	HDMI 2.0 Additional video ports via Rear Configurable IO Space <ul style="list-style-type: none"> • VGA • DisplayPort 	4096×2304 @60 Hz
AMD Radeon RX540	Discrete	Intel Core i5 - 8350U Intel Core i7 - 8650U	Discrete	Dedicated, 4 GB DDR5	HDMI 2.0 Additional video ports via Rear Configurable IO Space <ul style="list-style-type: none"> • VGA • DisplayPort 	4096×2304 @60 Hz

 **NOTE:** Additional video ports via Rear Configurable IO Space is available with discrete graphics solution only.

Intel HD Graphics Integrated

Intel HD graphics 620

This system can be configured with either of the following UMA graphic options or combined with any of the AMD discrete graphics options.

Table 6. Intel HD graphics 620 specification

Integrated Graphics Controller	Intel HD Graphics 620
Bus Type	Internal PCIe
Memory Interface	N/A (unified memory architecture)
Graphics Level	GT2
Estimated Maximum Power Consumption (TDP)	15 W (included in the CPU power)
Display Support	On System: HDMI 2.0 USB Type-C

Table 6. Intel HD graphics 620 specification (continued)

Integrated Graphics Controller	Intel HD Graphics 620
Maximum Vertical Refresh Rate	Up to 85 Hz depending on resolution
Operating Systems Graphics Video API Support	Support for DirectX 12, OpenCL 2.0, OpenGL 4.3/4.4, OpenGL ES
Supported Resolutions and Max Refresh Rates (Hz) (Note: Analog and/or digital)	System ports: Max Digital: (HDMI) 2560x1600, 4096x2304@24 Hz Docked: <ul style="list-style-type: none"> • Max Digital: (DisplayPort 1.2) 3840 x2160 @60 Hz • Max Digital: (SL-DVI) 1920x1080 @60 Hz • Analog: (VGA) system (14 inch/15 inch) 2048x1152 @60 Hz For 3 displays : up to max resolution each above
Numbers of Displays Supported	<ul style="list-style-type: none"> • System Ports: 3 displays max with LCD plus 2 displays max on each output (HDMI, USB Type-C) • Docked: 3 displays max (combo of LCD, VGA, DP, HDMI)

Intel UHD Graphics 620

Table 7. Intel UHD Graphics 620 (8th Generation Intel Core) specification

Integrated Graphics Controller	Intel UHD Graphics 620 (8th Generation Intel Core)
Bus Type	Internal PCIe
Memory Interface	N/A (unified memory architecture)
Graphics Level	GT2
Estimated Maximum Power Consumption (TDP)	15 W (included in the CPU power)
Display Support	On System: HDMI 2.0 USB Type-C
Maximum Vertical Refresh Rate	Up to 85 Hz depending on resolution
Operating Systems Graphics Video API Support	DirectX 11 (Windows 7/8.1), DirectX 12 (Windows 10, Windows 11), OpenGL 4.3
Supported Resolutions and Max Refresh Rates (Hz) (Note: Analog and/or digital)	System ports: <ul style="list-style-type: none"> • Max Digital: (HDMI) 4096x2304@24 Hz • Analog: (VGA) system (14 inches/15 inches) or docking 2048x1152 @60 Hz Docked: <ul style="list-style-type: none"> • Max Digital: (DisplayPort 1.2) 3860 x2160 @60 Hz • Max Digital: (SL-DVI) 1920x1080 @60 Hz • Analog: (VGA) system (14 inches/15 inches) 2048x1152 @60 Hz For 3 displays: <ul style="list-style-type: none"> • (native or docked) up to 1920x1200 max resolution each
Numbers of Displays Supported	<ul style="list-style-type: none"> • System Ports - 3 displays max with LCD plus 1 display max on each output (HDMI, VGA (14 inches/15 inches)) • Docked - 3 displays max (combo of LCD, VGA, DP, HDMI)

Intel HD Graphics 520

Table 8. Intel HD Graphics 520 Graphics specification

Integrated Graphics Controller	Intel UHD Graphics 620 (8th Generation Intel Core)
Bus Type	Internal PCIe
Memory Interface	N/A (unified memory architecture)
Graphics Level	GT2
Estimated Maximum Power Consumption (TDP)	15 W (included in the CPU power)
Display Support	On System: HDMI 2.0 USB Type-C
Maximum Vertical Refresh Rate	Up to 85 Hz depending on resolution
Operating Systems Graphics/ Video API Support	DirectX 11 (Windows 7/8.1), DirectX 12 (Windows 10, Windows 11), OpenGL 4.3
Supported Resolutions and Max Refresh Rates (Hz) (Note: Analog and/or digital)	System ports: <ul style="list-style-type: none"> • Max Digital: (HDMI) 4096x2304@24 Hz • Analog: (VGA) system (14 inches/15 inches) or docking 2048x1152 @60 Hz Docked: <ul style="list-style-type: none"> • Max Digital: (DisplayPort 1.2) 3860 x2160 @60 Hz • Max Digital: (SL-DVI) 1920x1080 @60 Hz • Analog: (VGA) system (14 inches/15 inches) 2048x1152 @60 Hz For 3 displays: <ul style="list-style-type: none"> • (native or docked) up to 1920x1200 max resolution each
Numbers of Displays Supported	<ul style="list-style-type: none"> • System Ports - 3 displays max with LCD plus 1 display max on each output (HDMI, VGA (14 inches/15 inches)) • Docked - 3 displays max (combo of LCD, VGA, DP, HDMI)

Intel HD Graphics 520



The Intel HD Graphics 520 (GT2) is an integrated graphics unit, which can be found in various ULV (Ultra Low Voltage) processors of the Skylake generation. This GT2 version of the Skylake GPU offers 24 Execution Units (EUs) clocked at up to

1050 MHz (depending on the CPU model). Due to its lack of dedicated graphics memory or eDRAM cache, the HD 520 has to access the main memory (2x 64-bit DDR3L-1600/DDR4-2133).

Performance

The exact performance of the HD Graphics 520 depends on various factors like L3 cache size, memory configuration (DDR3/DDR4) and maximum clock rate of the specific model. The fastest versions Core i7-6600U should perform similar to a dedicated GeForce 820M and handles modern games (as of 2015) in low settings.

Features

The revised video engine now decodes H.265/HEVC completely in hardware and more efficiently than before. Displays can be connected using a DP 1.2/eDP 1.3 (max. 3840 x 2160 @ 60 Hz), whereas HDMI is limited to the older version 1.4a (max. 3840 x 2160 @ 30 Hz). However, HDMI 2.0 can be added using a DisplayPort converter. Up to three displays can be controlled simultaneously.

Power Consumption

The HD Graphics 520 can be found in mobile processors specified at 15 W TDP and is therefore suited for compact laptops and Ultrabooks.

Key Specifications

The following table contains the key specifications of the Intel HD Graphics 520:

Table 9. Key specifications

Specification	Intel HD Graphics 520
Codename	Skylake GT2
Architecture	Intel Gen 6 (Skylake)
Pipelines	24 — unified
Core Speed	300 — 1050 (Boost) MHz
Memory Type	DDR3/DDR4
Memory Bus Width	64/128 bit
Shared Memory	Yes
Technology	14 nm
Features	QuickSync
DirectX	DirectX 12 (FL 12_1)
Max. Displays Supported	Up to 3
DP 1.2/eDP 1.3 max. resolution	3840 x 2160 @ 60 Hz
HDMI max. resolution	3840 x 2160 @ 30 Hz

Intel HD/UHD Graphics 620



The Intel HD/UHD Graphics 620 (GT2) is an integrated graphics unit, which can be found in various ULV (Ultra Low Voltage) processors of the Skylake generation. This GT2 version of the Skylake GPU offers 24 Execution Units (EUs) clocked at up to 1050 MHz (depending on the CPU model). Due to its lack of dedicated graphics memory or eDRAM cache, the HD 520 has to access the main memory (2x 64-bit DDR3L-1600/DDR4-2133).

Performance

The exact performance of the HD/UHD Graphics 620 depends on various factors like L3 cache size, memory configuration (DDR3L/DDR4) and maximum clock rate of the specific model.

Features

The revised video engine now decodes H.265/HEVC completely in hardware and more efficiently than before. Displays can be connected using a DP 1.2/eDP 1.3 (max. 3840 x 2160 @ 60 Hz), whereas HDMI is limited to the older version 1.4a (max. 3840 x 2160 @ 30 Hz). However, HDMI 2.0 can be added using a DisplayPort converter. Up to three displays can be controlled simultaneously.

Power Consumption

The HD Graphics 620 can be found in mobile processors specified at 15 W TDP and is therefore suited for compact laptops and Ultrabooks.

Key Specifications

The following table contains the key specifications of the Intel HD Graphics 620:

Table 10. Key specifications

Specification	Intel HD/UHD Graphics 620
Codename	Skylake GT2
Architecture	Intel Gen 6 (Skylake)
Pipelines	24 — unified
Core Speed	300 — 1050 (Boost) MHz
Memory Type	DDR3/DDR4
Memory Bus Width	64/128 bit
Shared Memory	Yes
Technology	14 nm
Features	QuickSync

Table 10. Key specifications (continued)

Specification	Intel HD/UHD Graphics 620
DirectX	DirectX 12 (FL 12_1)
Max. Displays Supported	Up to 3
DP 1.2/eDP 1.3 max. resolution	3840 x 2160 @ 60 Hz
HDMI max. resolution	3840 x 2160 @ 30 Hz

AMD Radeon 540 Graphics

Table 11. Radeon 540 Graphics specifications

Graphics Controller	AMD Radeon 540 Graphics
Graphics memory	2 GB GDDR5
Bus type	PCIe x16 Gen3
Memory Interface	64-bit
Clock Speeds	Up to 1124 MHz
Estimated Maximum Power Consumption (TDP)	50W TGP (GPU + frame buffer)
Display Support	HDMI/mDP/eDP/USB-C
Maximum Color Depth	Maximum 4:4:4 Color Depth:12 (bits per pixel)
Maximum Vertical Refresh Rate	Up to 85 Hz depending on resolution
Operating Systems Graphics/ Video API Support	DirectX 12, OpenGL 4.5
Supported Resolutions and Max Refresh Rates (Hz) (Note: Analog and/or digital)	<ul style="list-style-type: none"> • Single DisplayPort 1.4 - 5120 x 2880 @ 60 Hz • Dual DisplayPort 1.4 - 5120 x 2880 @ 60 Hz
Numbers of Display Support	Up to five displays operating at 4096 x 2160 @60 Hz

AMD Radeon RX 540 Graphics

Table 12. Radeon RX 540 graphics specifications

Graphics Controller	AMD Radeon RX 540 Graphics
Graphics memory	4 GB GDDR5
Bus type	PCIe x16 Gen3
Memory Interface	128 bit
Clock Speeds	Up to 1219 MHz
Estimated Maximum Power	50W TGP (GPU + frame buffer)
Display Support	eDP/DVI/ DisplayPort/HDMI
Maximum Color Depth	Maximum 4:4:4 Color Depth:12 (bits per pixel)

Table 12. Radeon RX 540 graphics specifications (continued)

Graphics Controller	AMD Radeon RX 540 Graphics
Maximum Vertical Refresh Rate	Up to 395 Hz at 1920 x 1080 Up to 118 Hz at 3840 x 2160
Operating Systems Graphics/ Video API Support	DirectX 12, OpenGL 4.5
Supported Resolutions and Max Refresh Rates (Hz)	<ul style="list-style-type: none"> • Max Digital : Single DisplayPort 1.4 - 5120 x 2880 @ 60 Hz (mDP/USB Type-C to DP) • Max Digital : Dual DisplayPort 1.4 - 5120 x 2880 @ 60 Hz (mDP/USB Type-C to DP)
Numbers of Display Support	Up to five displays operating at 4096 x 2160 @60 Hz

Corning Gorilla Glass

Corning Gorilla Glass 5: Corning’s latest composition was formulated to address breakage the #1 consumer complaint, according to Corning’s research. The new glass is just as thin and light as previous versions, but has been formulated to deliver dramatically improved native damage resistance allowing improved in-field performance. Corning Gorilla Glass 5 has been tested for performance when subjected to sharp contact damage, such as asphalt and other real-world surfaces.

Benefits

- Enhanced retained strength after use.
- High resistance to scratch and sharp contact damage.
- Improved drop performance.
- Superior surface quality.

Applications

- Ideal protective cover for electronic displays in:
 - Smartphones
 - Laptop and tablet computer screens
 - Wearable devices
- Touchscreen devices
- Optical components
- High strength glass articles

Dimensions

Thickness: 0.7 mm

Viscosity

Table 13. Viscosity

Parameters	Vectors
Softening Point ($10^{7.6}$ poises)	884 °C
Annealing Point ($10^{13.2}$ poises)	623 °C
Strain Point ($10^{14.7}$ poises)	571 °C

Properties

Table 14. Properties

Density	2.43 g/cm
Youngs Modulus	76.7 GPa
Poissons Ratio	0.21
Shear Modulus	31.7 GPa
Vickers Hardness (200 g load)	
<ul style="list-style-type: none"> • Un-strengthened • Strengthened 	489 kgf/mm ² 596 kgf/mm ² 596 kgf/mm ²
Fracture Toughness	0.69 MPa m ^{0.5}
Coefficient of Expansion (0 °C - 300 °C)	78.8 x 10 ⁻⁷ /°C

Chemical Strengthening

Capability of >850MPa CS, at 50 µm Depth Of Layer(DOL)

Specifications subject to change

Optical

Table 15. Optical

Refractive Index (590 nm)	
Core glass**	1.50
Compression layer	1.51
Photo-elastic constant	30.3 nm/cm/MPa

** Core index is used for FSM-based measurements since it is unaffected by ion-exchange conditions.

Chemical Durability

Durability is measured via weight loss per surface area after immersion in the solvents shown below. Values are highly dependent upon actual testing conditions. Data reported is for Corning Gorilla Glass 5.

Table 16. Chemical Durability

Reagent	Time	Temperature (°C)	Weight Loss (mg/cm ²)
HCl - 5%	24 hrs	95	5.9
NH ₄ F:HF - 10%	20 min	20	1.0
HF - 10%	20 min	20	25.2
NaOH - 5%	6 hrs	95	2.7

Electrical

Table 17. Electrical

Frequency (MHz)	Dielectric Constant	Loss Tangent
54	7.08	0.009
163	7.01	0.010
272	7.01	0.011
272	7.00	0.010
490	7.99	0.010
599	7.97	0.011
912	7.01	0.012
1499	6.99	0.012
1977	6.97	0.014
2466	6.96	0.014
2986	6.96	0.014

Terminated coaxial line similar to that outlined in NIST Technical Notes 1520 and 1355-R

Putting Corning Gorilla Glass 5 to the test.

- Greater damage resistance (upto 1.8X) with deep abrasion.
- Faster chemical strengthening with high Compressive Stress and deeper depth of compression
 - Shallower check depth with higher abrasions levels
- Enables thickness reduction

Pen Usage

Your computer uses several input devices. The standard external USB keyboard and mouse are present, plus you can opt for the electrostatic pen/stylus or use your finger as an input device.

Using the Pen as a 'Mouse'

You can use the pen the same way you use a mouse or touch pad with a laptop computer. Holding the pen near the display makes a small cursor appear. Moving the pen moves the cursor. The following table describes how to use the pen.

Table 18. Pen functions

Action	Function
Gently tap the pen tip on the screen	Same as a single-click on a mouse.
Gently tap the pen tip twice in quick succession on the screen.	Same as a double-click on a mouse.
Touch the pen on the screen and hold it in place momentarily until Windows draws a complete circle around the cursor.	Same as a right-click on a mouse.

Using the Pen as a Pen

The handwriting recognition software makes it easy to enter text into your applications with the pen. Some applications, such as Windows Journal, allow you to write with the pen directly into the application window.

Tablet PC Input Panel

When an application does not directly support pen input, you can use the **Tablet PC Input Panel** to enter text into your application. If you tap in an editable area, the Tablet PC Input Panel icon appears. Tapping the icon makes the Input Panel slide out from the edge of the display.

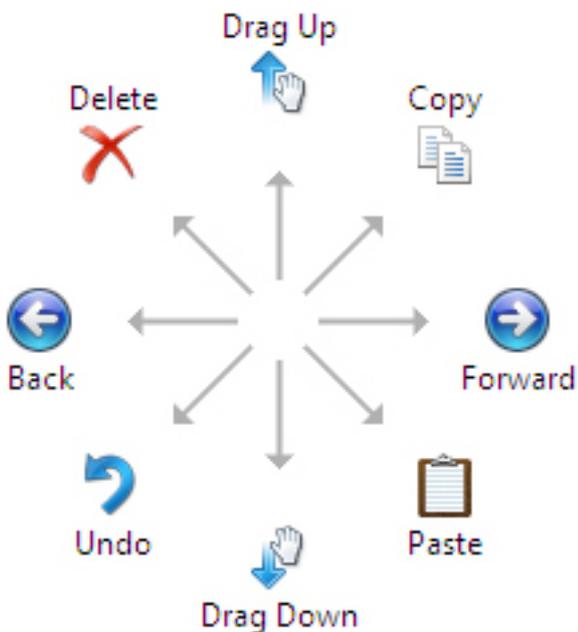


You can move the **Input Panel** tab by dragging it up or down along the edge of the screen. Then, when you tap it, the Input Panel opens at the same horizontal location on the screen that the tab appears.



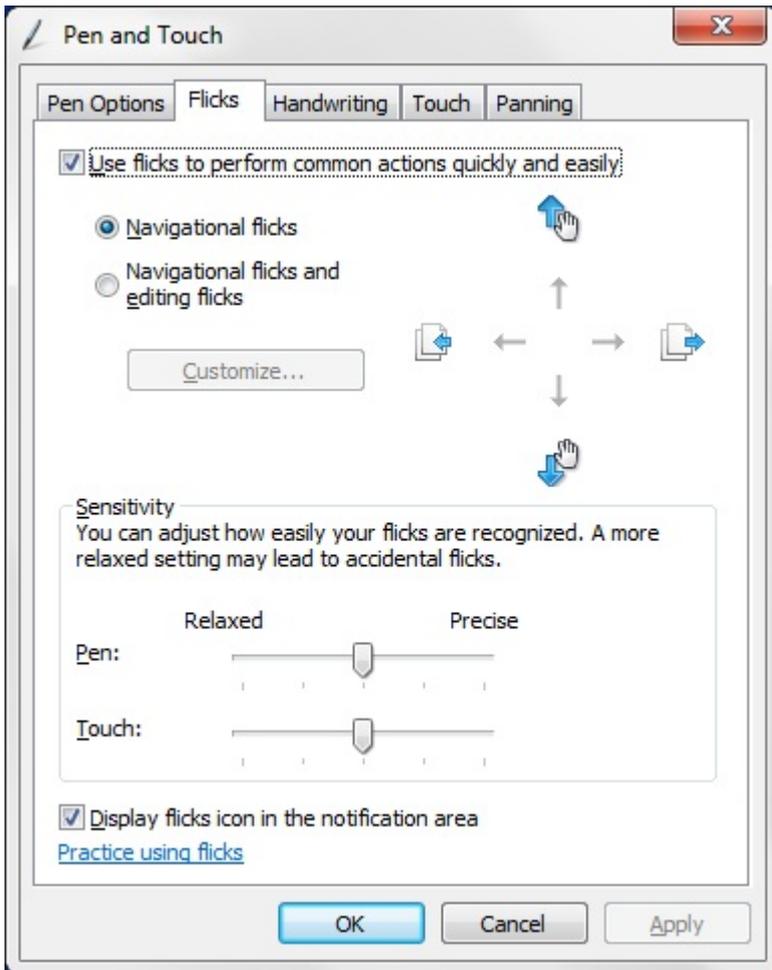
Pen Flicks

Pen flicks enable you to use the pen to perform actions that normally require a keyboard, such as pressing <Page Up> or using the directional arrow keys. Pen flicks are quick, directional gestures. Draw a short line in one of eight directions. When a pen flick is recognized, the Tablet PC performs the action assigned.



You can modify the default pen flick settings:

1. Click **Start > Control Panel > Pen and Touch** and click the **Flicks** tab.
2. Modify the settings and click **OK**.



Optical Disk Drive

DVDRW

DVDRW is a physical format for re-writable DVDs and can hold up to 4.7 GB. DVD+RW was created by the DVD+RW Alliance, an industry consortium of drive and disc manufacturers. Additionally, DVD+RW supports a method of writing called "lossless linking", which makes it suitable for random access and improves compatibility with DVD players.



The capacity of a single-layer disc is approximated as 4.7×10^9 bytes. In actuality, the disc is laid out with 2295104 sectors of 2048 bytes each which comes to 4,700,372,992 bytes, 4,590,208 kilobytes (KiB, binary kilobytes), 4482.625 megabytes (MiB, binary megabytes), or 4.377563476 gibabytes (GiB, binary gigabytes).

DVD±R (also DVD+/-R, "DVD plus/dash R", or "DVD plus/minus R") is not a separate DVD format, but rather is a shorthand term for a DVD drive that can accept both of the common recordable DVD formats (i.e. DVD-R and DVD+R). Likewise, DVD±RW (also written as DVD±R/W, DVD±R/RW, DVD±R/±RW, DVD+/-RW, and other arbitrary ways) handles both common re-writable disc types

DVD+RW must be formatted before recording by a DVD recorder.

- 8x DVD+/-RW drive

DVDRW Drive

There is a new drive offering from Dell for these systems that allows users to read and write DVDs and CDs. The drive is a tray-loading drive that fits into the media bay. It uses a SATA interface.

The DVDRW/BD-ROM combo drive will read and write all standard CD and DVD formats. Here are some specifications for the drive:

Table 19. DVD RW Specifications

DVDRW Drive Specs	Speed
CD Read	24x
CD-R write	8x
CD-RW write	8x
DVD-ROM read	8x
DVD+R write	8x
DVD-R write	8x
DVD+R DL write	2.4x
DVD-R DL write	2.4x
DVD+RW write	4x
DVD-RW write	4x

Blue Ray

In February 2002, a large group of companies announced the introduction of the Blu-ray Disc™ (BD) format, the next generation in optical storage. The new format offers an immense storage capacity (up to 50 GB) that is perfect for high-definition (HD) video recording and distribution, as well as for storing large amounts of data. The format shares the same form factors as existing CD and DVD optical discs, allowing for backwards compatibility.*

Features

Listed below are some of Blu-ray's features.

- Huge capacity
 - 25 GB (single layer) / 50 GB (double layer)
 - ① **NOTE:** All Dell Blu-Ray drives support dual layer (50 GB) discs. However, the new combo drives (DVDRW/BD-ROM) simply read dual layer discs but do not write to them.
 - Future potential to store 200 GB (Multilayer)
 - Ability to burn and read most media types**
 - Common format advantage
 - Blank media
 - Set top recorders and players
 - Prepackaged high-definition movies
 - High-definition camcorders
 - Next-generation HD gaming
 - PC storage and entertainment

Hardware Requirements

For Blu-ray to work properly, both software and hardware must meet several requirements. A description of these requirements is below. A Dell™ Blu-ray Disc system cannot be purchased without these requirements.

Table 20. System Requirements

Requirement	Device/Specification	
	Desktops	Notebooks
Processor	Intel® Core™2 Duo Processor E6800 (2.93 GHz) or Intel Core 2 Duo Processor E6700 (2.66 GHz) or Kentsfield	Intel Core 2 Duo T7100 (1.8 GHz) or better
Graphics card	Intel Core 2 Duo T7100 (1.8 GHz) or better	Intel Core 2 Duo T7100 (1.8 GHz) or better
Memory	1 GB DDR2 SDRAM	
RMSD drive	Philips® half-height drive	Panasonic® Slim-line drive
Software	Playback: Cyberlink® Burn and authoring: Sonic/Roxio	
Video	Codecs: MPEG2, MPEG4-AVC, VC-1 - must be capable of H.264 HW accel	
Audio	Codecs: LPCM, Dolby®, Dolby Digital +, Dolby Lossless, DTS™, DTS-HD™	
Display	20-inch high-definition flat panel (HDFP) - 2007FPW 24-inch high-definition flat panel (HDFP) - 2407FPW Must have HDCP** support with digital connectors	WSXGA+ (1680x1050) WUXGA (1920x1200)

There are a few possible profiles for Blu-ray; they are Standard and BD Live.

Table 21. Blue-ray Profiles

	Standard	BD Live (Not yet available)
Functionality	Large back-up device Blu-ray video playback Blu-ray video authoring	Standard Profile + Picture-in-Picture Internet connectivity Local storage
System requirements	Drive Graphics/CPU combination sufficient to handle BD BD software Monitor Memory	Standard Profile + Hardware-accelerated graphics System storage

Media Card Readers

NOTE: The media card reader is integrated into the system board on portable systems. If there is a hardware failure or the reader malfunctions, replace the system board.

The media card reader expands the usefulness and functionality of portable systems, especially when used with other devices such as digital cameras, portable MP3 players, and handheld devices. All these devices use a form of media card to store information. Media card readers allows for easy transfer of data between these devices.



Several different types of media or memory cards are available today. Below is a list of the different types of cards that work in the media card reader.

SD Card Reader

1. Memory Stick
2. Secure Digital (SD)
3. Secure Digital High Capacity (SDHC)
4. Secure Digital eXtended Capacity (SDXC)

UEFI BIOS

UEFI is an acronym for Unified Extensible Firmware Interface. The UEFI specification defines a new model for the interface between personal computer operating systems and platform firmware. The interface consists of data tables that contain platform related information, plus boot and runtime service calls that are available to the operating system and its loader. Together, these provide a standard environment for booting an operating system and running pre-boot applications. One of the main differences between BIOS and UEFI is the way applications are coded. Assembler was used if functions or applications had to be coded for the BIOS while a higher level language code will be used to program the UEFI.

Dell UEFI BIOS implementation will supersede the existing two different sets of BIOS in the portables and desktop products into one single UEFI BIOS moving forward.

Important Information

There is no difference in between the conventional BIOS and the UEFI BIOS unless the UEFI option is checked in the 'Boot List Option' setting in the BIOS page. This will allow the user to create a UEFI boot option list manually without affecting the existing boot priority list. With the implementation of UEFI BIOS, the changes are more related to the manufacturing tools and functionalities with very minimal impact to the customer's usages.

Few things to remember are:

- If customers have a UEFI boot media and ONLY if they have UEFI boot media (either in the optical media or via USB storage), the one-time boot menu will show an additional section listing the UEFI boot options. If they don't have UEFI boot media attached, they will never see this option. Almost all will never get to see this option unless the UEFI boot option is specified manually through the 'Boot Sequence' settings.
- How to change Service Tag/Owner Tag?

When the service technician replaces a system board, he's required to set the service tag upon the system starts up at one time off basis. Failure to set a service tag may result system battery not being able to charge. Therefore, it is very important that the service technician set the correct system service tag. If a wrong service tag is set, there's no way to reset it and the technician will have to place order for another system board replacement.

- How to change Asset tag information?

To change the Asset tag information, we can use one of the following software utilities.

Portables Technology Dell Command Configure toolkit

Customers may also report that after a motherboard replacement, the asset field is already populated in the system BIOS, and needs to be cleared or set. For older systems and all newer systems with the UEFI BIOS platform, customers can download the Dell Command Configure Toolkit (DCC) to customize the BIOS options or even change the ownership or asset tag from within Windows. This technology is described in Software and Troubleshooting section.

Systems management - From on-premises to the cloud

Dell Client Command Suite - a free toolkit available for download, for all OptiPlex and Latitude PCs at <https://dell.com/command>, automates and streamlines systems management tasks, saving time, money, and resources. It consists of the following modules that can be used independently, or with a variety of systems management consoles such as SCCM.

Dell Command | Deploy enables easy operating system (OS) deployment across all major OS deployment methodologies and provides numerous system-specific drivers that have been extracted and reduced to an OS-consumable state.

Dell Command | Configure is a graphical user interface (GUI) admin tool for configuring and deploying hardware settings in a pre-OS or post-OS environment, and it operates seamlessly with SCCM and Airwatch and can be self-integrated into LANDesk and KACE. Simply, this is all about the BIOS. Command | Configure allows you to remotely automate and configure over 150+ BIOS settings for a personalized user experience.

Dell Command | PowerShell Provider can do the same things as Command | Configure, but with a different method. PowerShell is a scripting language that allows customers to create a customized and dynamic configuration process.

Dell Command | Monitor is a Windows Management Instrumentation (WMI) agent that provides IT admins with an extensive inventory of the hardware and health-state data. Admins can also configure hardware remotely by using command line and scripting.

Dell Command | Update (end-user tool) is factory-installed and allows admins to individually manage and automatically present and install Dell updates to the BIOS, drivers, and software. Command | Update eliminates the time-consuming hunting and pecking process of update installation.

Dell Command | Update Catalog provides searchable metadata that allows the management console to retrieve the latest system-specific updates (driver, firmware or BIOS). The updates are then delivered seamlessly to end-users using the customer's systems management infrastructure that is consuming the catalog (like SCCM).

Dell Command | vPro Out of Band console extends hardware management to systems that are offline or have an unreachable OS (Dell exclusive features).

Dell Command | Integration Suite for System Center - This suite integrates all the key components of the Client Command Suite into Microsoft System Center Configuration Manager 2012 and Current Branch versions.

Dell Client Command Suite's integration with VMware Workspace ONE Powered by AirWatch, now allows customers to manage their Dell client hardware from the cloud, using a single Workspace ONE console.

Out-of-Band Systems Management- Intel vPro and Intel Standard Manageability

Intel vPro and Intel Standard Manageability must be configured in the Dell factory at the time of purchase, as they are NOT field upgradable. They offer out-of-band management and DASH compliance.

Intel vPro

Available with Intel Core i5 and i7 processors and offers the most complete set of out-of-band management features including KVM, IPv6 support, graceful shutdown, and all the features from previous versions of vPro. It uses the latest version of Intel's Active Management Technology (AMT).

To learn more about vPro, visit Intel's website at <https://www.intel.com/content/www/us/en/architecture-and-technology/vpro/vpro-platform-general.html>.

A unique and new Dell Remote Provisioning feature for Intel vPro quickly activates vPro capabilities on a PC, reducing vPro set-up time from months to less than an hour. The Dell Remote Provisioning feature for Intel vPro is available as a part of the module: **Dell Command | Integration Suite for Systems Center**

Intel Standard Manageability (ISM)

ISM offers a limited set of out-of-band features like remote power on/off, Serial-over-LAN redirect, Wake-on-LAN, etc.

To learn more about Intel ISM, visit Intel's website at: <https://software.intel.com/en-us/blogs/2009/03/27/what-is-standard-manageability>.

Trusted Platform Module

Trusted Platform Module (TPM) is a dedicated cryptoprocessor designed to secure hardware by integrating cryptographic keys into devices. A software can use a Trusted Platform Module to authenticate hardware devices. As each TPM chip has a unique and secret RSA key burned in as it is produced, it can perform the platform authentication.

i **NOTE:** Trusted Platform Module (TPM) is part of the system board. In an event of system board replacement, the encryption needs to be suspended in the OS and re-enabled on new system board's BIOS prior to resuming the encryption.

⚠ CAUTION: Attempt to replace the system board without prior suspending the encryption, will cause operating system corruption and may eventually lead to No-Boot scenario.

Fingerprint Reader

This topic explains the software used in fingerprint reader

The Portables Technology has an integrated fingerprint reader located on the palm rest to the right of the touch pad. The fingerprint reader is an option, so not all systems have it. Included with the driver for the fingerprint reader is a software package from Dell ControlVault, that provides functionality for the device. Dell provides all support for the software, same as on the Latitude systems.

Dell ControlVault Software

The software package for the fingerprint reader is ControlVault by Dell. It provides the following functionality to the fingerprint reader:

- Uses the fingerprint reader for Windows logon and system start-up password authentication
- Registers websites and Windows applications for password replacement
- Launches a favorite application with a finger swipe
- Stores confidential information in an encrypted folder

To gain any of this functionality, a user must first enroll fingerprints. An easy-to-follow wizard guides the user through the enrollment process. The user can choose to save fingerprints to the hard drive or the fingerprint reader

i **NOTE:** A user should enroll more than one finger's print.

USB features

Universal Serial Bus, or USB, was introduced in 1996. It dramatically simplified the connection between host computers and peripheral devices like mice, keyboards, external drivers, and printers.

Table 22. USB evolution

Type	Data Transfer Rate	Category	Introduction Year
USB 2.0	480 Mbps	High Speed	2000

Table 22. USB evolution (continued)

Type	Data Transfer Rate	Category	Introduction Year
USB 3.0/USB 3.1 Gen 1	5 Gbps	SuperSpeed	2010
USB 3.1 Gen 2	10 Gbps	SuperSpeed	2013

USB 3.0/USB 3.1 Gen 1 (SuperSpeed USB)

For years, the USB 2.0 has been firmly entrenched as the de facto interface standard in the PC world with about 6 billion devices sold, and yet the need for more speed grows by ever faster computing hardware and ever greater bandwidth demands. The USB 3.0/USB 3.1 Gen 1 finally has the answer to the consumers' demands with a theoretically 10 times faster than its predecessor. In a nutshell, USB 3.1 Gen 1 features are as follows:

- Higher transfer rates (up to 5 Gbps)
- Increased maximum bus power and increased device current draw to better accommodate power-hungry devices
- New power management features
- Full-duplex data transfers and support for new transfer types
- Backward USB 2.0 compatibility
- New connectors and cable

The topics below cover some of the most commonly asked questions regarding USB 3.0/USB 3.1 Gen 1.

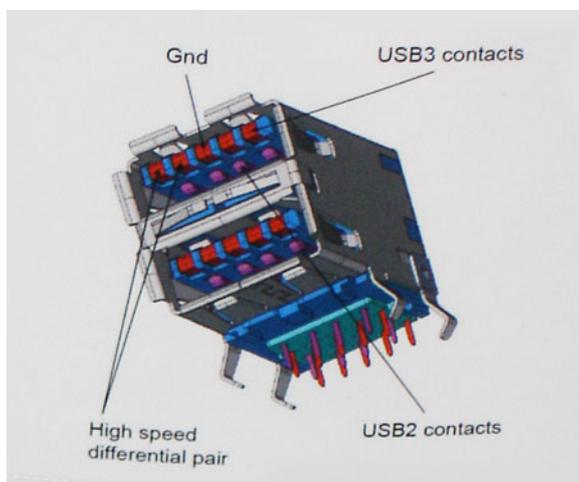


Speed

Currently, there are 3 speed modes defined by the latest USB 3.0/USB 3.1 Gen 1 specification. They are Super-Speed, Hi-Speed and Full-Speed. The new SuperSpeed mode has a transfer rate of 4.8 Gbps. While the specification retains Hi-Speed, and Full-Speed USB mode, commonly known as USB 2.0 and 1.1 respectively, the slower modes still operate at 480 Mbps and 12 Mbps respectively and are kept to maintain backward compatibility.

USB 3.0/USB 3.1 Gen 1 achieves the much higher performance by the technical changes below:

- An additional physical bus that is added in parallel with the existing USB 2.0 bus (refer to the picture below).
- USB 2.0 previously had four wires (power, ground, and a pair for differential data); USB 3.0/USB 3.1 Gen 1 adds four more for two pairs of differential signals (receive and transmit) for a combined total of eight connections in the connectors and cabling.
- USB 3.0/USB 3.1 Gen 1 utilizes the bidirectional data interface, rather than USB 2.0's half-duplex arrangement. This gives a 10-fold increase in theoretical bandwidth.



With today's ever increasing demands placed on data transfers with high-definition video content, terabyte storage devices, high megapixel count digital cameras etc., USB 2.0 may not be fast enough. Furthermore, no USB 2.0 connection could ever come close to the 480Mbps theoretical maximum throughput, making data transfer at around 320 Mbps (40 MB/s) — the actual real-world maximum. Similarly, USB 3.0/USB 3.1 Gen 1 connections will never achieve 4.8Gbps. We will likely see a real-world maximum rate of 400MB/s with overheads. At this speed, USB 3.0/USB 3.1 Gen 1 is a 10x improvement over USB 2.0.

Applications

USB 3.0/USB 3.1 Gen 1 opens up the laneways and provides more headroom for devices to deliver a better overall experience. Where USB video was barely tolerable previously (both from a maximum resolution, latency, and video compression perspective), it's easy to imagine that with 5-10 times the bandwidth available, USB video solutions should work that much better. Single-link DVI requires almost 2Gbps throughput. Where 480Mbps was limiting, 5Gbps is more than promising. With its promised 4.8Gbps speed, the standard will find its way into some products that previously weren't USB territory, like external RAID storage systems.

Listed below are some of the available SuperSpeed USB 3.0/USB 3.1 Gen 1 products:

- External Desktop USB 3.0/USB 3.1 Gen 1 Hard Drives
- Portable USB 3.0/USB 3.1 Gen 1 Hard Drives
- USB 3.0/USB 3.1 Gen 1 Drive Docks & Adapters
- USB 3.0/USB 3.1 Gen 1 Flash Drives & Readers
- USB 3.0/USB 3.1 Gen 1 Solid-state Drives
- USB 3.0/USB 3.1 Gen 1 RAIDs
- Optical Media Drives
- Multimedia Devices
- Networking
- USB 3.0/USB 3.1 Gen 1 Adapter Cards & Hubs

Compatibility

The good news is that USB 3.0/USB 3.1 Gen 1 has been carefully planned from the start to peacefully co-exist with USB 2.0. First of all, while USB 3.0/USB 3.1 Gen 1 specifies new physical connections and thus new cables to take advantage of the higher speed capability of the new protocol, the connector itself remains the same rectangular shape with the four USB 2.0 contacts in the exact same location as before. Five new connections to carry receive and transmitted data independently are present on USB 3.0/USB 3.1 Gen 1 cables and only come into contact when connected to a proper SuperSpeed USB connection.

USB Powershare

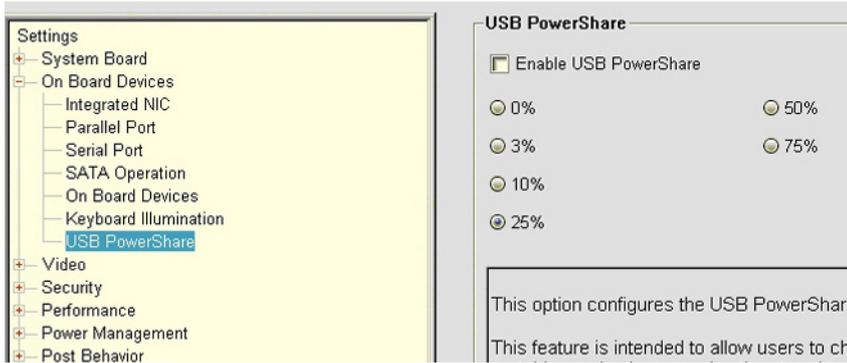
USB PowerShare is a feature which allows for external USB devices (i.e. cellular phones, portable music players, etc.) to charge using the portable system's battery.



Only the USB connector with a **SS+USB+Battery** icon, can be used.

This functionality is enabled in the system setup under the **On Board Devices** heading. You can select how much of the battery's charge can be used as well (pictured below). If you set the USB PowerShare to 25%, the external device is

allowed to charge until the battery reaches 25% of full capacity (e.g. 75% of the portable's battery charge is used up).



USB Type-C

USB Type-C is a new, tiny physical connector. The connector itself can support various exciting new USB standards like USB 3.1 and USB power delivery (USB PD).

Alternate Mode

USB Type-C is a new connector standard that is very small. It is about a third the size of an old USB Type-A plug. This is a single connector standard that every device should be able to use. USB Type-C ports can support a variety of different protocols using “alternate modes,” which allows you to have adapters that can output HDMI, VGA, DisplayPort, or other types of connections from that single USB port

USB Power Delivery

The USB PD specification is also closely intertwined with USB Type-C. Currently, smartphones, tablets, and other mobile devices often use a USB connection to charge. A USB 2.0 connection provides up to 2.5 watts of power — that'll charge your phone, but that's about it. A laptop might require up to 60 watts, for example. The USB Power Delivery specification ups this power delivery to 100 watts. It's bi-directional, so a device can either send or receive power. And this power can be transferred at the same time the device is transmitting data across the connection.

This could spell the end of all those proprietary laptop charging cables, with everything charging via a standard USB connection. You could charge your laptop from one of those portable battery packs you charge your smartphones and other portable devices from today. You could plug your laptop into an external display connected to a power cable, and that external display would charge your laptop as you used it as an external display — all via the one little USB Type-C connection. To use this, the device and the cable have to support USB Power Delivery. Just having a USB Type-C connection doesn't necessarily mean they do.

USB Type-C and USB 3.1

USB 3.1 is a new USB standard. USB 3's theoretical bandwidth is 5 Gbps, while USB 3.1's is 10 Gbps. That's double the bandwidth, as fast as a first-generation Thunderbolt connector. USB Type-C isn't the same thing as USB 3.1. USB Type-C is just a connector shape, and the underlying technology could just be USB 2 or USB 3.0. In fact, Nokia's N1 Android tablet uses a USB Type-C connector, but underneath it's all USB 2.0 — not even USB 3.0. However, these technologies are closely related.

Ethernet

The Intel I219LM Jacksonville WGI219LM family of Gigabit Ethernet controllers provides compact, single-port integrated physical layer devices that connect to the Intel Skylake chipsets.

The Intel WGI219LM is the corporate LAN product with support for Intel vPro; technology, Intel AMT2, Energy Efficient Ethernet (802.3az), Intel SIPP, and Server OS support.

Product Features

General

- 10 BASE-T IEEE 802.3 specification conformance
- 100 BASE-TX IEEE 802.3 specification conformance
- 1000 BASE-T IEEE 802.3 specification conformance
- Energy Efficient Ethernet (EEE)
- IEEE 802.3az support [Low Power Idle (LPI) mode]
- IEEE 802.3u autonegotiation conformance
- Supports carrier extension (half duplex)
- Loopback modes for diagnostics
- Advanced digital baseline wander correction
- Automatic MDI/MDIX crossover at all speeds of operation
- Automatic polarity correction
- MDC/MDIO management interface
- Flexible filters in PHY to reduce integrated LAN controller power
- Smart speed operation for automatic speed reduction on faulty cable plants
- PMA loopback capable (no echo cancel)
- 802.1as/1588 conformance
- Power Optimizer Support
- Intel Stable Image Platform Program (SIPP)
- Network proxy/ARP Offload support
- Up to 32 programmable filters
- No support for Gb/s half-duplex operation

Security and Manageability

- Intel vPro support with appropriate Intel chipset components

Performance

- Jumbo Frames (up to 9 Kb)
- 802.1Q & 802.1p
- Receive Side Scaling (RSS)
- Two Queues (Tx & Rx)

Power

- Ultra Low Power at cable disconnect (<1 mW) enables platform support for connected standby
- Reduced power consumption during normal operation and power down modes
- Integrated Intel Auto Connect Battery Saver (ACBS)
- Single-pin LAN disable for easier BIOS implementation
- Fully integrated Switching Voltage Regulator (iSVR)
- Low Power LinkUp(LPLU)

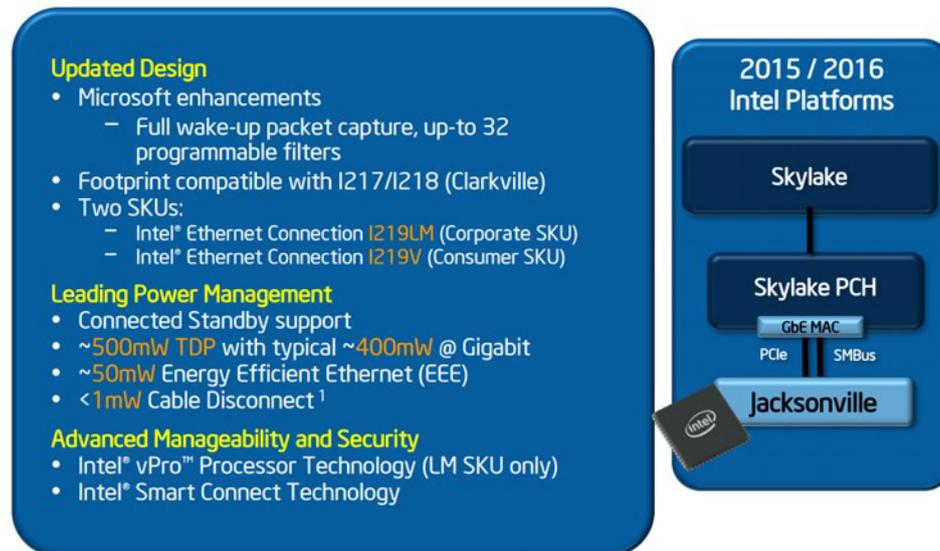
MAC/PHY Interconnect

- PCIe-based interface for active state operation (S0 state)
- SMBus-based interface for host and management traffic (Sx low power state)

Package/Design

- 48-pin package, 6x6mm with a 0.4 mm lead pitch and an Exposed Pad for ground
- Three configurable LED outputs
- Integrated MDI interface termination resistors to reduce BOM costs
- Reduced BOM cost by sharing SPI flash with PCH

Intel® Ethernet Connection I219 (Jacksonville)



HDMI 2.0

This topic explains the HDMI 2.0 and its features along with the advantages.

HDMI (High-Definition Multimedia Interface) is an industry-supported, uncompressed, all-digital audio/video interface. HDMI provides an interface between any compatible digital audio/video source, such as a DVD player, or A/V receiver and a compatible digital audio and/or video monitor, such as a digital TV (DTV). The intended applications for HDMI TVs, and DVD players. The primary advantage is cable reduction and content protection provisions. HDMI supports standard, enhanced, or high-definition video, plus multichannel digital audio on a single cable.

HDMI 2.0 Features

- **HDMI Ethernet Channel** - Adds high-speed networking to an HDMI link, allowing users to take full advantage of their IP-enabled devices without a separate Ethernet cable
- **Audio Return Channel** - Allows an HDMI-connected TV with a built-in tuner to send audio data "upstream" to a surround audio system, eliminating the need for a separate audio cable
- **3D** - Defines input/output protocols for major 3D video formats, paving the way for true 3D gaming and 3D home theater applications
- **Content Type** - Real-time signaling of content types between display and source devices, enabling a TV to optimize picture settings based on content type
- **Additional Color Spaces** - Adds support for additional color models used in digital photography and computer graphics
- **4K Support** - Enables video resolutions far beyond 1080p, supporting next-generation displays that will rival the Digital Cinema systems used in many commercial movie theaters
- **HDMI Micro Connector** - A new, smaller connector for phones and other portable devices, supporting video resolutions up to 1080p
- **Automotive Connection System** - New cables and connectors for automotive video systems, designed to meet the unique demands of the motoring environment while delivering true HD quality

Advantages of HDMI

- Quality HDMI transfers uncompressed digital audio and video for the highest, crispest image quality.
- Low -cost HDMI provides the quality and functionality of a digital interface while also supporting uncompressed video formats in a simple, cost-effective manner
- Audio HDMI supports multiple audio formats from standard stereo to multichannel surround sound
- HDMI combines video and multichannel audio into a single cable, eliminating the cost, complexity, and confusion of multiple cables currently used in A/V systems
- HDMI supports communication between the video source (such as a DVD player) and the DTV, enabling new functionality

Removing and installing components

This section provides detailed information on how to remove or install the components from your computer.

Topics:

- [Safety instructions](#)
- [Recommended tools](#)
- [Stylus](#)
- [SIM card](#)
- [Memory card](#)
- [Handle](#)
- [Latch Doors](#)
- [Battery](#)
- [Secondary SSD carrier](#)
- [Primary SSD carrier](#)
- [SSD](#)
- [HDD carrier](#)
- [Bottom Chassis Cover](#)
- [Keyboard](#)
- [WWAN card](#)
- [WLAN card](#)
- [Global Positioning System \(GPS\)](#)
- [Memory modules](#)
- [Coin-cell battery](#)
- [PCIe Heatsink Fan Assembly](#)
- [Primary SSD Rail](#)
- [Docking Port Assembly](#)
- [Heatsink Assembly](#)
- [Rear Input-Output Board](#)
- [Hinge Covers](#)
- [Display assembly](#)
- [LCD Bezel and Back Cover Assembly](#)
- [Microphone](#)
- [Camera](#)
- [Battery Bay](#)
- [Left I/O board](#)
- [Smart Card](#)
- [ExpressCard Reader](#)
- [Speaker](#)
- [System board](#)
- [Bottom Base Assembly](#)

Safety instructions

Use the following safety guidelines to protect your computer from potential damage and to ensure your personal safety. Unless otherwise noted, each procedure included in this document assumes that the following conditions exist:

- You have read the safety information that shipped with your computer.
- A component can be replaced or, if purchased separately, installed by performing the removal procedure in reverse order.

 **WARNING:** Before working inside your computer, read the safety information that shipped with your computer. For additional safety best practices information, see the [Regulatory Compliance Homepage](#)

CAUTION: Many repairs may only be done by a certified service technician. You should only perform troubleshooting and simple repairs as authorized in your product documentation, or as directed by the online or telephone service and support team. Damage due to servicing that is not authorized by Dell is not covered by your warranty. Read and follow the safety instructions that came with the product.

CAUTION: To avoid electrostatic discharge, ground yourself by using a wrist grounding strap or by periodically touching an unpainted metal surface at the same time as touching a connector on the back of the computer.

CAUTION: Handle components and cards with care. Do not touch the components or contacts on a card. Hold a card by its edges or by its metal mounting bracket. Hold a component such as a processor by its edges, not by its pins.

CAUTION: When you disconnect a cable, pull on its connector or on its pull-tab, not on the cable itself. Some cables have connectors with locking tabs; if you are disconnecting this type of cable, press in on the locking tabs before you disconnect the cable. As you pull connectors apart, keep them evenly aligned to avoid bending any connector pins. Also, before you connect a cable, ensure that both connectors are correctly oriented and aligned.

NOTE: Disconnect all power sources before opening the computer cover or panels. After you finish working inside the computer, replace all covers, panels, and screws before connecting to the power source.

CAUTION: Exercise caution when handling Lithium-ion batteries in laptops. Swollen batteries should not be used and should be replaced and disposed properly.

NOTE: The color of your computer and certain components may appear differently than shown in this document.

Before working inside your computer

1. Ensure that your work surface is flat and clean to prevent the computer cover from being scratched.
2. Turn off your computer.
3. If the computer is connected to a docking device (docked), undock it.
4. Disconnect all network cables from the computer (if available).

CAUTION: If your computer has an RJ45 port, disconnect the network cable by first unplugging the cable from your computer.

5. Disconnect your computer and all attached devices from their electrical outlets.
6. Open the display.
7. Press and hold the power button for few seconds, to ground the system board.

CAUTION: To guard against electrical shock unplug your computer from the electrical outlet before performing Step # 8.

CAUTION: To avoid electrostatic discharge, ground yourself by using a wrist grounding strap or by periodically touching an unpainted metal surface at the same time as touching a connector on the back of the computer.

8. Remove any installed ExpressCards or Smart Cards from the appropriate slots.

Safety Precautions

Follow the safety precautions described in the following sections when you perform an installation or a disassembly/reassembly procedure:

- Turn off the system and all attached peripherals.
- Disconnect the system and all attached peripherals from AC power, and then remove the battery.
- Disconnect all network cables, telephone or telecommunications lines from the system.
- Use a wrist grounding strap and mat when working inside any computer system to avoid electrostatic discharge (ESD) damage.

- After removing a system component, carefully place the removed component on an anti-static mat.
- Wear shoes with non-conductive rubber soles to help reduce the risk of being shocked or seriously injured in an electrical accident.

Standby Power

Dell products with standby power must be completely unplugged before the case is opened. Systems that incorporate standby power are essentially powered while turned off. The internal power enables the system to be remotely turned on (wake on LAN), suspended into a sleep mode, and have other advanced power management features.

After you unplug a system and before you remove components, wait approximately 30 to 45 seconds to allow the charge to drain from the circuits.

Bonding

Bonding is a method for connecting two or more grounding conductors to the same electrical potential. This is done through the use of a Field Service ESD kit. When connecting a bonding wire, always ensure that it is connected to bare metal and never to a painted or non-metal surface. The wrist strap should be secure and in full contact with your skin, and be sure to always remove all jewelry such as watches, bracelets, or rings prior to bonding yourself and the equipment.

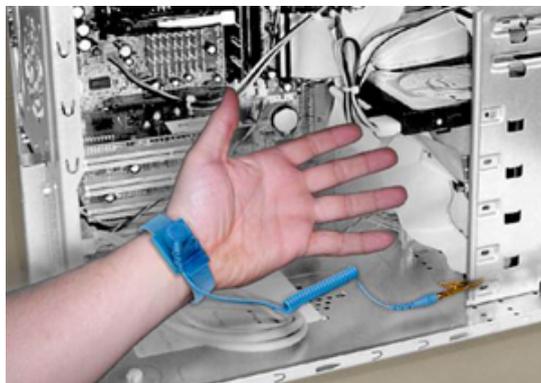


Figure 7. Bonding Properly

Electrostatic Discharge Protection

ESD is a major concern when you handle electronic components, especially sensitive components such as expansion cards, processors, memory DIMMs, and system boards. Very slight charges can damage circuits in ways that may not be obvious, such as intermittent problems or a shortened product life span. As the industry pushes for lower power requirements and increased density, ESD protection is an increasing concern.

Due to the increased density of semiconductors used in recent Dell products, the sensitivity to static damage is now higher than in earlier Dell products. For this reason some previously approved methods of handling parts are no longer applicable.

There are two recognized types of ESD damage: catastrophic and intermittent failures.

- **Catastrophic** —The damage causes an immediate and complete loss of device functionality. An example of catastrophic failure is a memory DIMM that has received a static shock and immediately generates a "No POST/No Video" symptom with a beep code emitted for missing or nonfunctional memory.

NOTE: Catastrophic failures represent approximately 20 percent of ESD-related failures.

- **Intermittent** —The DIMM receives a static shock, but the tracing is merely weakened and does not immediately produce outward symptoms related to the damage. The weakened trace may take weeks or months to melt, and in the meantime may cause degradation of memory integrity, intermittent memory errors, etc.

NOTE: Intermittent failures represent approximately 80 percent of ESD-related failures. The high rate of intermittent failures means that most of the time when damage occurs, it is not immediately recognizable.

The more difficult type of damage to recognize and troubleshoot is the intermittent (also called latent or "walking wounded") failure. The following image shows an example of intermittent damage to a memory DIMM trace. Although the damage is done, the symptoms may not become an issue or cause permanent failure symptoms for some time after the damage occurs.

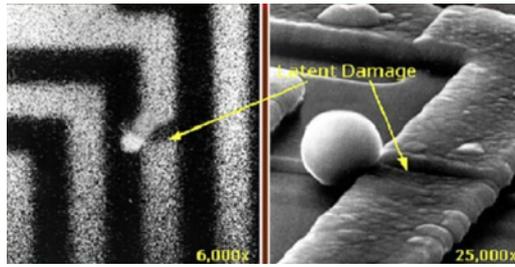


Figure 8. Intermittent (Latent) Damage to a Wiring Trace

Do the following to prevent ESD damage:

- Use a wired ESD wrist strap that is properly grounded.

The use of wireless anti-static straps is no longer allowed; they do not provide adequate protection.

Touching the chassis before handling parts does not ensure adequate ESD protection on parts with increased sensitivity to ESD damage.

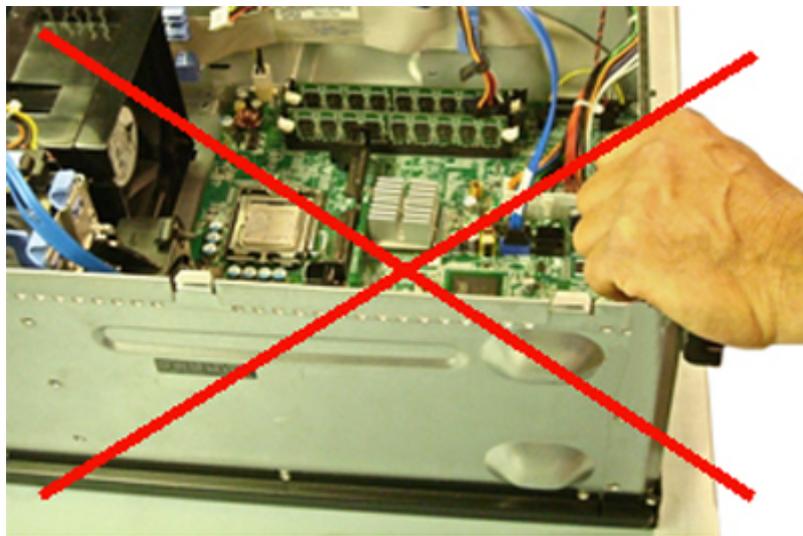


Figure 9. Chassis "Bare Metal" Grounding (Unacceptable)

- Handle all static-sensitive components in a static-safe area. If possible, use anti-static floor pads and workbench pads.
- When handling static-sensitive components, grasp them by the sides, not the top. Avoid touching pins and circuit boards.
- When unpacking a static-sensitive component from its shipping carton, do not remove the component from the anti-static packing material until you are ready to install the component. Before unwrapping the anti-static packaging, be sure to discharge static electricity from your body.
- Before transporting a static-sensitive component, place it in an anti-static container or packaging.

The ESD Field Service Kit

The unmonitored Field Service kit is the most commonly used. Each Field Service kit includes three main components: anti-static mat, wrist strap, and bonding wire.



Figure 10. ESD Field Service Kit

The anti-static mat is dissipative and should be used to safely place parts on during service procedures. When using an anti-static mat, your wrist strap should be snug and the bonding wire should be connected to the mat and to bare-metal on the system being worked on. Once deployed properly, service parts can be removed from the ESD bag and placed directly on the mat. Remember, the only safe place for ESD-sensitive items are in your hand, on the ESD mat, in the system, or inside a bag.



Figure 11. Anti-Static Mat

The wrist strap and bonding wire can be either directly connected between your wrist and bare metal on the hardware if the ESD mat is not required, or connected to the anti-static mat to protect hardware that is temporarily placed on the mat. The physical connection of the wrist strap and bonding wire between your skin, the ESD mat, and the hardware is known as bonding. Use only Field Service kits with a wrist strap, mat, and bonding wire. Never use wireless wrist straps.

Always be aware that the internal wires of a wrist strap are prone to damage from normal wear and tear, and must be checked regularly with a wrist strap tester in order to avoid accidental ESD hardware damage. It is recommended to test the wrist strap and bonding wire a minimum of once per week.

Table 23. Wrist Straps

Wrist Strap and Bonding Wire	Wireless ESD Strap (Unacceptable)
	

ESD Wrist Strap Tester

The wires inside of an ESD strap are prone to damage over time. When using an unmonitored kit, it is best practice to regularly test the strap prior to each service call, and at a minimum, test once per week. A wrist strap tester is the best method for doing this test. If you do not have your own wrist strap tester, check with your regional office to find out if they have one. To perform the test, plug the wrist-strap's bonding-wire into the tester while it is strapped to your wrist and push the button to test. A green LED is lit if the test is successful; a red LED is lit and an alarm sounds if the test fails.

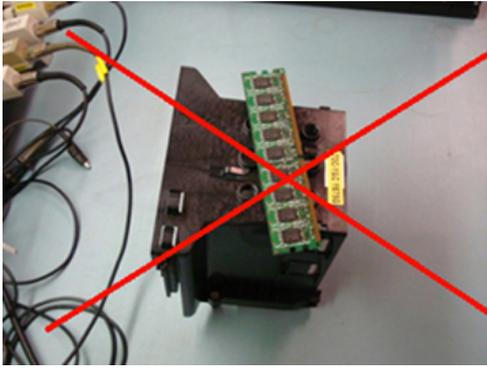
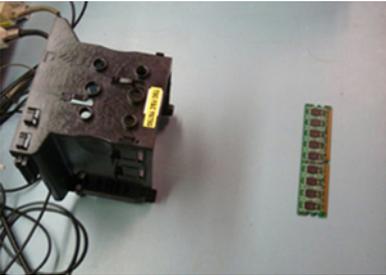


Figure 12. Wrist Strap Tester

Insulator Elements

It is critical to keep ESD sensitive devices, such as plastic heat sink casings, away from internal parts that are insulators and often highly charged.

Table 24. Placement of Insulator Elements

Unacceptable — DIMM lying on an insulator part (plastic heat sink shroud)	Acceptable — DIMM separated from the insulator part
	

Consider the Working Environment

Before deploying the ESD Field Service kit, assess the situation at the customer location. For example, deploying the kit for a server environment is different than for a desktop or portable environment. Servers are typically installed in a rack within a data center; desktops or portables are typically placed on office desks or cubicles.

Always look for a large open flat work area that is free of clutter and large enough to deploy the ESD kit with additional space to accommodate the type of system that is being repaired. The workspace should also be free of insulators that can cause an ESD event. On the work area, insulators such as Styrofoam and other plastics should always be moved at least 12 inches or 30 centimeters away from sensitive parts before physically handling any hardware components.

ESD Packaging

All ESD-sensitive devices must be shipped and received in static-safe packaging. Metal, static-shielded bags are preferred. However, you should always return the damaged part using the same ESD bag and packaging that the new part arrived in. The ESD bag should be folded over and taped shut and all the same foam packing material should be used in the original box that the new part arrived in.

ESD-sensitive devices should be removed from packaging only at an ESD-protected work surface, and parts should never be placed on top of the ESD bag because only the inside of the bag is shielded. Always place parts in your hand, on the ESD mat, in the system, or inside an anti-static bag.



Figure 13. ESD Packaging

Transporting Sensitive Components

When transporting ESD-sensitive components such as replacement parts or parts to be returned to Dell, it is critical to place these parts in anti-static bags for safe transport.

ESD Protection Summary

It is strongly suggested that all field service engineers use the traditional wired ESD grounding wrist strap and protective anti-static mat at all times when servicing Dell products. In addition, it is critical that engineers keep sensitive parts separate from all insulator parts while performing service and that they use anti-static bags for transporting sensitive components.

Lifting Equipment

NOTE: Do not lift greater than 50 pounds. Always obtain assistance from another person or persons, or use a mechanical lifting device.

Adhere to the following guidelines when lifting equipment:

1. Get a firm balanced footing. Keep your feet apart for a stable base, and point your toes out.
2. Bend your knees. Do not bend at the waist.
3. Tighten stomach muscles. Abdominal muscles support your spine when you lift, offsetting the force of the load.
4. Lift with your legs, not your back.
5. Keep the load close. The closer it is to your spine, the less force it exerts on your back.
6. Keep your back upright, whether lifting or setting down the load. Do not add the weight of your body to the load. Avoid twisting your body and back.
7. Follow the same techniques in reverse to set the load down.

After working inside your computer

After you complete any replacement procedure, ensure that you connect external devices, cards, and cables before turning on your computer.

CAUTION: To avoid damage to the computer, use only the battery designed for this particular Dell computer. Do not use batteries designed for other Dell computers.

1. Connect any external devices, such as a port replicator or media base, and replace any cards, such as an ExpressCard.
2. Connect any telephone or network cables to your computer.

CAUTION: To connect a network cable, first plug the cable into the network device and then plug it into the computer.

3. Connect your computer and all attached devices to their electrical outlets.
4. Turn on your computer.

Recommended tools

The procedures in this document require the following tools:

- Phillips #0 screwdriver
- Phillips #1 screwdriver
- Plastic scribe
- 5.5 mm Socket wrench
- A pair of tweezers

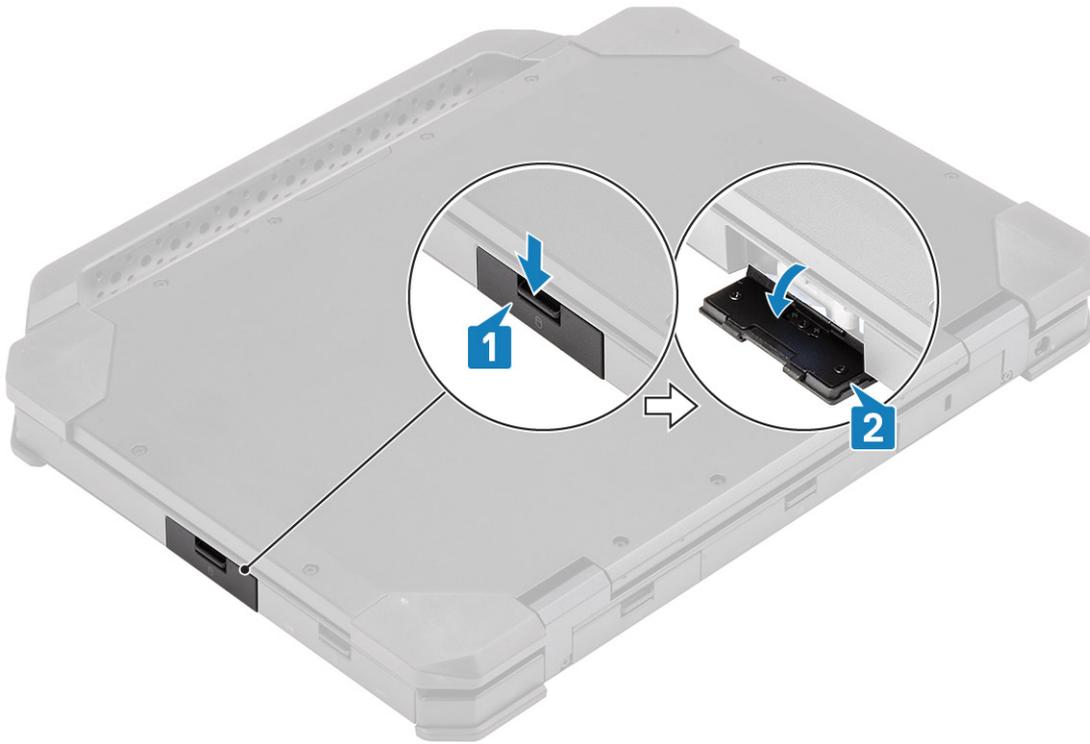


NOTE: The #0 screw driver is for screws 0-1 and the #1 screw driver is for screws 2-4.

Stylus

Removing the stylus

1. Press the latch [1] and open the right I/O door [2].



2. Withdraw the stylus out of the slot.



Installing the stylus

1. Insert the stylus in the slot.



2. Close the I/O door [1] and press the door until it latches [2].



SIM card

Removing the SIM card

1. Remove the SIM card out of the slot on the system board.



2. Close the [right I/O door](#).
3. Follow the procedure in [After working inside your computer](#).

Installing the SIM card

1. Follow the procedure in [Before working inside your computer](#).
2. Open the [right I/O door](#).
3. Insert the SIM card into the slot on the system board.



Memory card

Installing the memory card

1. Open the [right I/O door](#).
2. Insert the memory card in the slot on the system board.



Removing the memory card

1. Remove the memory card from the slot on the system board.



2. Close the [right I/O door](#).

Handle

Removing the Handle

1. Follow the procedure in [Before working inside your computer](#).
2.  **CAUTION:** The following epoxy screw locations require additional focus. These screws are difficult to remove and can be damaged during the removal process. To prevent damage to the screws and surrounding plastics, use the correct screwdriver for each screw .

Remove the two epoxy M3.5*7 screws [1] that secures the handle to the computer.

3. Separate the handle from the computer [2].



Installing the Handle

1. Install the handle on the computer [1].
2. Tighten the two epoxy M3.5*7 screws [2] securing the handle to the computer.

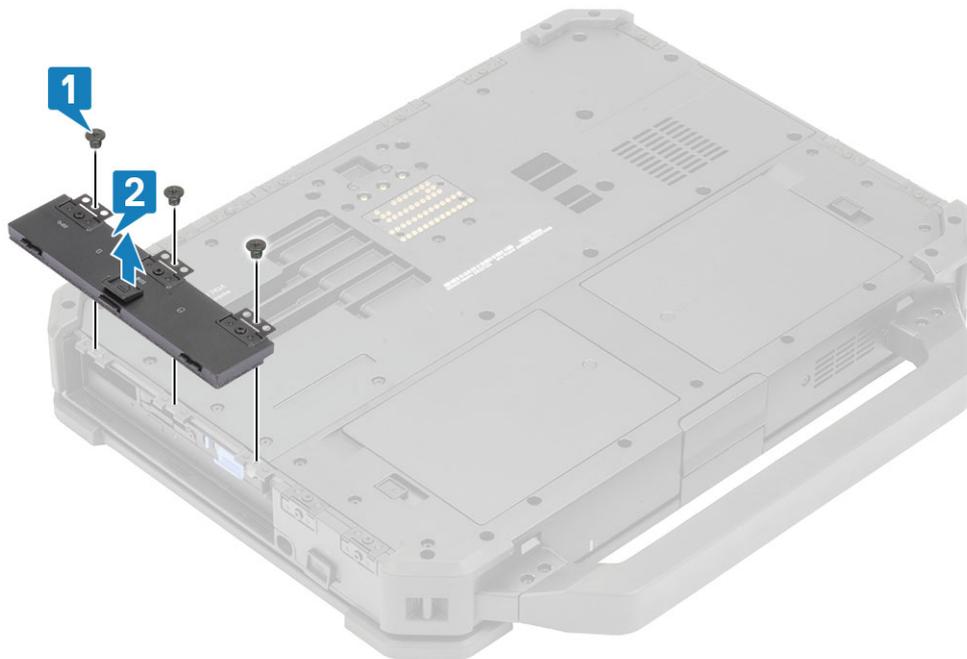


3. Follow the procedure in [After working inside your computer](#).

Latch Doors

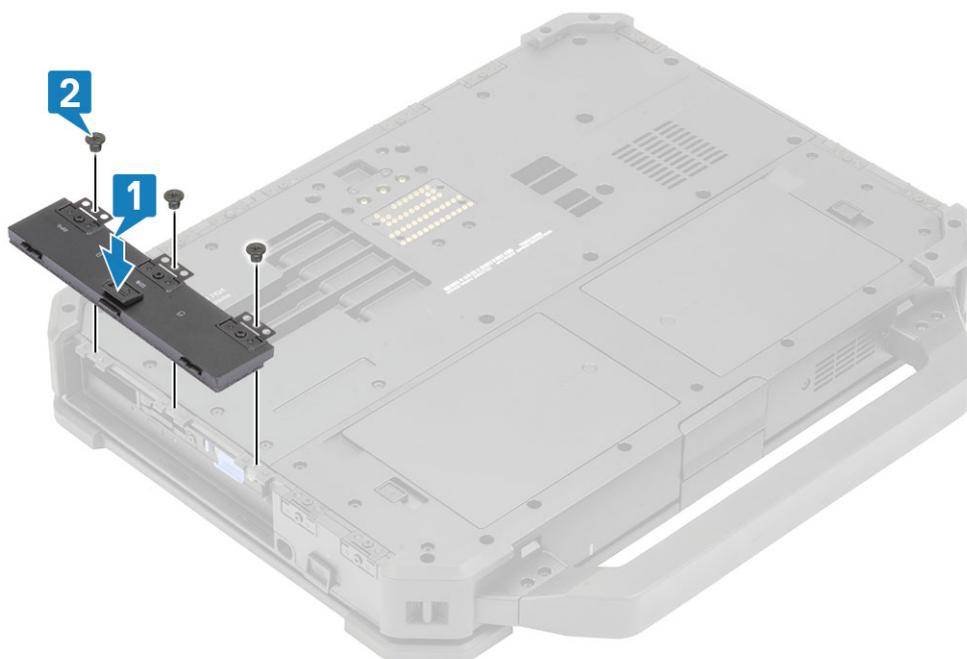
Removing the latch doors

1. Follow the procedure in [Before working inside your computer](#).
2. Open the I/O door.
3. Remove the screws [1] securing door hinges to the computer and lift the I/O door [2] away from the computer.



Installing the latch doors

1. Install the door on the computer [1].
2. Install the screws securing door hinges to the computer [2].



3. Lock the I/O door.
 4. Follow the procedure in [After working inside your computer](#).
- NOTE:** Depending on its location each door may have one, two, or three screws.

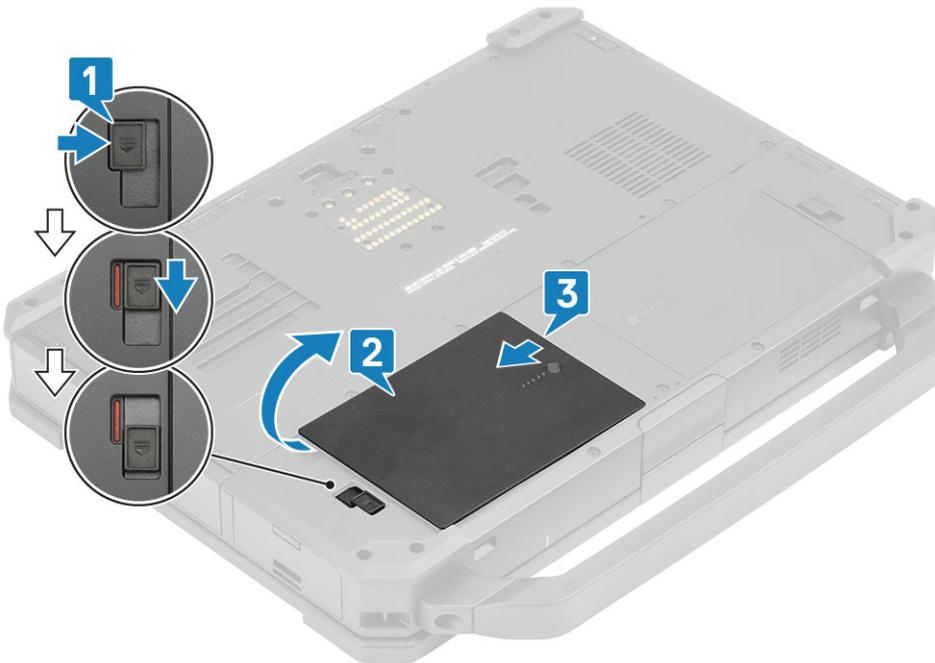
Battery

Removing the Battery

1. **NOTE:** This laptop can accommodate two hot-swap capable batteries(primary and optional), both the batteries follows the same installation and removal procedure.

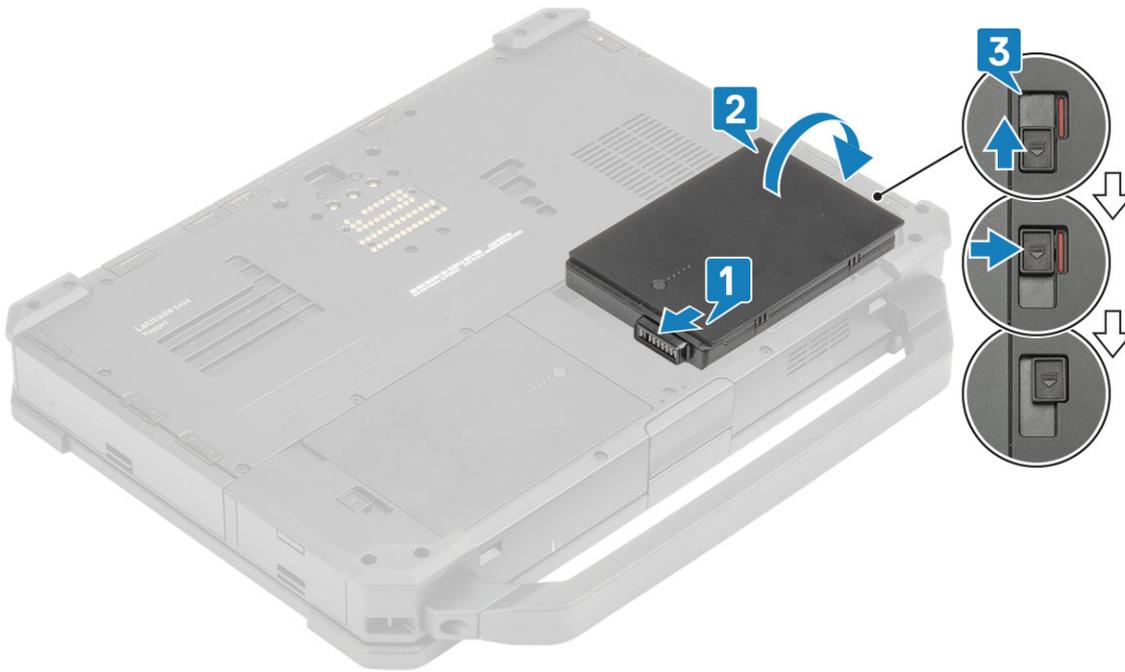
Follow the procedure in [Before working inside your computer](#).

2. Unlock the battery [1] and slide the latch along the groove to disengage locking mechanism.
3. Pry on the recess point [2] and slide the battery forward [3] to remove it from the computer.



Installing the Batteries

1. Slide in the battery in battery bay to align the battery contacts[1], with one on the computer.
2. Press the edge of the battery [2] to engage the latch mechanism and lock the battery [3].



3. Follow the procedure in [After working inside your computer](#).

NOTE: This laptop can accommodate two hot-swap capable batteries(primary and optional), both the batteries follows the same installation and removal procedure.

Secondary SSD carrier

Removing the Secondary SSD carrier

1. Follow the procedure in [Before working inside your computer](#).
2. Open the [right I/O door](#).
3. Release the SSD carrier by sliding the blue hard drive release latch towards left [1].
4. Pull the SSD carrier out of the system using the blue tab [2].



Installing the Secondary SSD carrier

1. Slide the secondary SSD carrier [1] in to the slot on the computer.
2. Push the carrier in the slot until blue tab clicks and close the right I/O door [2].



3. Follow the procedure in [After working inside your computer](#).

Primary SSD carrier

Removing the Primary SSD carrier

1. Follow the procedure in [Before working inside your computer](#).

CAUTION: Attempt to retrieve the primary SSD carrier from an operational computer can cause operating system crash and potential data loss.

2. Remove the: [Batteries](#).
3. Release the SSD carrier by sliding the blue hard drive release latch [1] towards right.
4. Slide the SSD carrier out of the computer using the blue pull tab [2] out of the computer.



Installing the Primary SSD carrier

1. Insert the primary SSD carrier [1] in to the computer.
2. Push the carrier into the slot until the blue tab clicks and close the right I/O door [2].



3. Install the: [Batteries](#)
4. Follow the procedure in [After working inside your computer](#).

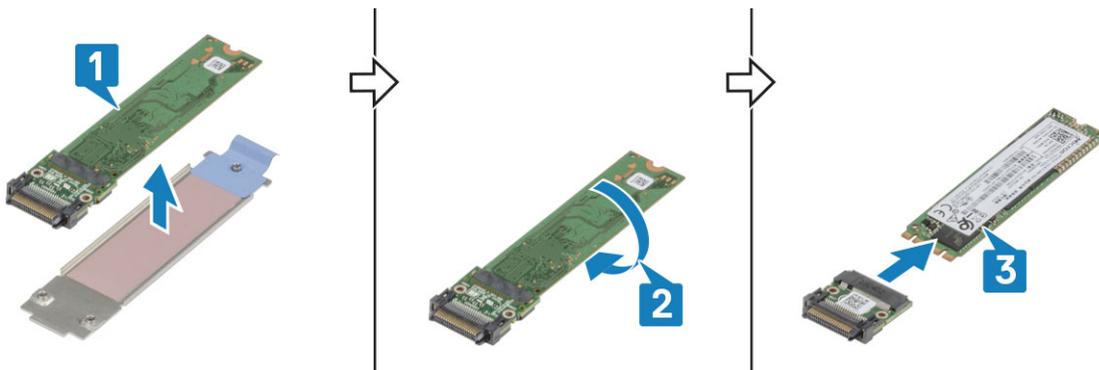
SSD

Removing the SSD from carrier

1. Follow the procedure in [Before working inside your computer](#).
2. Remove the:
 - a. Batteries.
 - b. SSD(Primary or Secondary).
3. Remove the two 'M2*5' screws [1] and flip over the SSD carrier [2].
4. Remove the single 'M2*5' screw [3] and separate the cover from the SSD carrier [4].

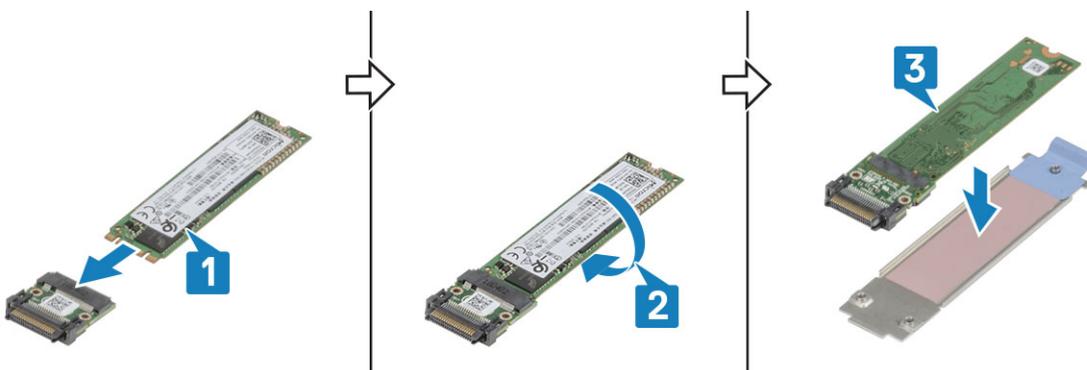


5. Separate the SSD and interposer [1] from the SSD carrier tray.
6. Flip over the assembly [2] and disconnect the SSD from the interposer [3].

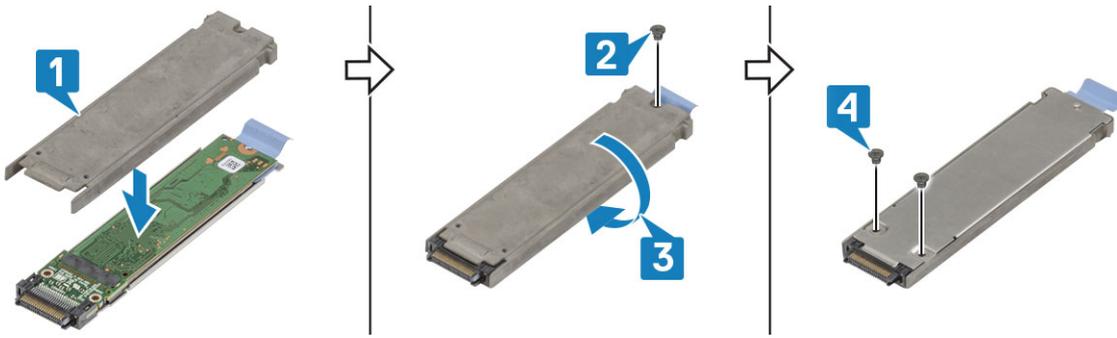


Installing the SSD in carrier

1. Connect the SSD to the interposer [1], flip over [2].
2. Install the SSD with interposer on the SSD carrier tray preassembled with new thermal pad [3].



3. Install the cover [1] on the SSD carrier and install the single 'M2*5' screw [2].
4. Flip over the SSD carrier [3] and tighten the two 'M2*5' screws [4] securing the cover to the SSD carrier.



5. Install the:
 - a. SSD(Primary or Secondary).
 - b. Batteries
6. Follow the procedure in [After working inside your computer.](#)

HDD carrier

Removing the Hard Drive carrier

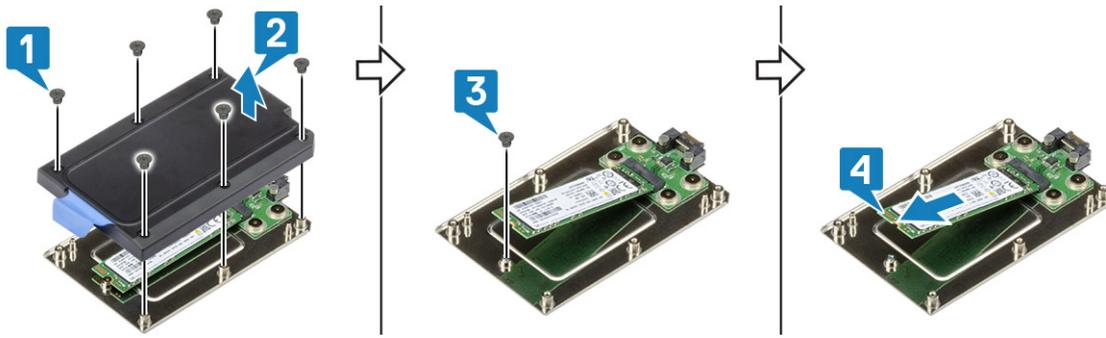
1. Follow the procedure in [Before working inside your computer.](#)
2. Remove the: [Batteries.](#)
3. Press the blue latch [1] and slid the HDD carrier out of the slot on the system [2]



4. **NOTE:** Depending on the configuration ordered the system may have a Hard Drive or a Solid State Drive in the carrier. The installation and removal procedure remains same.

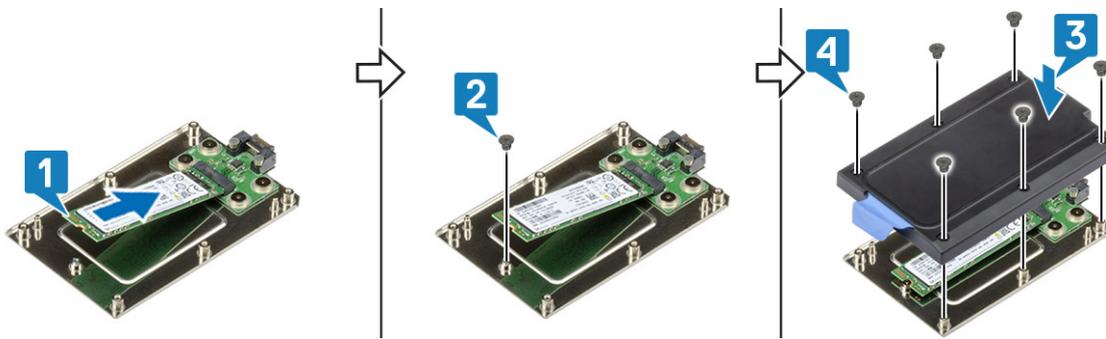
Remove the six screws [1] and lift the cover from the top of the carrier [2].

5. Remove the single screw [3] and slid the SSD out of the carrier [4].



Installing the Hard Drive carrier

1. Slide the SSD in the carrier [1] and secure it using the single screw [2].
2. Secure the cover on the carrier [3] and tighten the six screws [4].



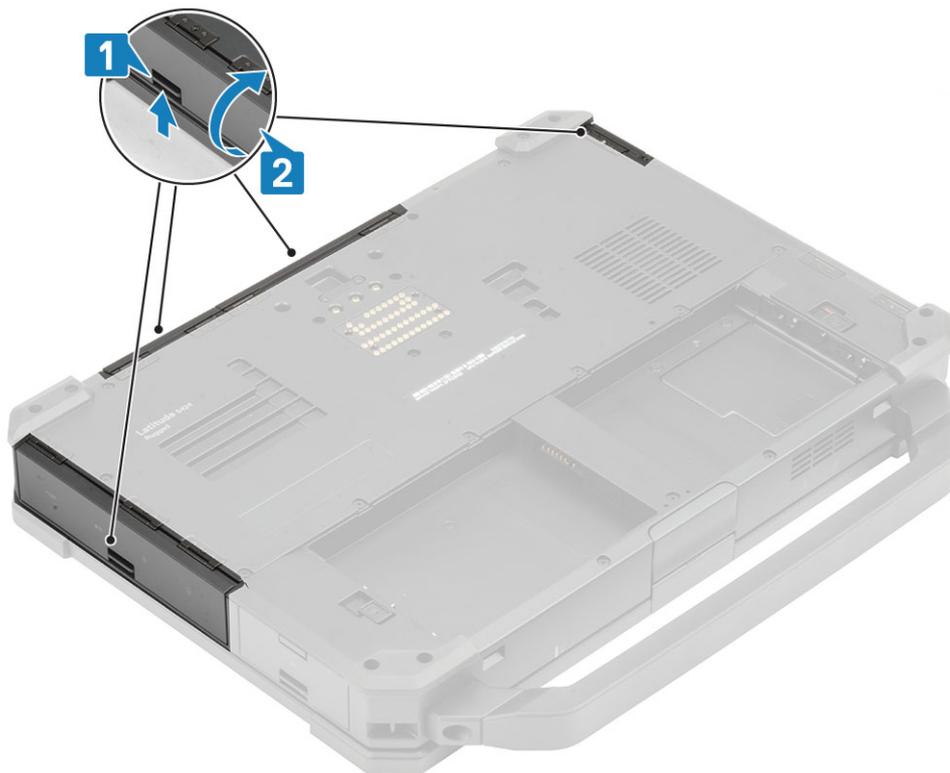
3. Slide the HDD carrier in the slot [1] and close the IO door [2]



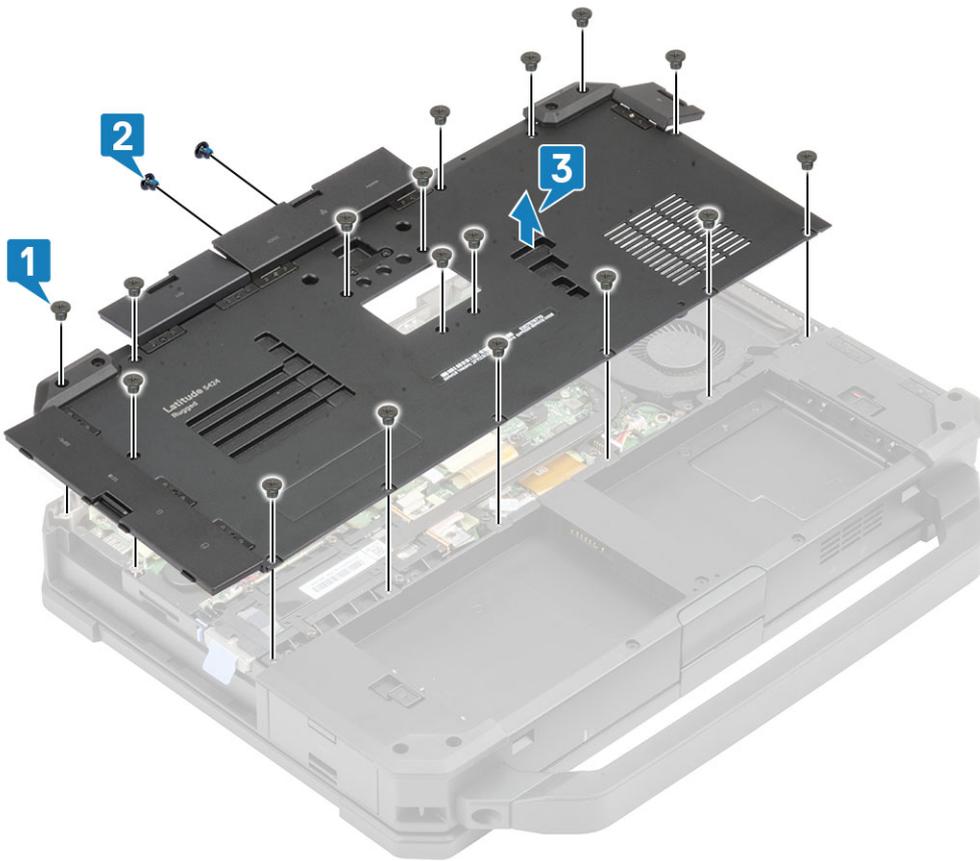
Bottom Chassis Cover

Removing the Bottom Chassis Cover

1. Follow the procedure in [Before working inside your computer](#).
2. Remove the:
 - a. [Batteries](#).
3. Unlock [1] and open the left, right, and rear I/O door [2].

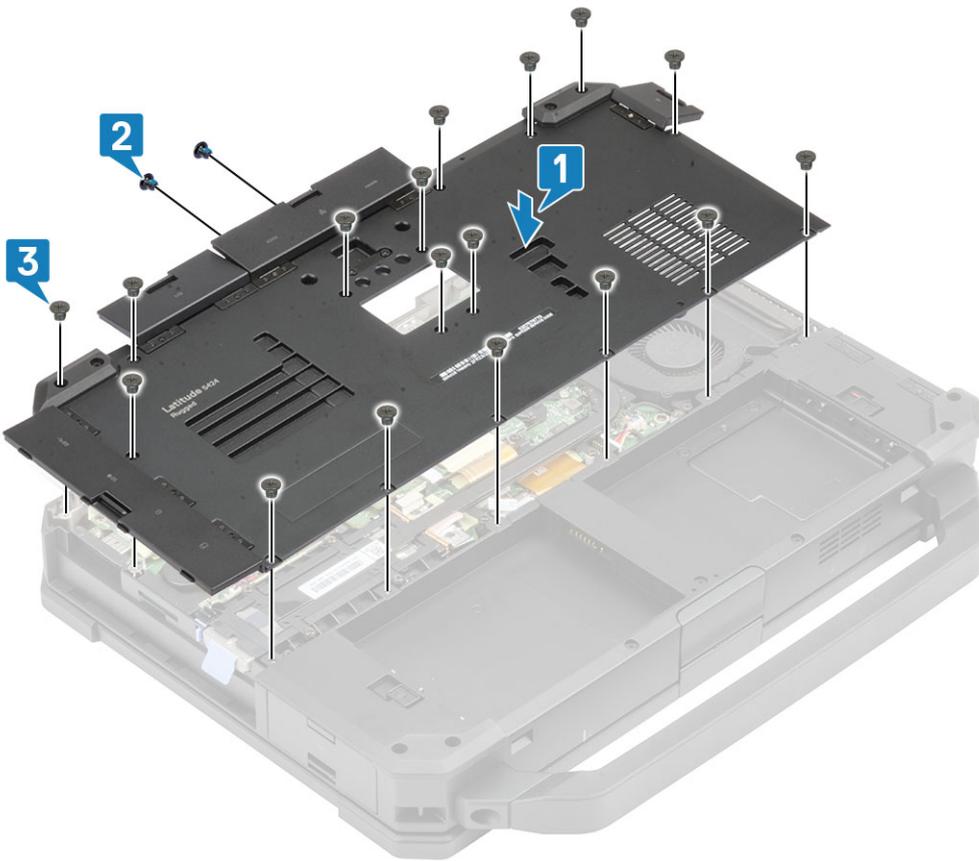


4. Remove the 19 'M2.5*5' screws on the bottom chassis cover [1], two 'M2.5*6' screws [2] in the rear I/O space.
5. Remove the bottom chassis cover [3] from the computer.



Installing the Bottom Chassis Cover

1. Install the bottom chassis cover over the bottom base [1] of the computer.
2. Install the two 'M2.5*6' screws [2] in the rear I/O space and 19 'M2.5*5' screws [3] on the bottom chassis cover.



3. Close the left, right, and rear I/O doors.

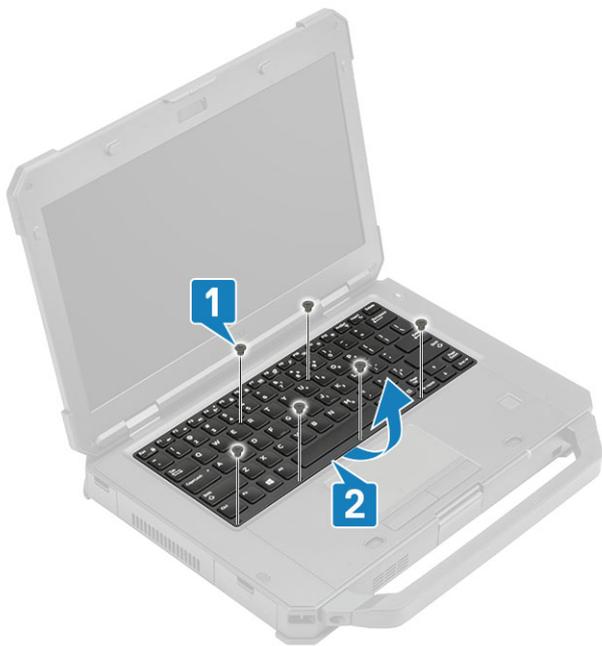


4. Install the:
 - a. [Batteries](#)
5. Follow the procedure in [After working inside your computer](#).

Keyboard

Removing the Keyboard

1. Follow the procedure in [Before working inside your computer](#).
2. Remove the: [Batteries](#).
3. Remove the six 'M2.5*5' screws on the keyboard [1] and pry at the bottom edge of the keyboard [2].



4. Slide the keyboard slightly [1] towards touch pad and flip it over inclined over the LCD panel [2].



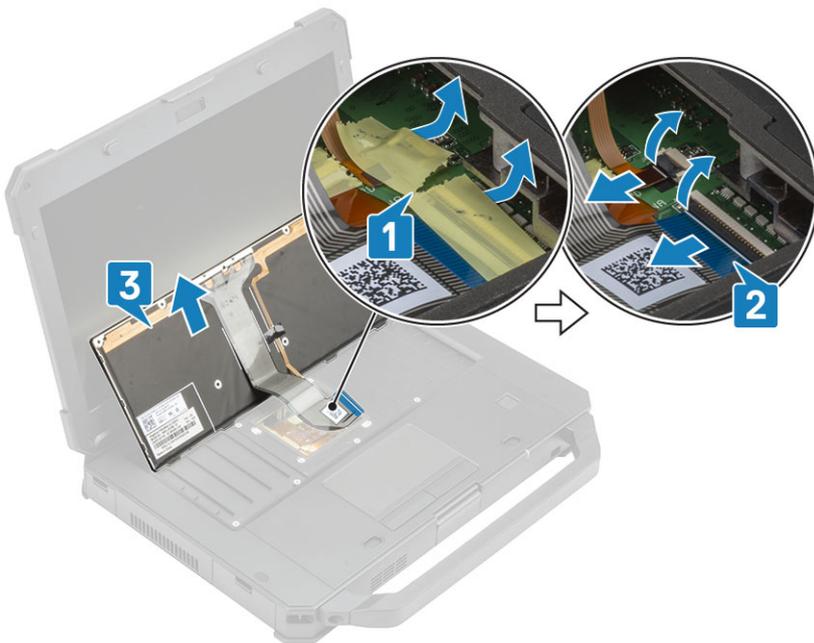
5. Remove the four 'M2*3' screws [1] on the keyboard cover and remove it from the computer [2].



6. Peel-off the tape on the keyboard and back-light FPC [1] and disconnect it from the system board [2].

i **NOTE:** Tweezers might be required to access the keyboard and back-light FPC connectors on the system board.

7. Separate the keyboard from the system [3].



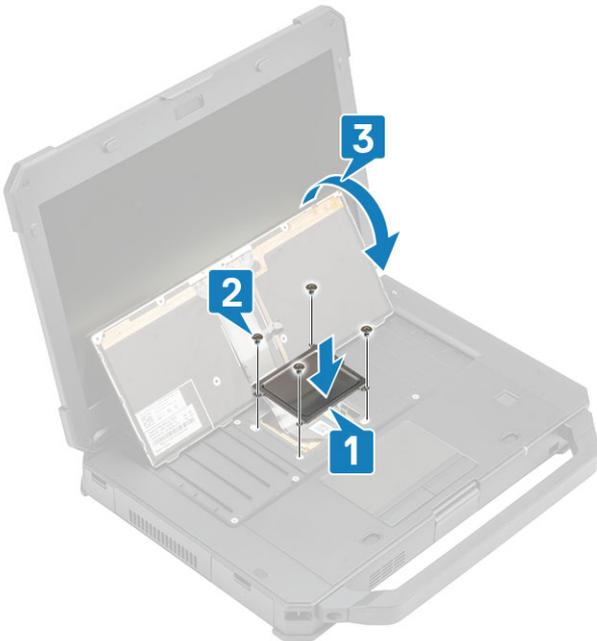
Installing the Keyboard

1. Install the keyboard [1] and connect the keyboard and back-light FPC to the system board [2].

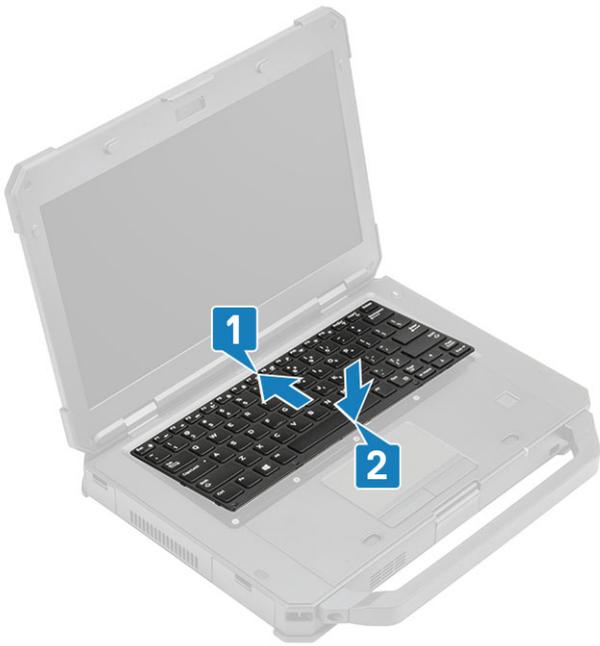
2. Secure keyboard and back-light FPC connections using an insulation tape [3].



3. Install the keyboard cover [1] and tighten the four 'M2*3' screws [2] to secure it to the chassis.
4. Flip the keyboard [3] over on the chassis [3].



5. Slide the keyboard towards LCD [1] to align it to screw holes [2].



6. Install the six 'M2.5*5' screws on the keyboard to secure it to the computer.



7. Follow the procedure in [After working inside your computer](#).

WWAN card

Removing the WWAN card

1. Follow the procedure in [Before working inside your computer](#).
2. Remove the:
 - a. [Batteries](#)
 - b. [Bottom chassis cover](#)
3. Remove the single 'M2*3' screw [1], remove the metal bracket [2] on the WWAN card.
4. Disconnect the antennae cables [3] and remove the WWAN card [4] out of the M.2 slot on the system board.



Installing the WWAN card

1. Install the WWAN card in the M.2 slot [1] on the system board and connect the antennae cables [2].
2. Secure the WWAN card using the metal bracket [3] and tighten the single M2.3 screw [4] securing the WWAN card to the system board.



3. Install the:
 - a. [Bottom chassis cover](#)

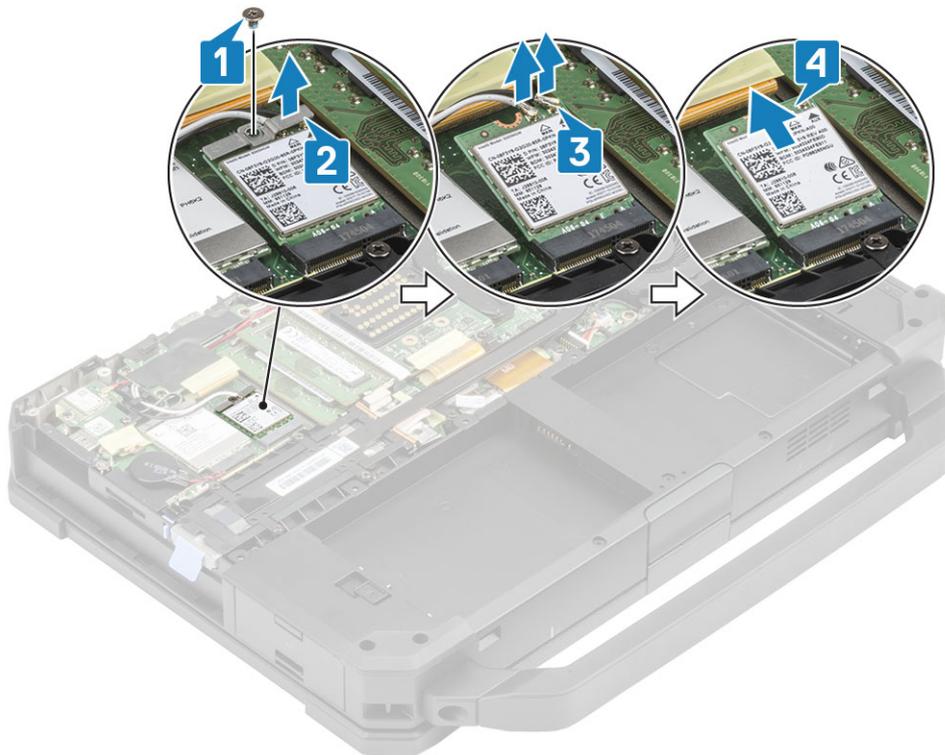
b. Batteries

4. Follow the procedure in [After working inside your computer](#).

WLAN card

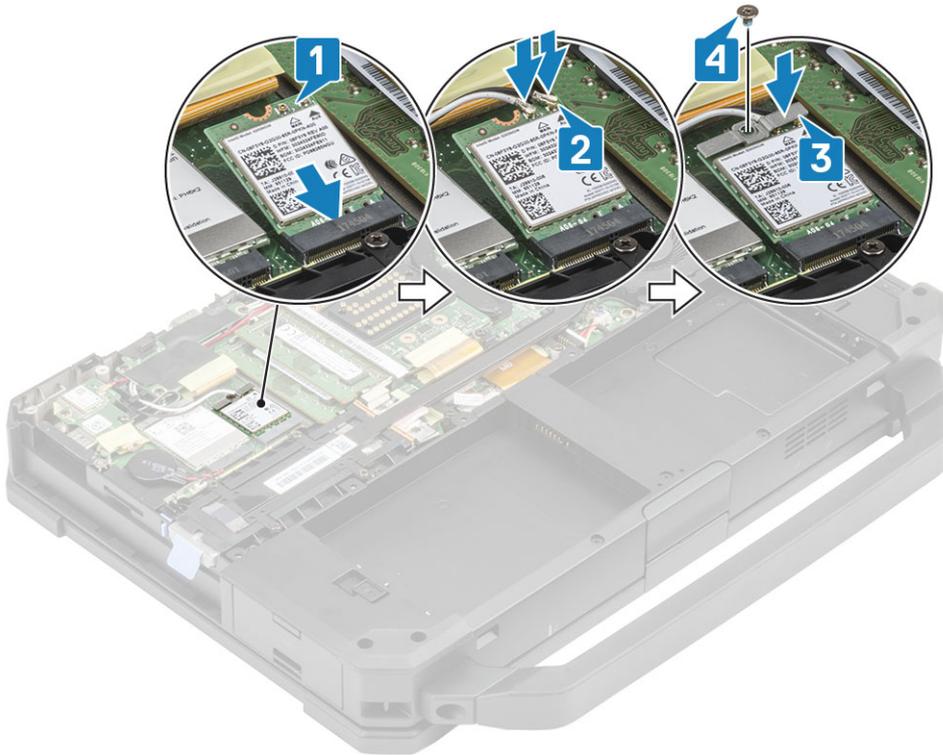
Removing the WLAN card

1. Follow the procedure in [Before working inside your computer](#).
2. Remove the:
 - a. Batteries
 - b. Bottom chassis cover
3. Remove the single 'M2*3' screw [1] and remove the metal bracket [2] on the WLAN card.
4. Disconnect the antennae cables [3] and remove the WLAN card out from the M.2 slot [4] on the system board.



Installing the WLAN card

1. Install the WLAN card into the M.2 slot [1] on the system board and connect the antennae cables [2].
2. Place the metal bracket on the WLAN card [3] and secure it using the single 'M2*3' screw [4].

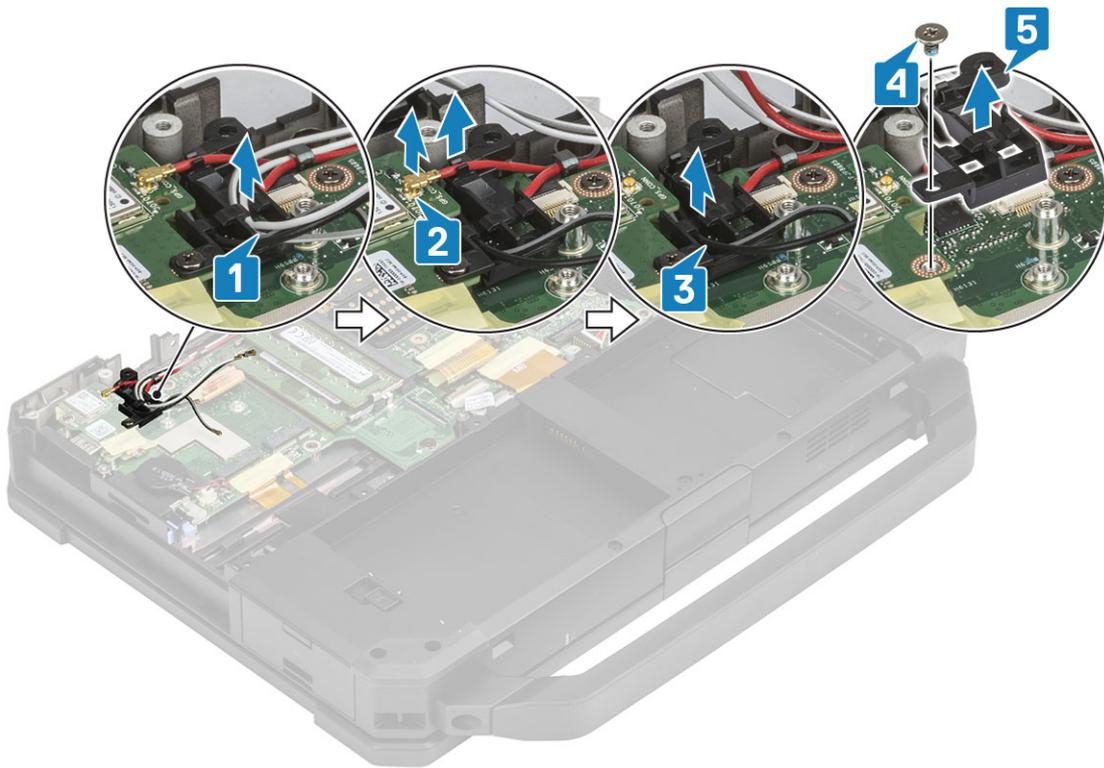


3. Install the:
 - a. Batteries
 - b. Bottom chassis cover
4. Follow the procedure in [After working inside your computer](#).

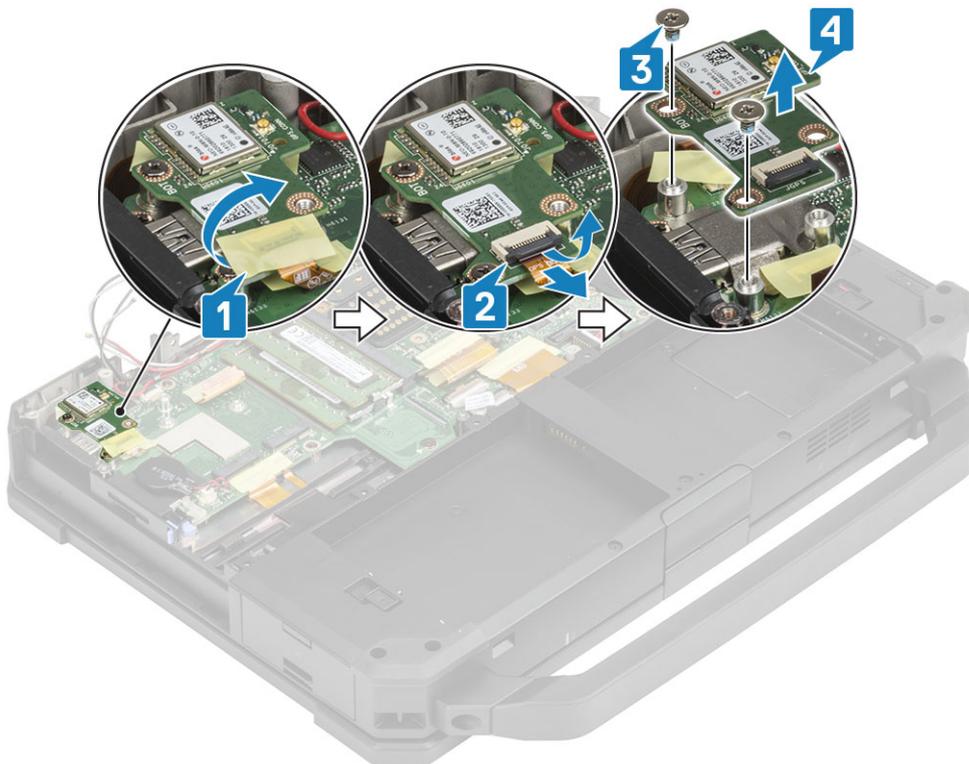
Global Positioning System (GPS)

Removing the GPS module

1. Follow the procedure in [Before working inside your computer](#).
2. Remove the:
 - a. Batteries
 - b. Bottom chassis cover
 - c. Rear I/O board
3. Unroute the aux cables [1] for WLAN and WWAN and disconnect the antennae cable [2] on GPS module.
4. Unroute the main antennae cables [3] and loosen the single 'M2.5*5' screw [4] to separate the RF bracket [5] from the system board.

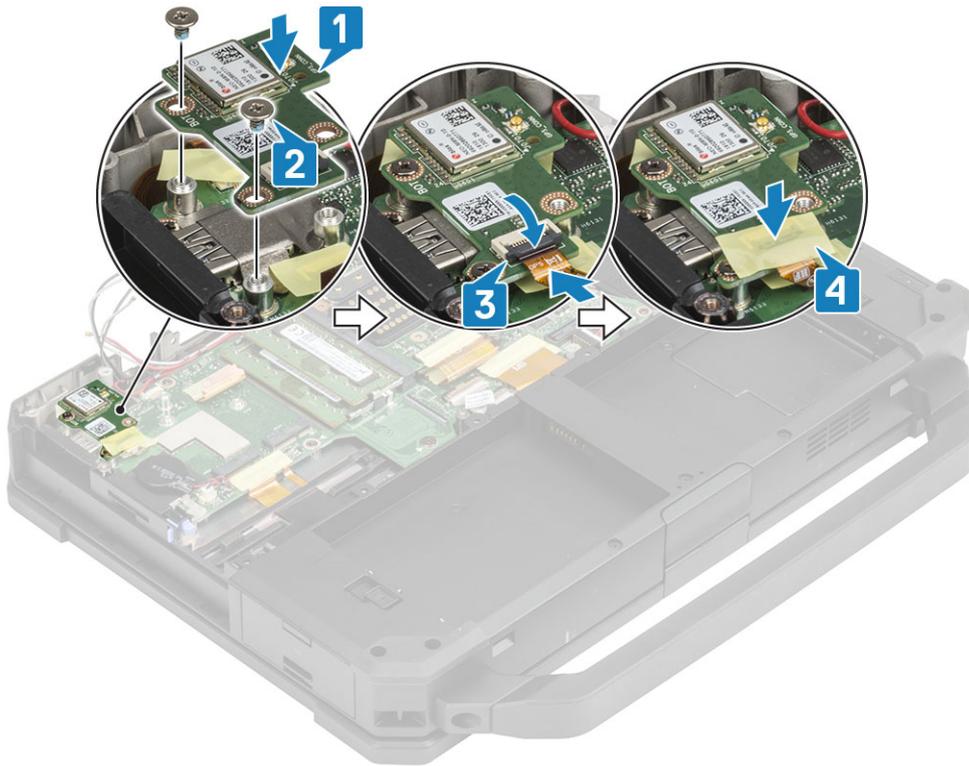


5. Peel off the inductive tape on the GPS FPC connector [1] and disconnect the GPS FPC connector [2] from GPS module.
6. Remove the two 'M2.5*5' screws [3] and separate the GPS module [4] from the system board.

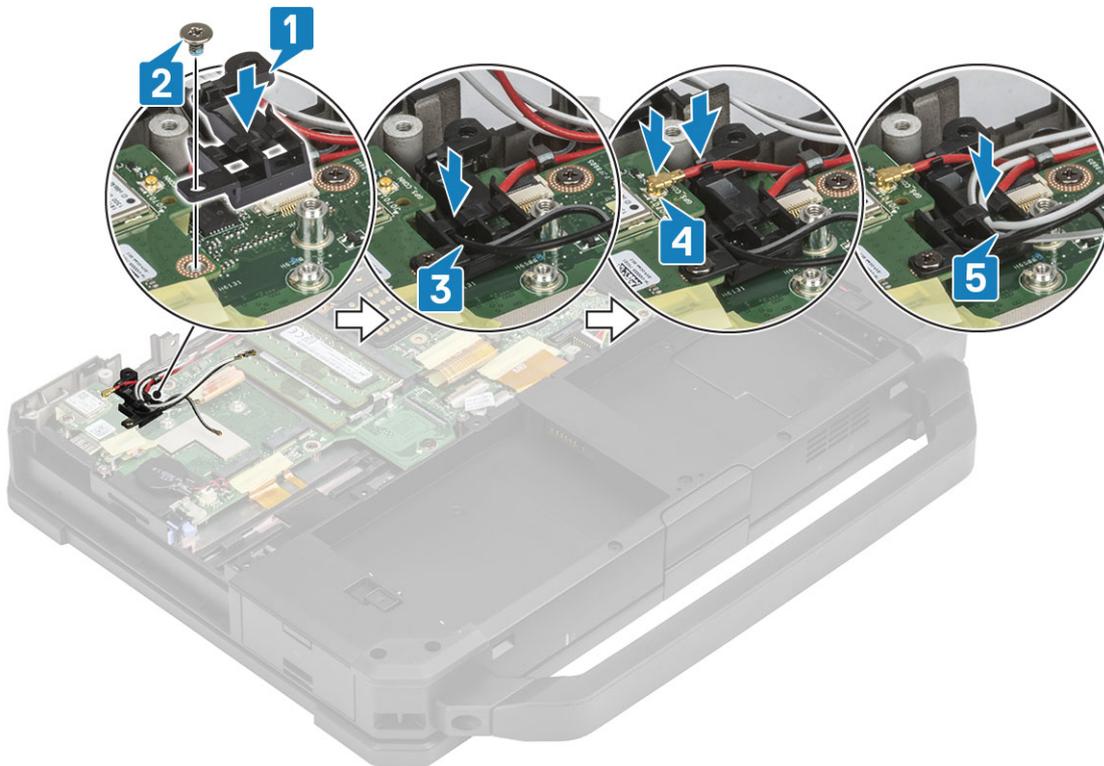


Installing the GPS module

1. Align and place the GPS module on the system board and tighten the two 'M2.5*5' screws on GPS module [2].
2. Connect the GPS FPC(system board side first) [3] and secure it using a piece of tape [4].



3. Install the RF bracket [1] on the system board and secure it using the single 'M2.5*5' screw [2].
4. Route the aux cables for WLAN and WWAN cards through the RF bracket [3].
5. Connect the antennae cable [4] on GPS module and route the main antennae cables [5] through the RF bracket.

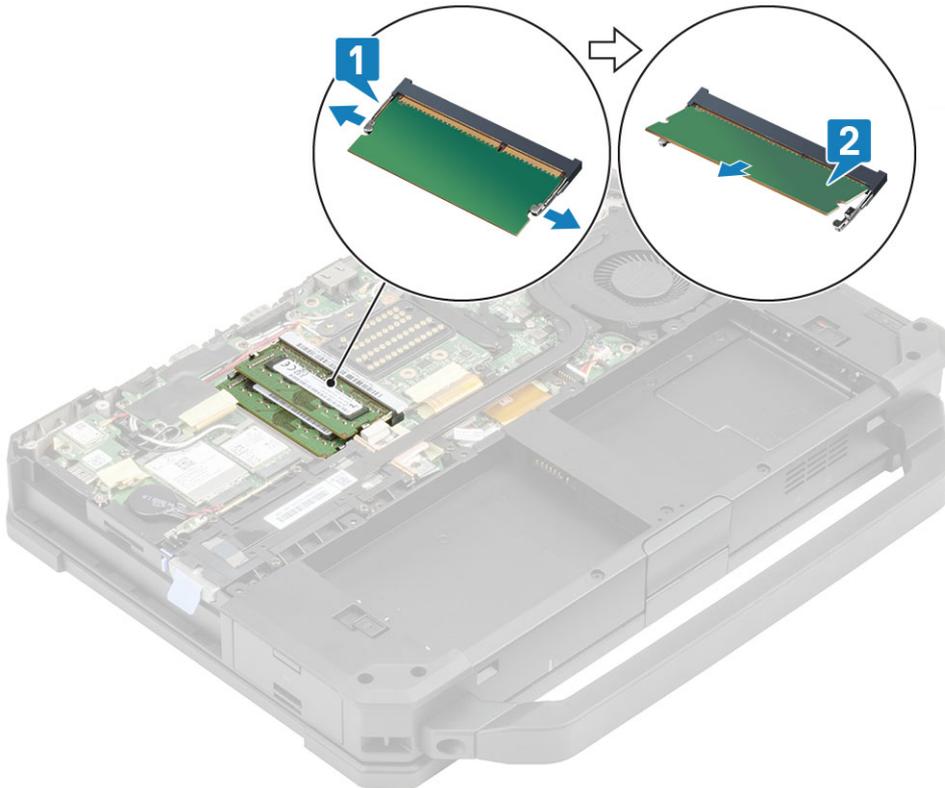


6. Install the:
 - a. Rear I/O board
 - b. Bottom Chassis Cover
 - c. Batteries
7. Follow the procedure in [After working inside your computer.](#)

Memory modules

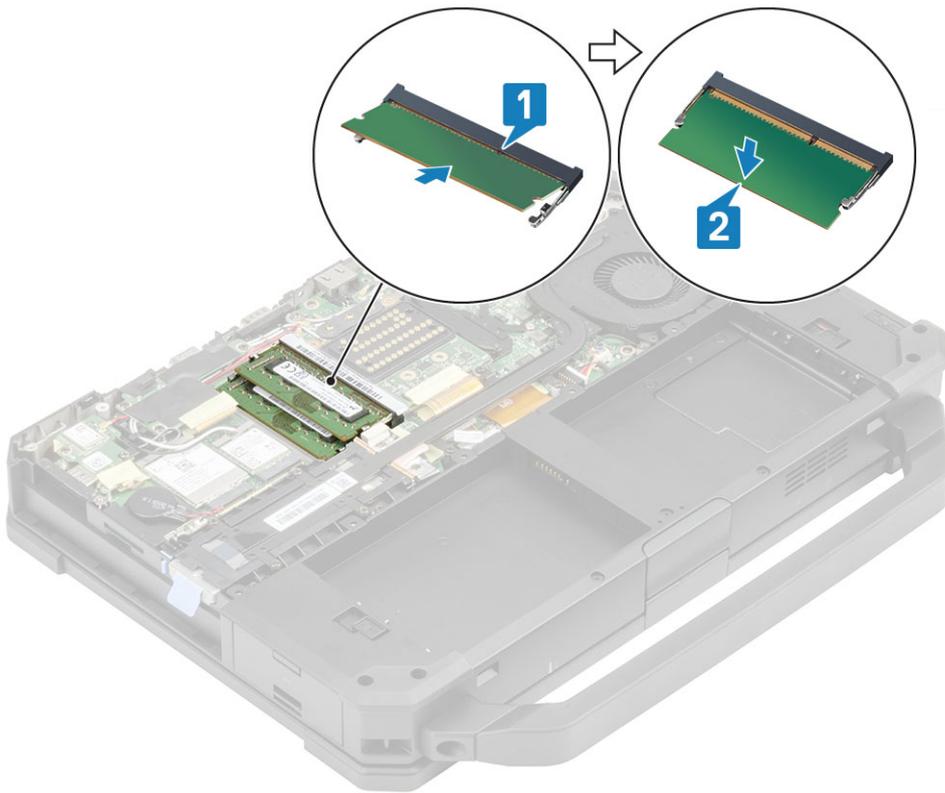
Removing the Memory

1. Follow the procedure in [Before working inside your computer](#).
2. Remove the:
 - a. [Batteries](#)
 - b. [Bottom chassis cover](#)
3. Pull the clips securing the memory module [1] until the socket disengages and remove the memory module from the memory socket [2] on the system board.



Installing the Memory

1. Align and insert the memory module along the keyed notch [1] at an acute angle and press the memory module [2] until securing clips engages.



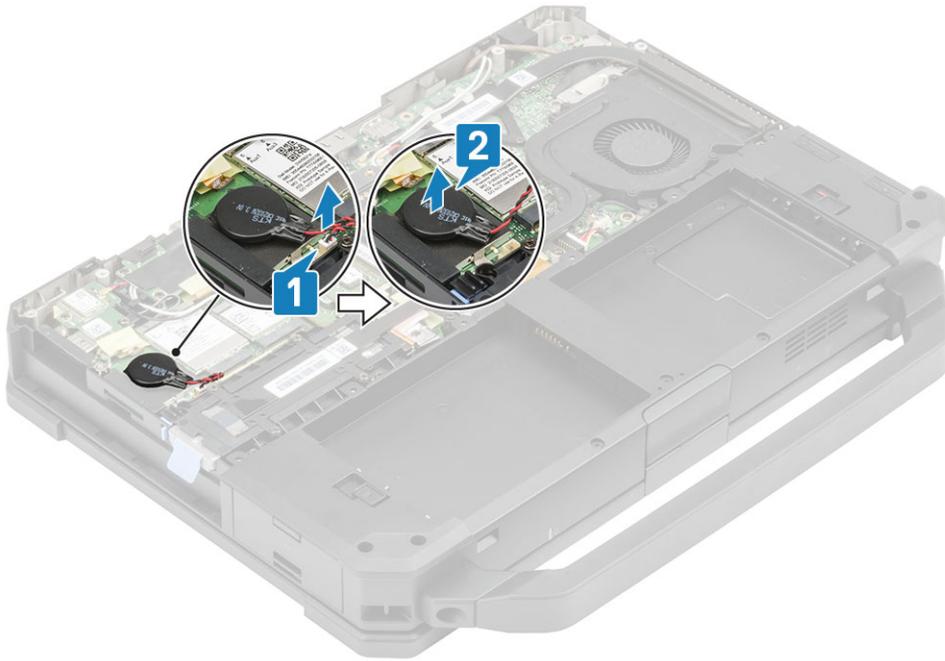
2. Install the:
 - a. [Batteries](#)
 - b. [Bottom Chassis Cover](#)
3. Follow the procedure in [After working inside your computer](#).

Coin-cell battery

Removing the Coin cell

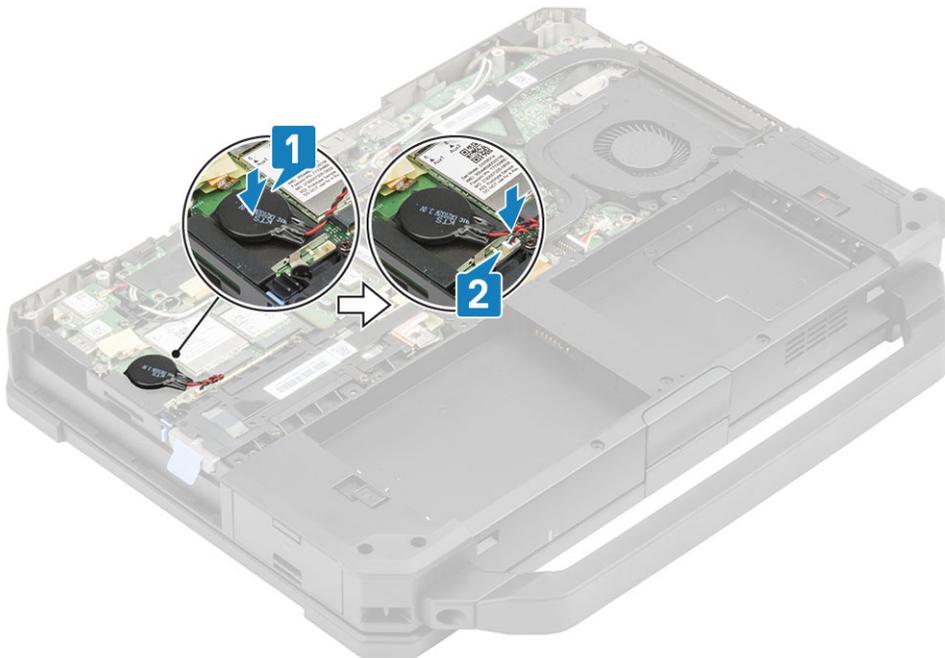
1. Follow the procedure in [Before working inside your computer](#).
2. Remove the:
 - a. [Bottom chassis cover](#)
 - b. [Batteries](#)
3.  **NOTE:** Removing or Disconnecting the coin cell may reset systemboard / BIOS / system time to defaults or engage bit locker or other similar security protocol devices.

Disconnect the coin cell connector from the system board [1] and remove it from the system [2].



Installing the Coin cell

1. Install the coin cell [1] and connect the coin cell connector to the system board [2].

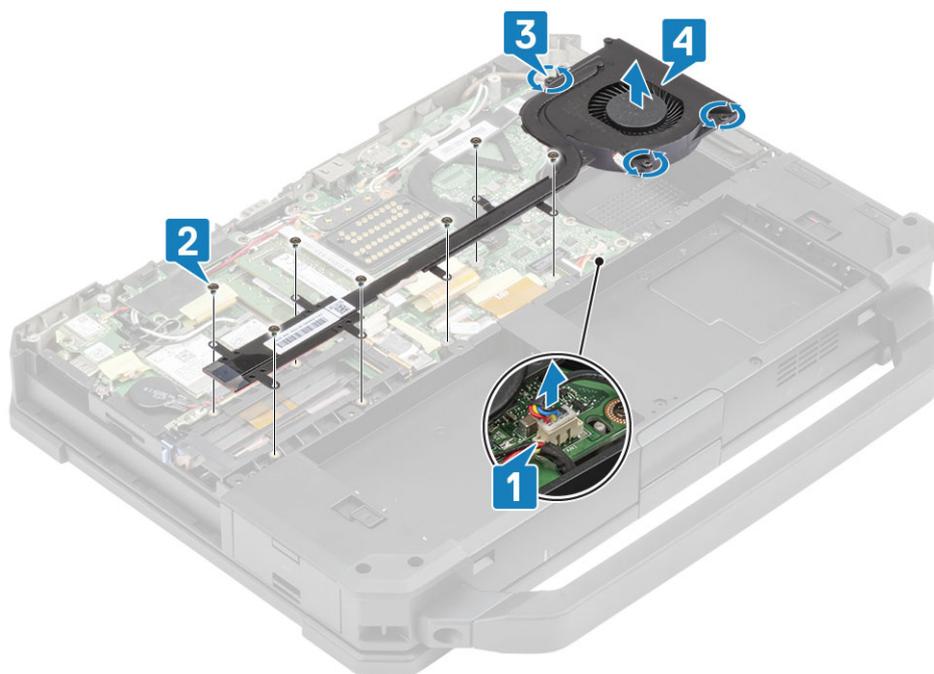


2. Install the:
 - a. [Bottom chassis cover](#)
 - b. [Batteries](#)
3. Follow the procedure in [After working inside your computer](#).

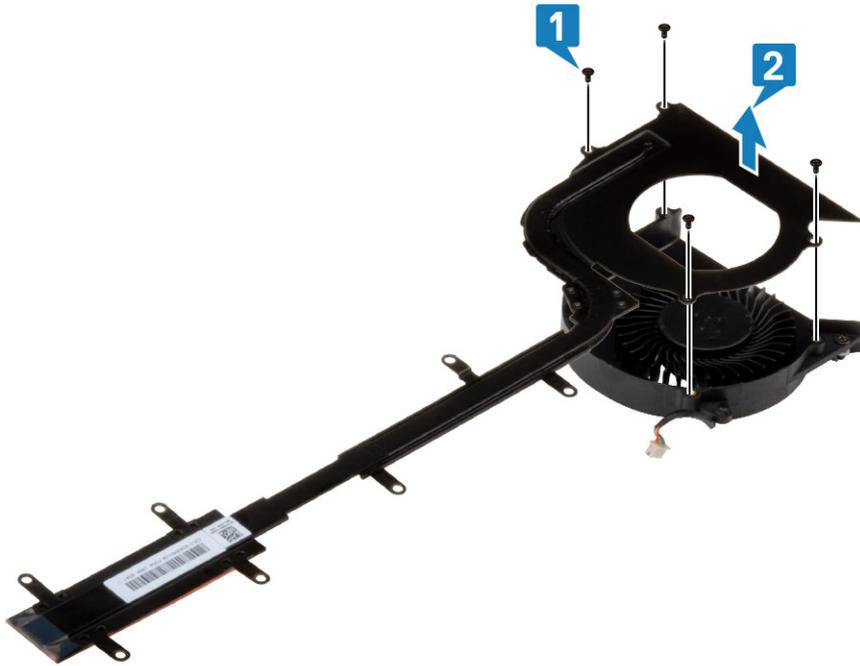
PCIe Heatsink Fan Assembly

Removing the PCIe Heatsink fan assembly

1. Follow the procedure in [Before working inside your computer](#).
2. Remove the:
 - a. [Batteries](#)
 - b. [Bottom chassis cover](#)
3. Disconnect the fan cable [1] from the system board.
4. Remove the seven 'M2.5*5' screws [2] from the heat sink pipe and loosen the three captive screws from fan case [3].
5. Remove the PCIe heatsink fan assembly from the computer [4].

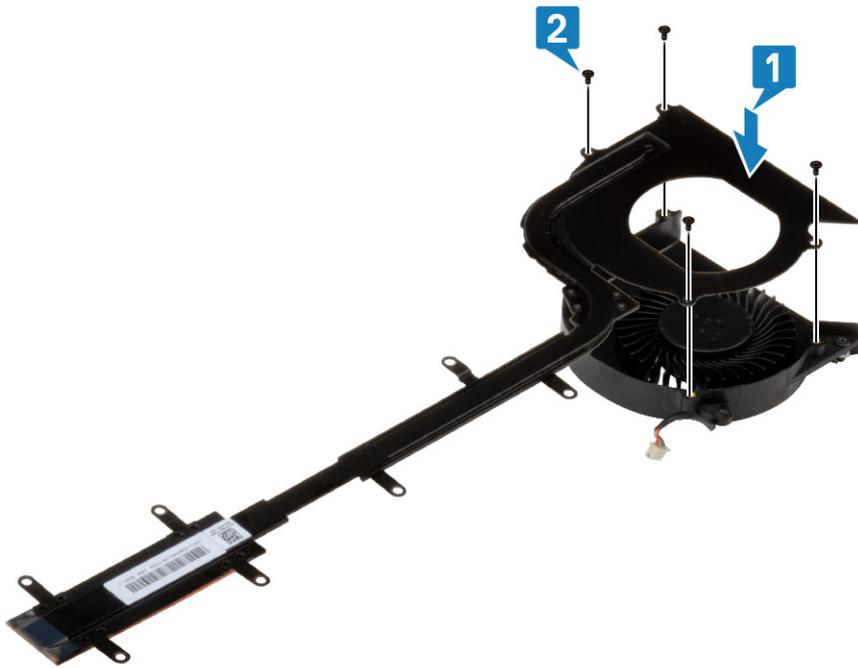


6. Remove the four M2*3 screws [1] to separate the heatsink from the fan [2].

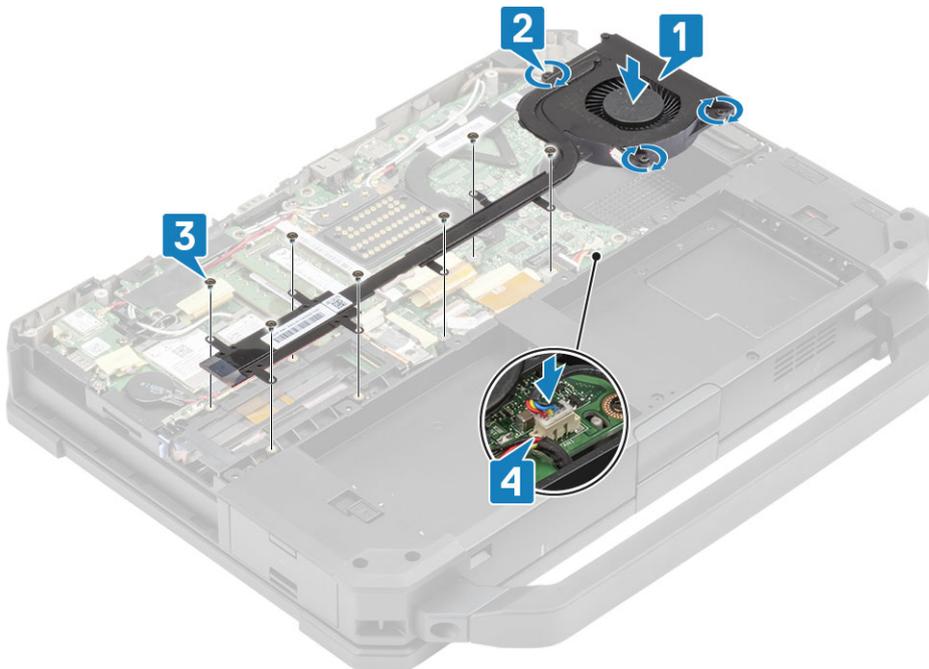


Installing the PCIe heatsink fan assembly

1. Replace the fan to th heatsink assembly [1] and secure it using four M2*3 screws [2] .



2. Install the PCIe heatsink fan assembly [1] in the chassis and tighten the three captive screws [2] on the fan case.
3. Install the seven 'M2.5' screws [3] on the heat sink pipe and connect the fan cable [4].



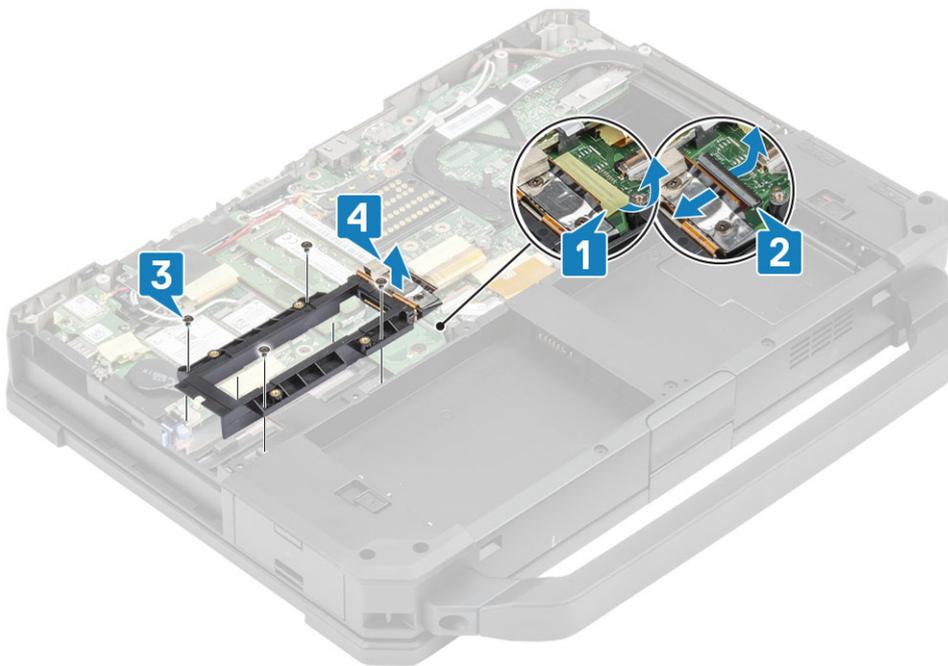
4. Install the:
 - a. [Bottom chassis cover](#)
 - b. [Batteries](#)

5. Follow the procedure in [After working inside your computer](#).

Primary SSD Rail

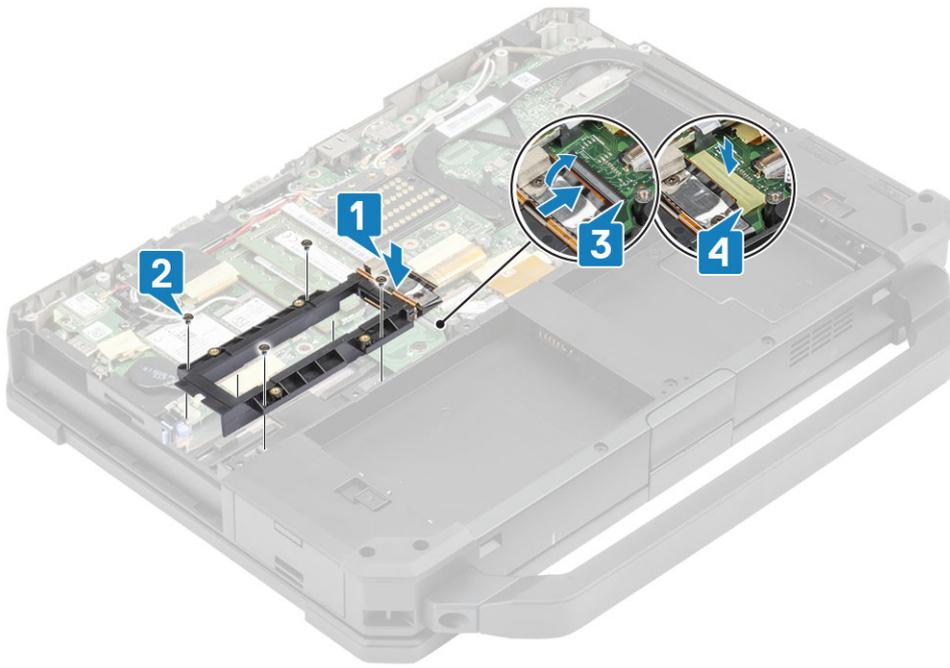
Removing the Primary SSD rail

1. Follow the procedure in [Before working inside your computer](#).
2. Remove the:
 - a. [Batteries](#)
 - b. [Primary SSD](#)
 - c. [Bottom chassis cover](#)
 - d. [PCIe heatsink assembly](#)
3. Peel off the inductive tape on the SSD FPC connector [1] on system board and disconnect it [2].
4. Remove the 4 'M2*3' screws [3] and remove it from the computer [4].



Installing the Primary SSD rail

1. Install the primary SSD rail on the system board [1] and tighten the four 'M2*3' screws [2] securing it to the system board.
2. Connect the SSD FPC connector [3] to the system board and secure it using a piece of tape [4].

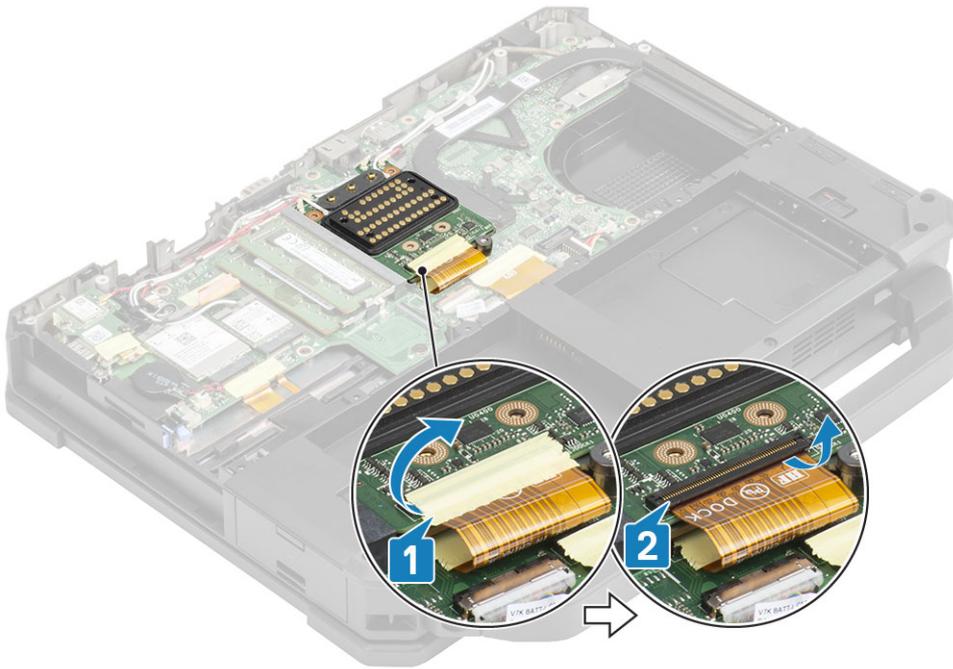


3. Install the:
 - a. [PCIe heatsink fan assembly](#)
 - b. [Bottom chassis cover](#)
 - c. [Primary SSD](#)
 - d. [Batteries](#)
4. Follow the procedure in [After working inside your computer](#).

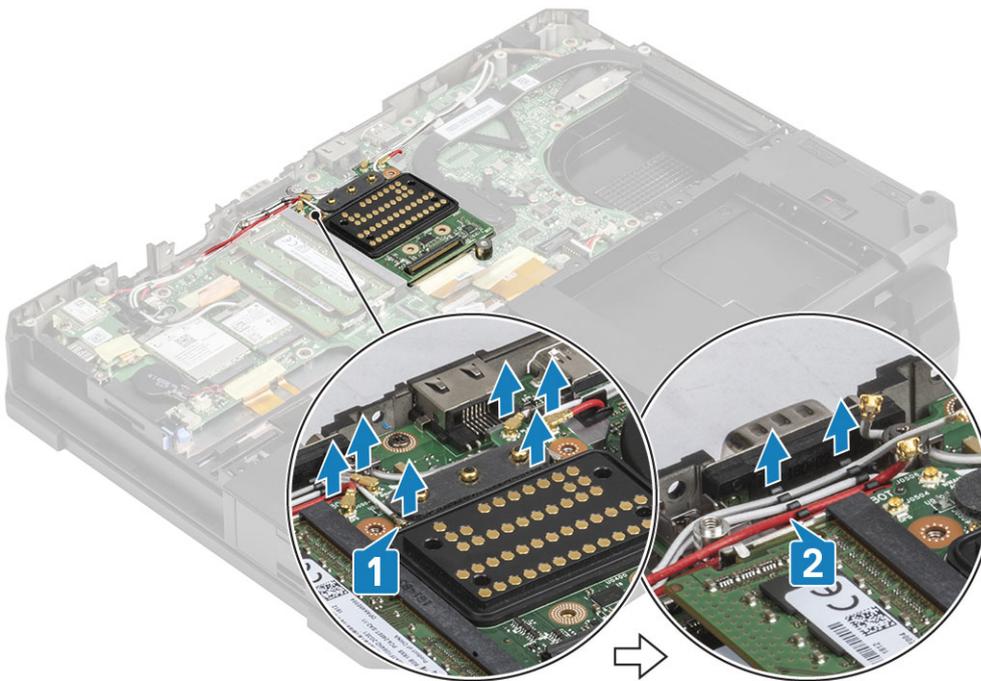
Docking Port Assembly

Removing the Docking port assembly

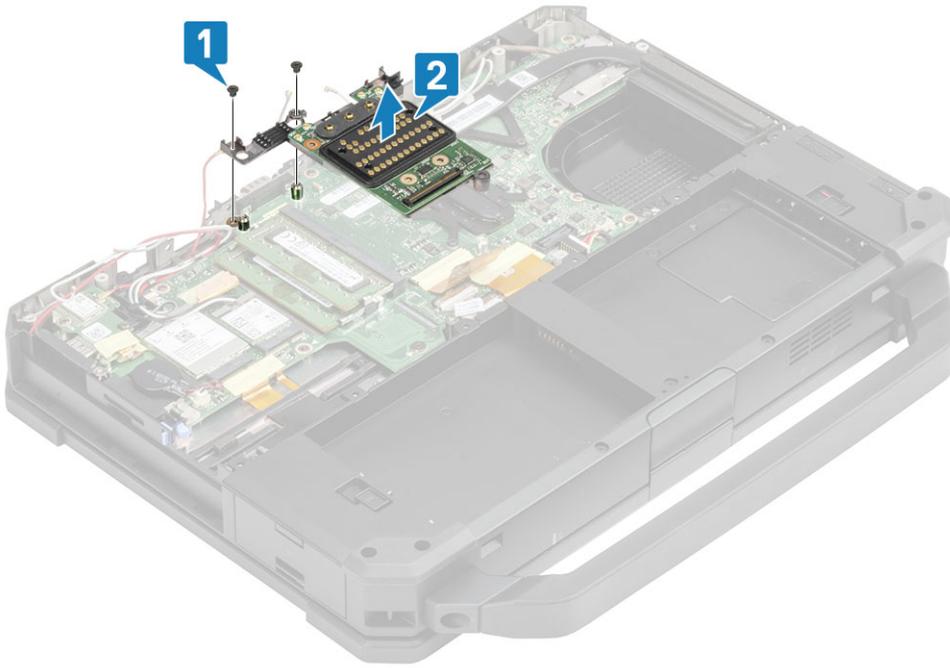
1. Follow the procedure in [Before working inside your computer](#).
2. Remove the:
 - a. [Batteries](#)
 - b. [Bottom chassis cover](#)
 - c. [PCIe Heatsink assembly](#)
3. Peel off the tape securing the dock FPC [1] and disconnect the dock FPC [2].



4. Disconnect the antennae cables from RF passthrough connectors [1] and unroute the antennae cables [2] from the routing channels on the dock assembly.

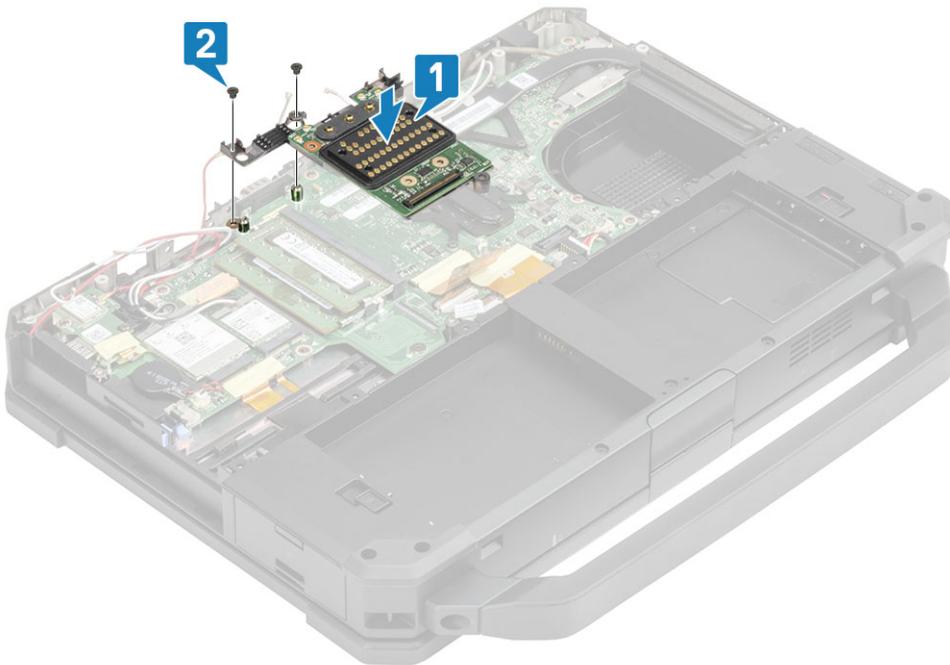


5. Remove the two 'M2.5*5' screws [1] and separate the docking board assembly from the chassis [2].

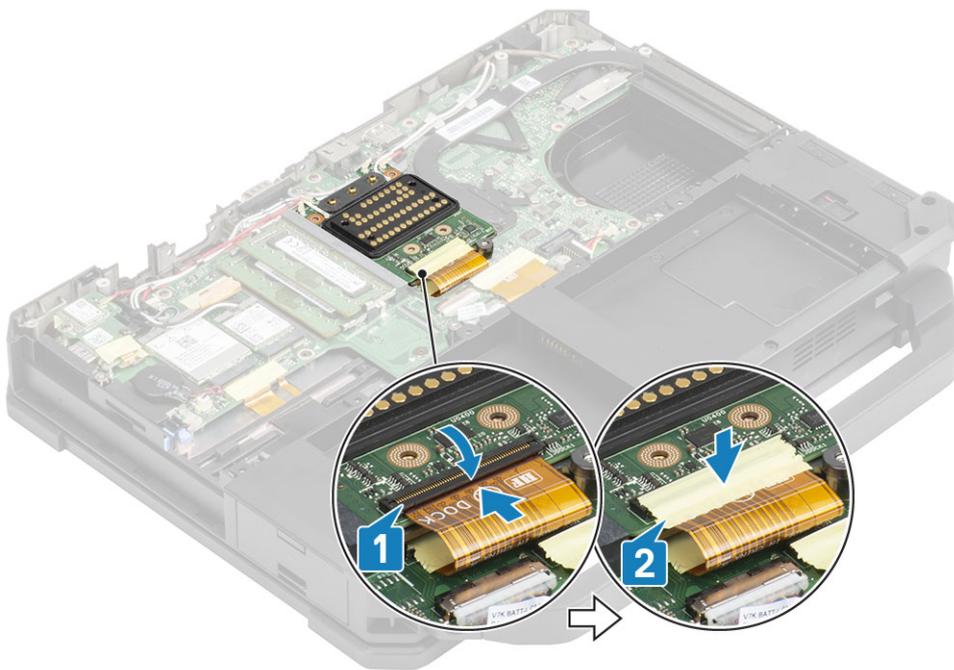


Installing the Docking Port Assembly

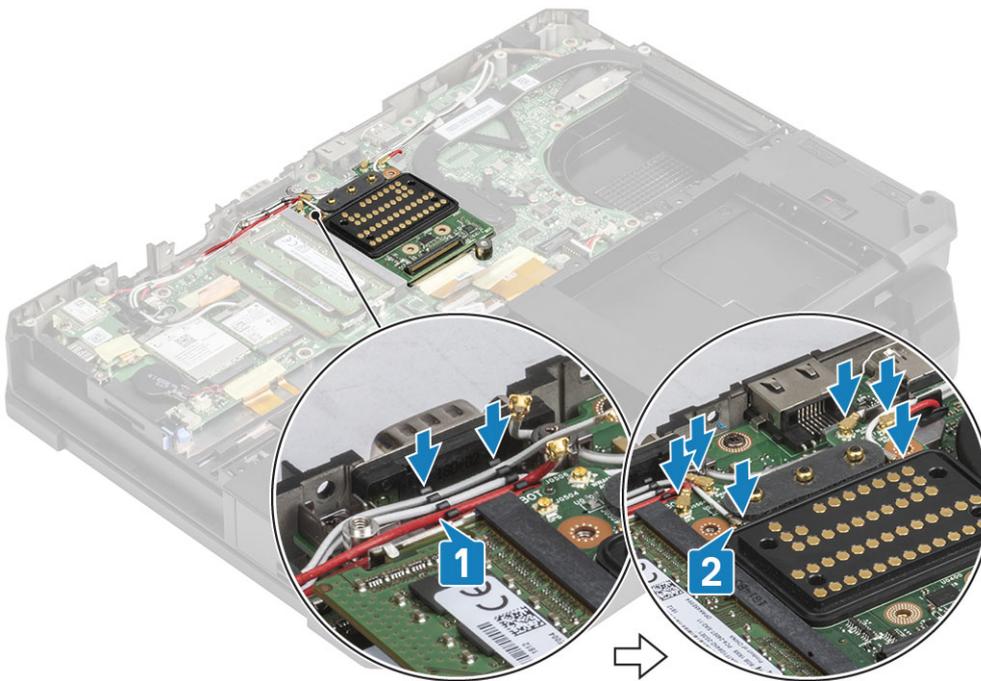
1. Install the docking port assembly [1] and install the two 'M2.5*5' screws [2] securing it to the system board.



2. Connect the dock FPC [1] and secure it using a piece of tape [2].



3. Secure the antennae cables along the routing channels [1] and connect the antennae cables on RF passthrough connectors [2].



4. Install the:
 - a. [PCIe Heatsink assembly](#)
 - b. [Batteries](#)
 - c. [Bottom chassis cover](#)
5. Follow the procedure in [After working inside your computer](#).

Heatsink Assembly

Removing the Heatsink assembly

1. Follow the procedure in [Before working inside your computer](#).
2. Remove the:
 - a. Batteries
 - b. Bottom chassis cover
 - c. WLAN card
 - d. WWAN card
 - e. PCIe Heatsink fan assembly
 - f. Docking port assembly
3. **i** **NOTE:** Depending on the order configuration details the system may have either of the heatsink assembly.



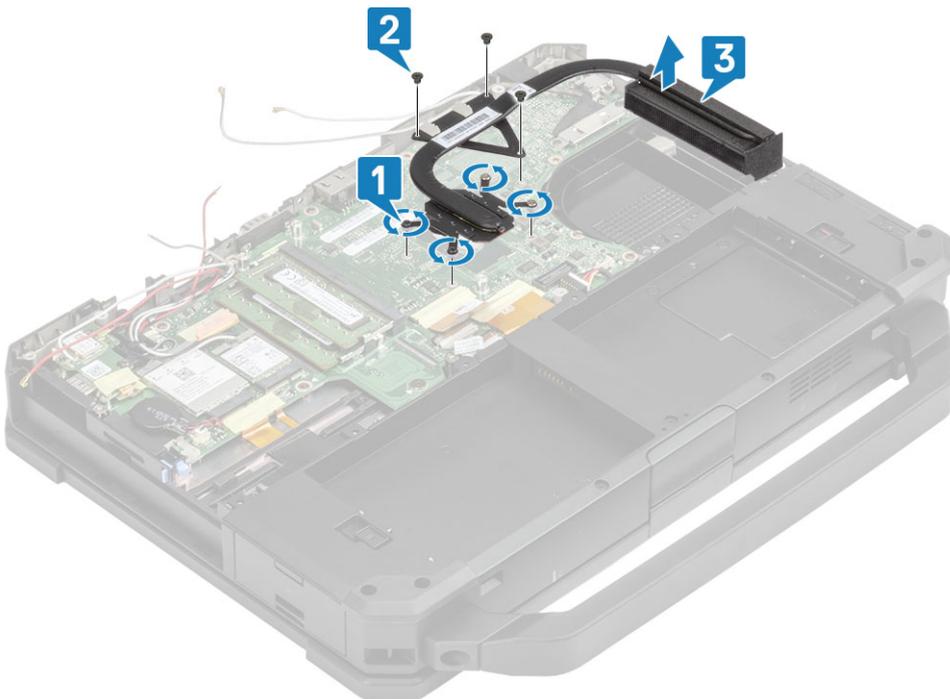
assembly

DSC Heatsink

Unroute the antennae cables from the tabs on the heatsink pipe.



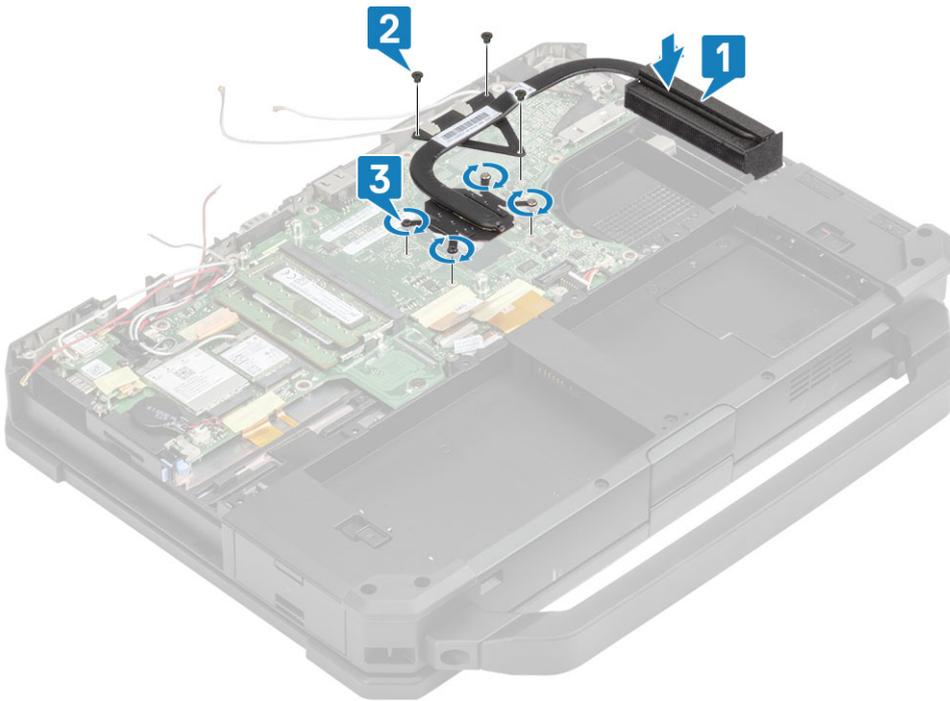
4. Remove the five 'M2.5*5' screws [1] and two 'M1.6*5' [2] screw from the thermal module.
5. Lift and the heat sink assembly from the computer [3].



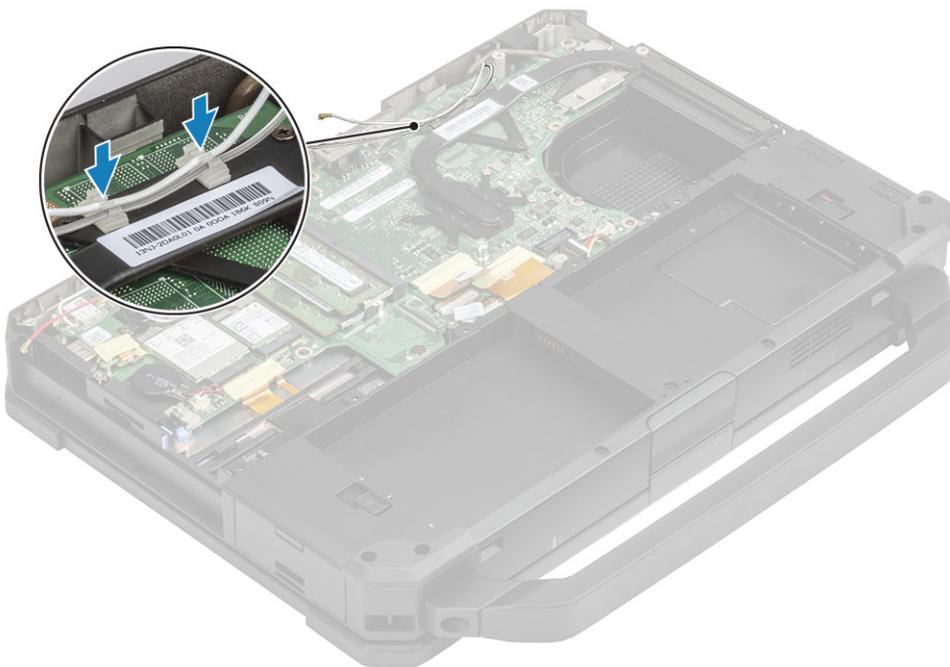
NOTE: Discreet and UMA bases have different types of heatsink assembly.

Installing the Heatsink assembly

1. Install the heatsink assembly [1] in the computer and tighten the two 'M1.6*5' [2] screw near the CPU.
2. Install the five 'M2.5*5' captive screws [3] on the thermal module securing the thermal module to the system board.



3. Route the antennae cables along the routing channel on the heatsink pipe.



4. Install the:
 - a. Docking port assembly
 - b. PCIe Heatsink assembly
 - c. WWAN card
 - d. WLAN card
 - e. Bottom chassis cover
 - f. Batteries
5. Follow the procedure in [After working inside your computer](#).

Rear Input-Output Board

Removing the Rear I-O board

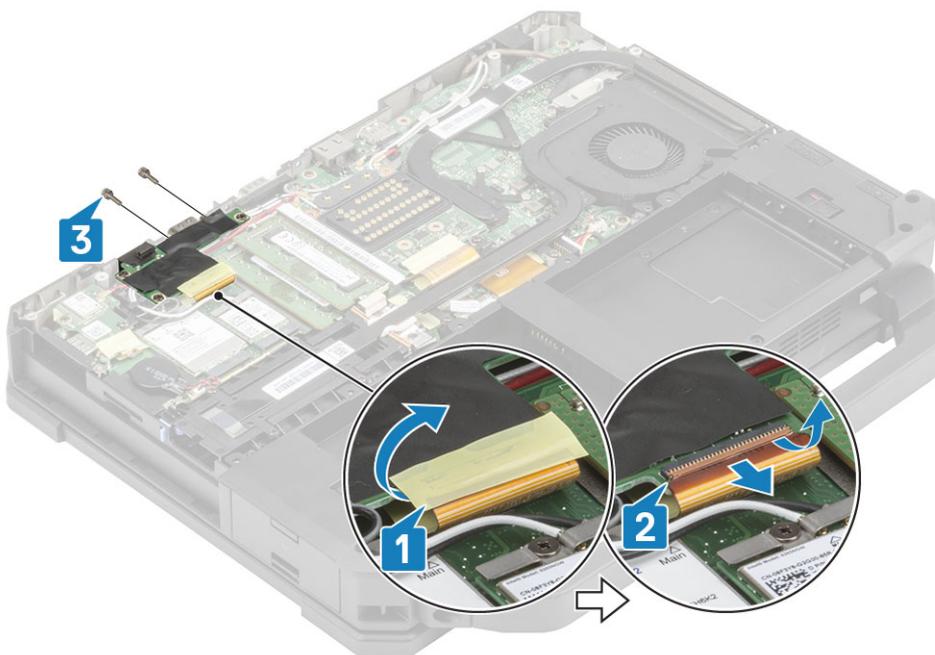
1. Follow the procedure in [Before working inside your computer](#).

NOTE: A 5 mm socket wrench should be used to remove/install the caps screws located in rear I/O space.

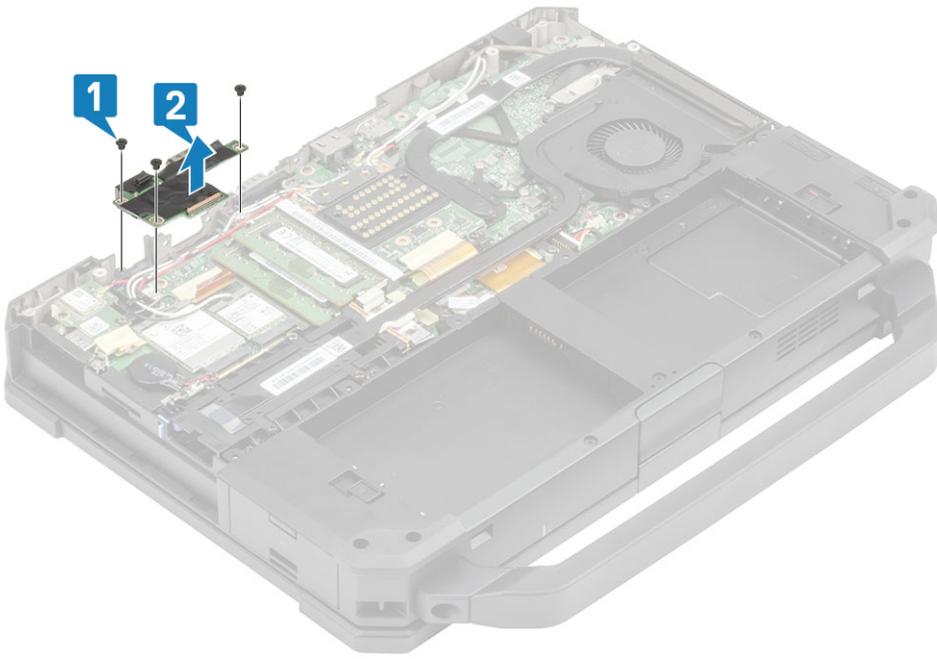
2. Remove the:
 - a. Batteries
 - b. WLAN card
 - c. WWAN card
 - d. PCIe heatsink fan assembly
 - e. Docking port assembly
 - f. Bottom chassis Cover

CAUTION: The following epoxy screw locations will require additional focus. These screws are difficult to remove and there may be damage during the removal process. To prevent damage to the screws and surrounding plastics, please use the correct screwdriver for each screw type.

3. Peel off the inductive tape on the I/O board FPC connector [1] to disconnect it from the system board [2].
4. Remove the two epoxy cap screws on the serial port in the rear I/O space [3].

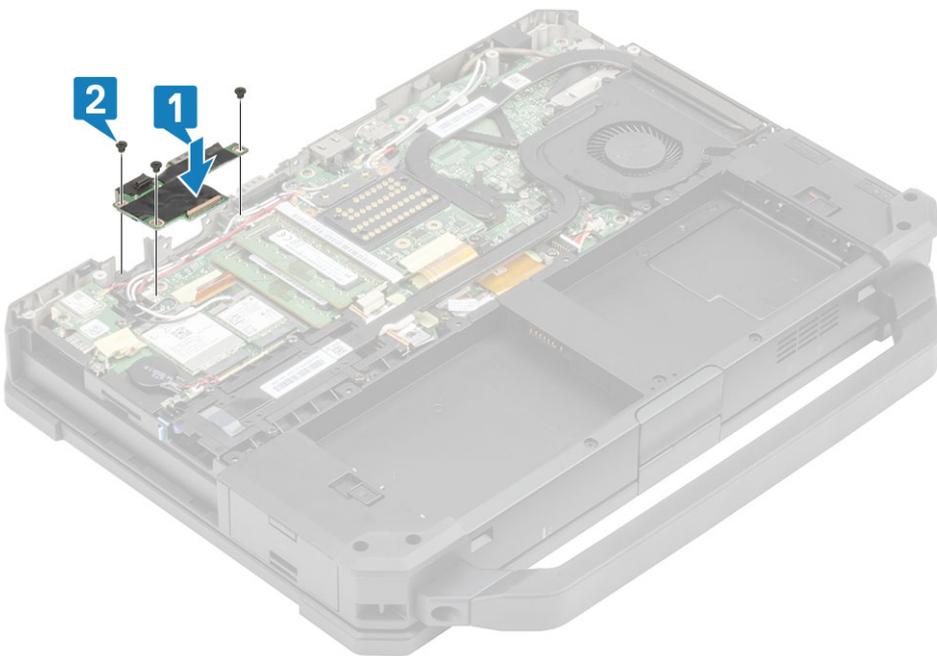


5. Loosen the three 'M2.5*5' screws [1] and lift the I/O board away from the system [2].

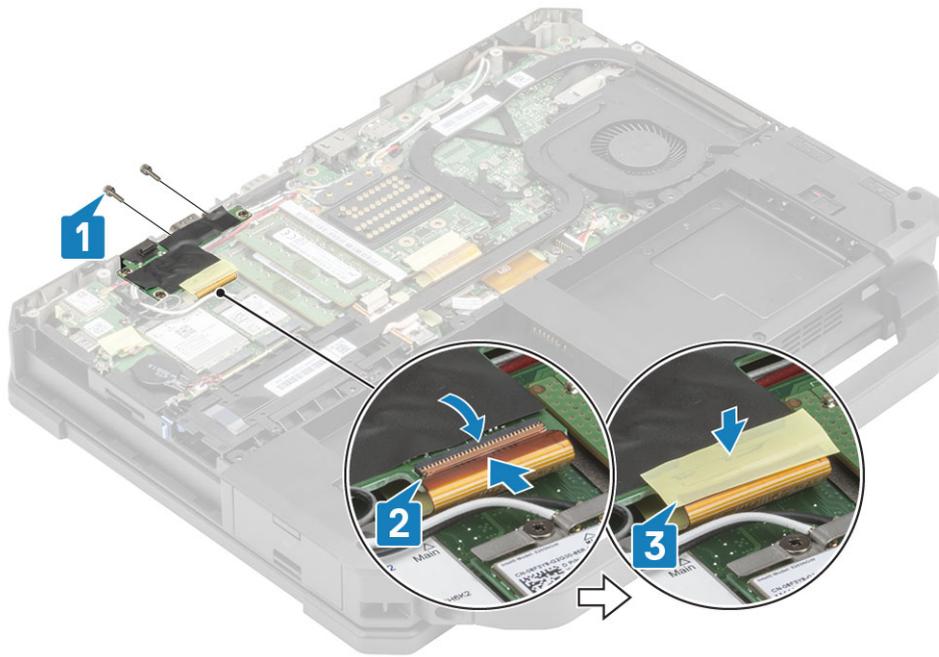


Installing the Rear I-O board

1. Install the rear I/O board on the system board and slide the serial port through the face plate [1].
2. Secure the I/O board using three 'M2.5*5' screws [2].



3. Tighten the two epoxy cap screws on the serial port [1] in the rear I/O space.
4. Connect the I/O board FPC [2] to the system board and then to I/O board itself [3] and secure it using a piece of tape [3].

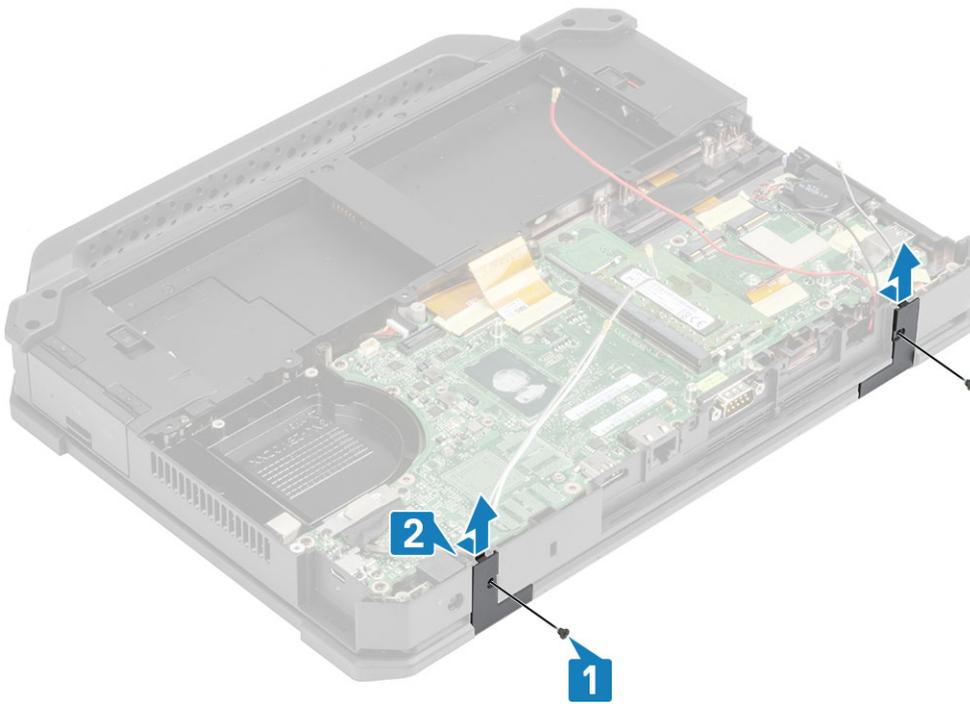


5. Install the:
 - a. Docking port assembly
 - b. PCIe heatsink fan assembly
 - c. WWAN card
 - d. WLAN card
 - e. Bottom chassis cover
 - f. Batteries
6. Follow the procedure in [After working inside your computer](#).

Hinge Covers

Removing the Hinge Covers

1. Follow the procedure in [Before working inside your computer](#).
2. Remove the:
 - a. Batteries
 - b. Bottom chassis cover
 - c. Heatsink
3. Remove the two 'M2.5*5' on either sides [1] and lift to remove the brackets [2] from the computer.



4. Press the latch [1] and open the LCD lid [2].



5. Hold the LCD lid at an obtuse angle and push the hinge covers from the rear end to remove it from the computer.



Installing the Hinge Covers

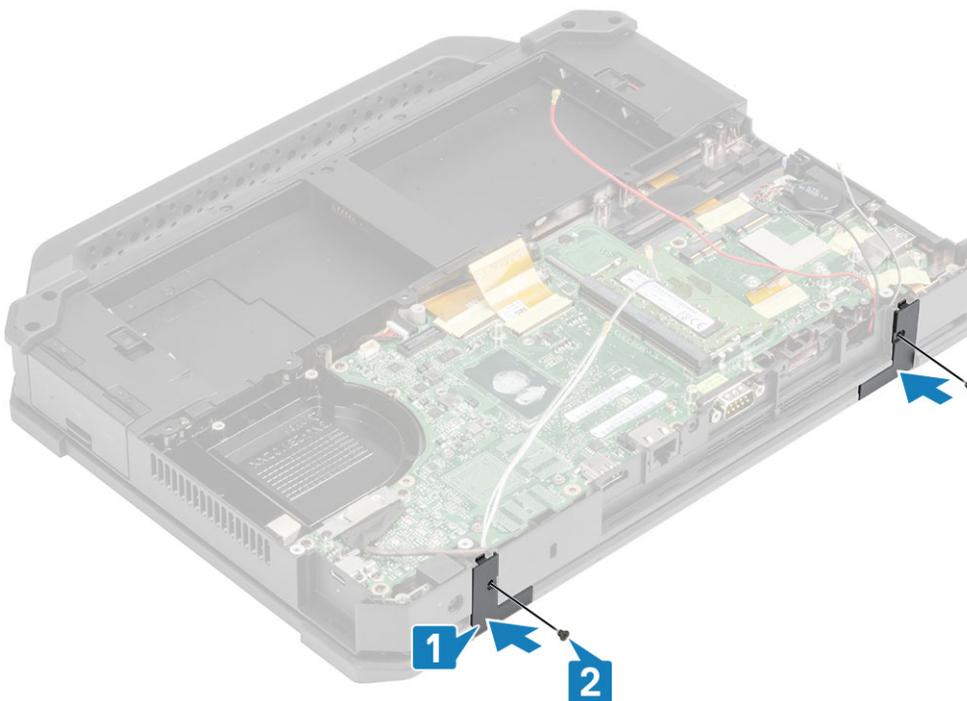
1. Press the latch [1] and open the LCD lid [2].



2. Keep LCD lid open at an obtuse angle and insert the hinge covers from front until it clicks in its place.



3. Place the brackets[1] and secure it using two 'M2.5*5' on either sides [2].



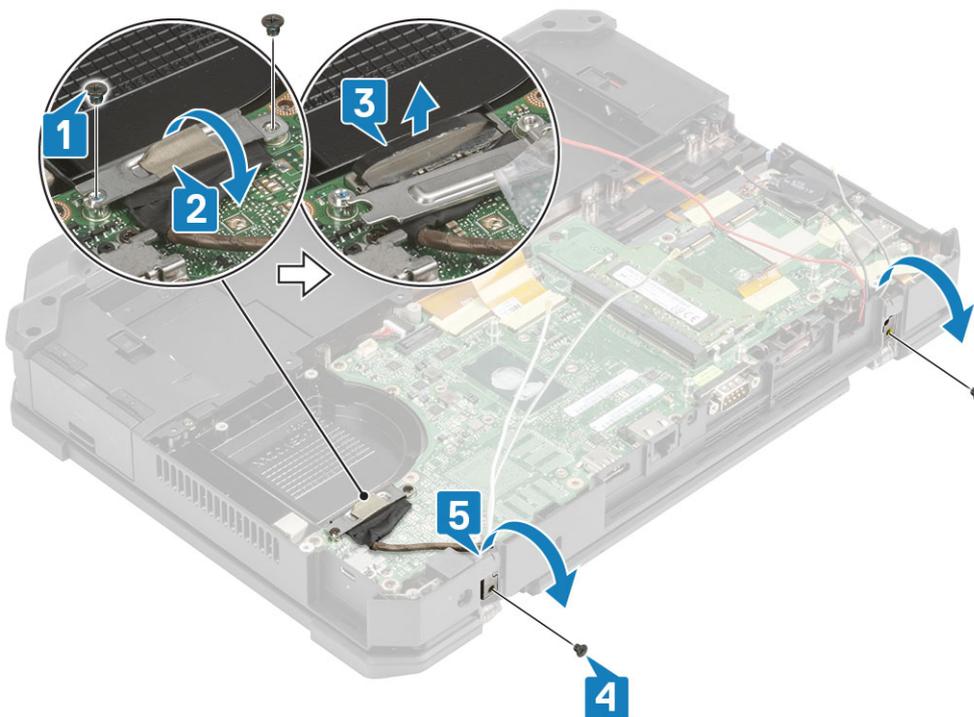
4. Install the:
 - a. Heatsink
 - b. Bottom chassis cover
 - c. Batteries
5. Follow the procedure in [After working inside your computer.](#)

Display assembly

Removing the Display assembly

1. Follow the procedure in [Before working inside your computer](#).
2. Remove the:
 - a. Batteries
 - b. Bottom chassis cover
 - c. PCIe heatsink assembly
 - d. Docking port assembly
 - e. WLAN card
 - f. WWAN card
 - g. GPS module
 - h. Heatsink assembly
 - i. Hinge covers
3. Remove the two 'M2*3' screws [1] on the EDP bracket, and turn it up side down [2].
4. **CAUTION:** The following epoxy screw locations will require additional focus. These screws are difficult to remove and there may be damage during the removal process. To prevent damage to the screws and surrounding plastics, please use the correct screwdriver for each screw type.

Pull and disconnect the EDP cable from the system board [3] and remove the two 'M2*3' epoxy screws [4] securing the hinges to base assembly [5].



5. Open the LCD lid.



6. **CAUTION:** The following epoxy screw locations will require additional focus. These screws are difficult to remove and there may be damage during the removal process. To prevent damage to the screws and surrounding plastics, please use the correct screwdriver for each screw type.

Loosen the four epoxy screws on hinges [1] and to separate the LCD assembly from the computer [2].

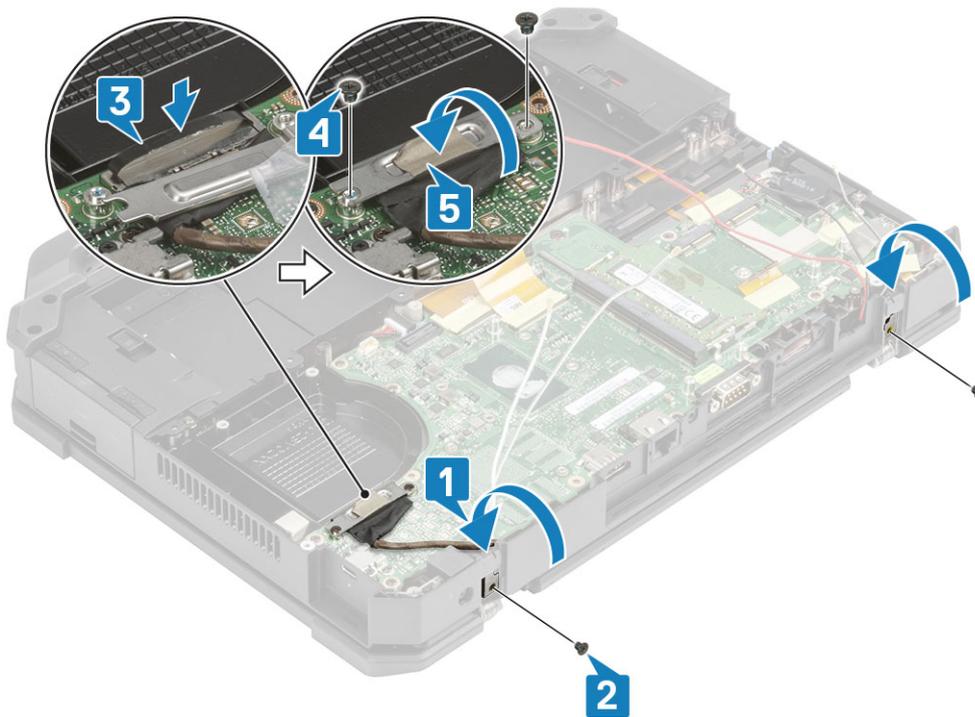


Installing the Display Assembly

1. Tighten the two epoxy screws on left [1] and on the right [2] side and .
2. Close the lid [3].



3. Install the two 'M2*3' epoxy screws securing the hinges to base assembly [1] and rethread the antennae cables [2].
4. Connect the EDP cable [3] to the system board and place the EDP bracket over the cable [4].
5. Install the two 'M2*3' screws [5] and secure the EDP bracket to the system board.



6. Install the:
 - a. Hinge covers
 - b. Heatsink
 - c. GPS card
 - d. WLAN card
 - e. WWAN card
 - f. PCIe heatsink assembly
 - g. Docking port assembly
 - h. Bottom chassis cover
 - i. Batteries
7. Follow the procedure in [After working inside your computer](#).

LCD Bezel and Back Cover Assembly

Removing the LCD with bezel and the display back cover assembly

1. Follow the procedure in [Before working inside your computer](#).
2. Remove the:
 - a. Batteries
 - b. Bottom chassis cover
 - c. WLAN card
 - d. WWAN card
 - e. PCIe heatsink assembly
 - f. Docking port assembly
 - g. Heatsink
 - h. Hinge covers
 - i. Display assembly
3. Loosen the 12 'M2.5' screws from the back cover.

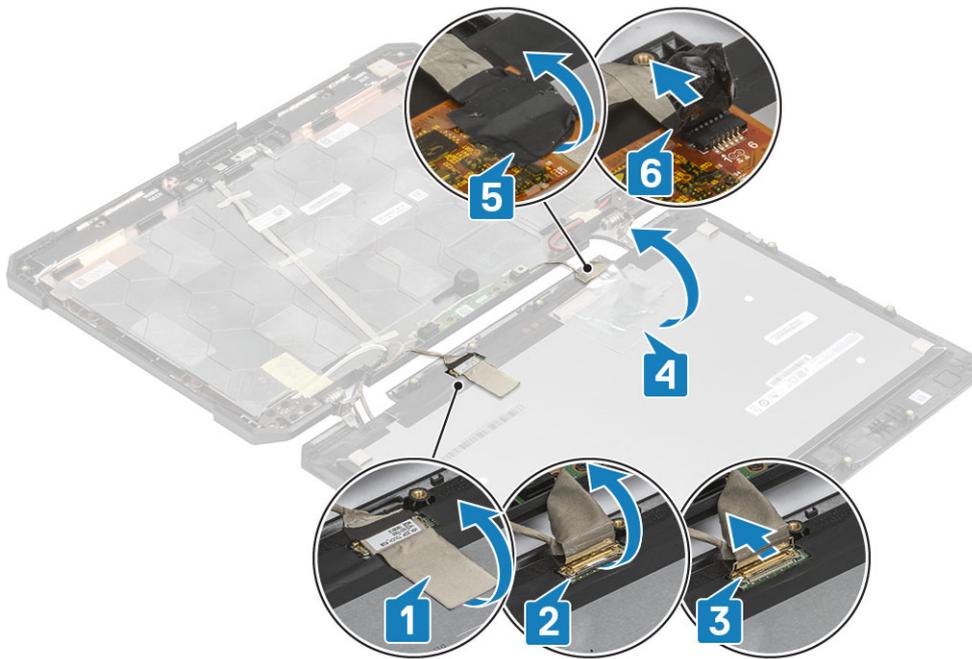


4. **CAUTION:** The following epoxy screw locations will require additional focus. These screws are difficult to remove and there may be damage during the removal process. To prevent damage to the screws and surrounding plastics, please use the correct screwdriver for each screw type.

Remove the four 'M2.5' epoxy screws securing the bezel to the back cover [1] and pry at bottom edge to separate the two subassemblies [2].

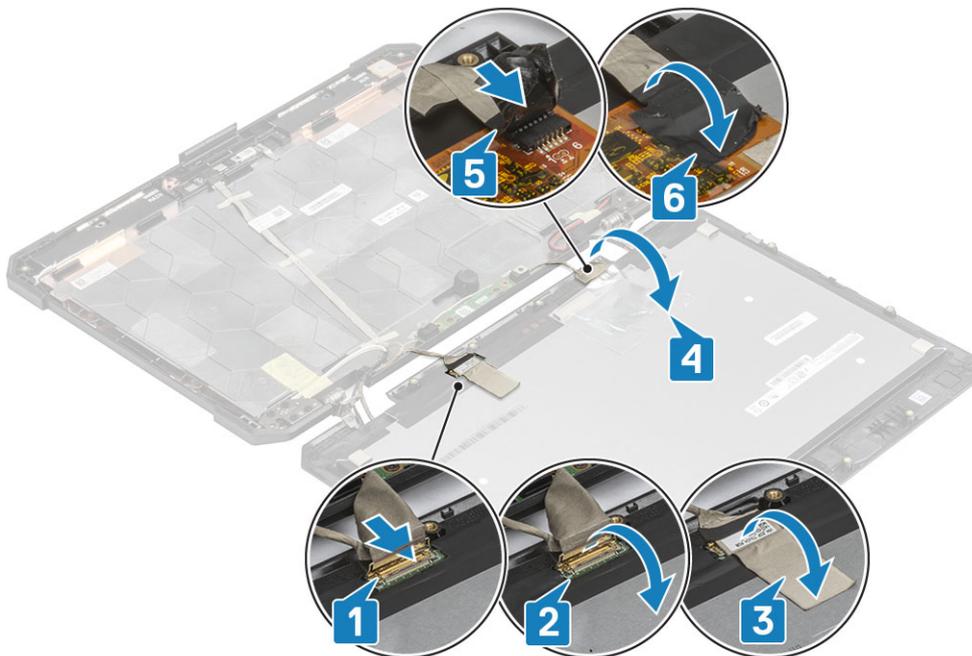


5. Peel off the tape on the LCD connections [1] and open the connector [2] to disconnect the EDP cable [3] from the LCD.
6. Peel off the reflective tape [4] on the LCD panel and the touch connector [5] and disconnect the cable from the board [6].



Installing the LCD with bezel and the display back cover assembly

1. Replace the EDP cable [1] on the LCD connector and close the actuator [2].
2. Secure the connector using a piece of tape [3] and adhere the reflective tape on the display panel [4].
3. Connect the touch controller cable [5] and use insulation tape on the connector [6].



4. Align and place the bezel on the back cover [1] and secure it using the four M2.5 epoxy screws [2].



5. Install the 12 'M2.5' screws to secure the back cover to the LCD with bezel assembly.



6. Install the:

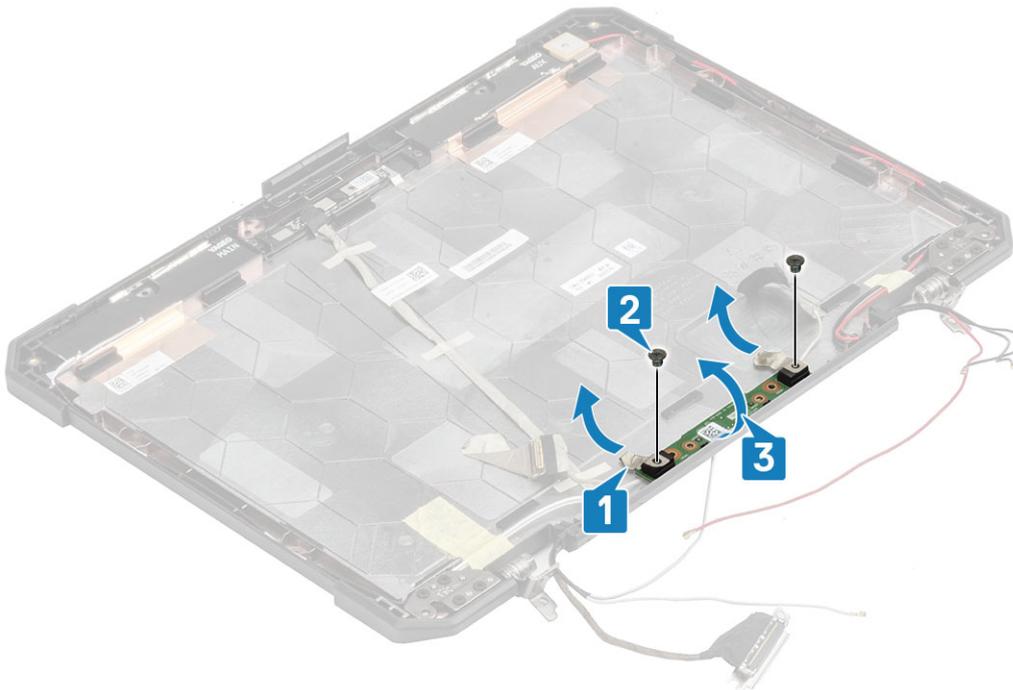
- a. [Display assembly](#).
- b. [Hinge covers](#)
- c. [Heatsink](#)
- d. [PCIe heatsink assembly](#)
- e. [Docking port assembly](#)
- f. [WWAN card](#)
- g. [WLAN card](#)
- h. [Bottom chassis cover](#)
- i. [Batteries](#)

7. Follow the procedure in [After working inside your computer](#).

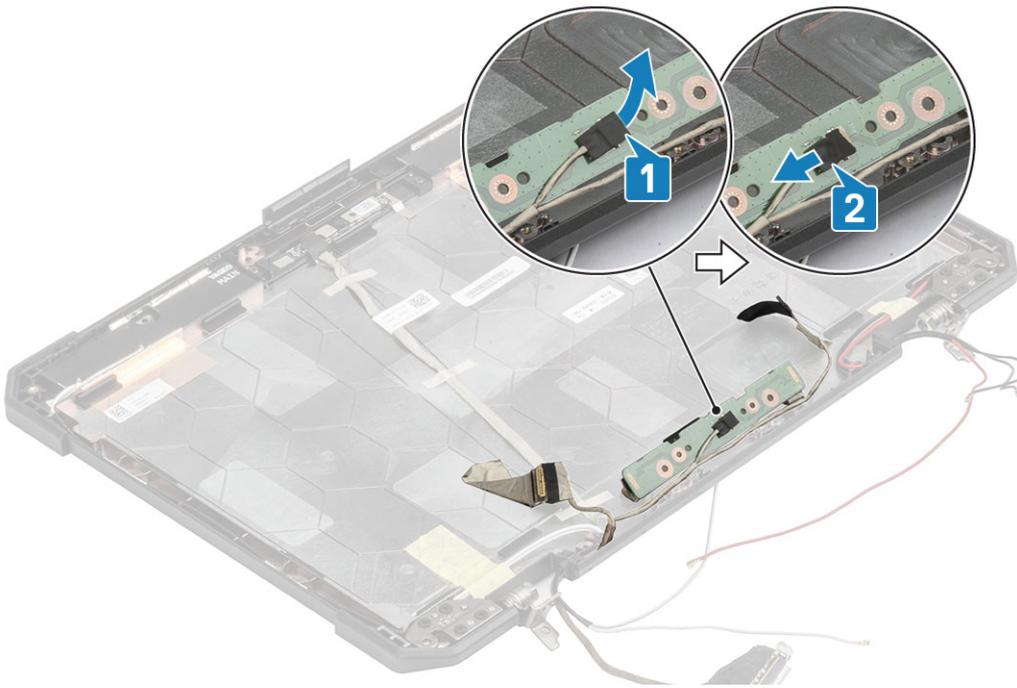
Microphone

Removing the Microphone

1. Follow the procedure in [Before working inside your computer](#).
2. Remove the:
 - a. [Batteries](#)
 - b. [Bottom chassis cover](#)
 - c. [Memory](#)
 - d. [WLAN card](#)
 - e. [WWAN card](#)
 - f. [PCIe heatsink assembly](#)
 - g. [Docking port assembly](#)
 - h. [Heatsink](#)
 - i. [Hinge covers](#)
 - j. [Display assembly](#).
 - k. [LCD bezel and back cover assembly](#).
3. Peel off the tape securing the microphone daughterboard[1] and remove the two 'M2*3' screws [2] to turn the daughterboard [3] up side down.

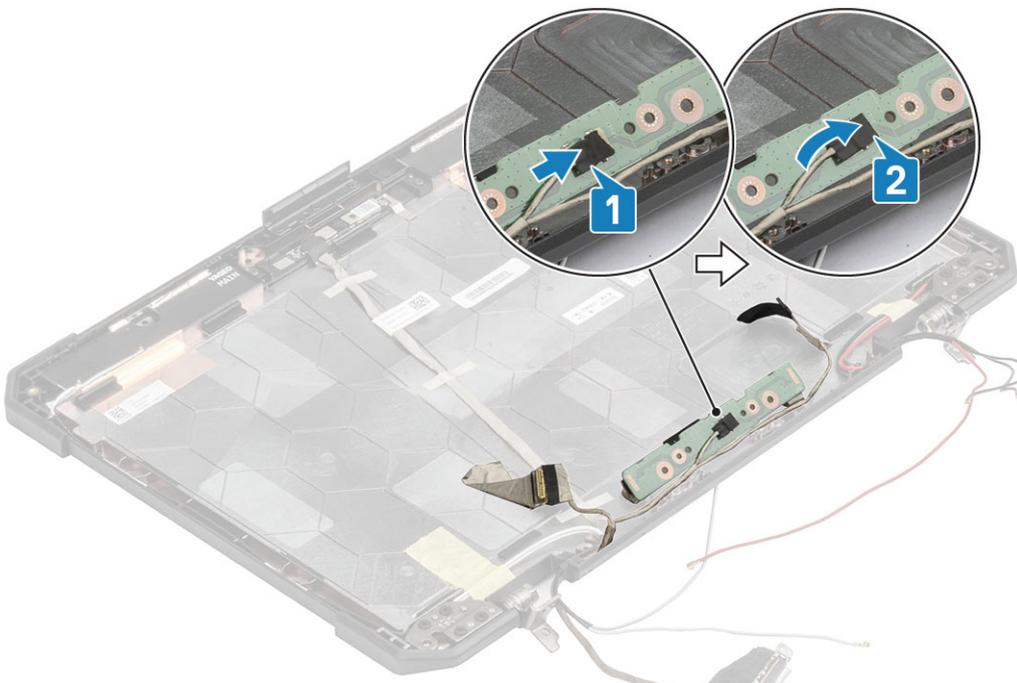


4. Peel off the insulation tape [1] and disconnect the EDP cable connectors [2].

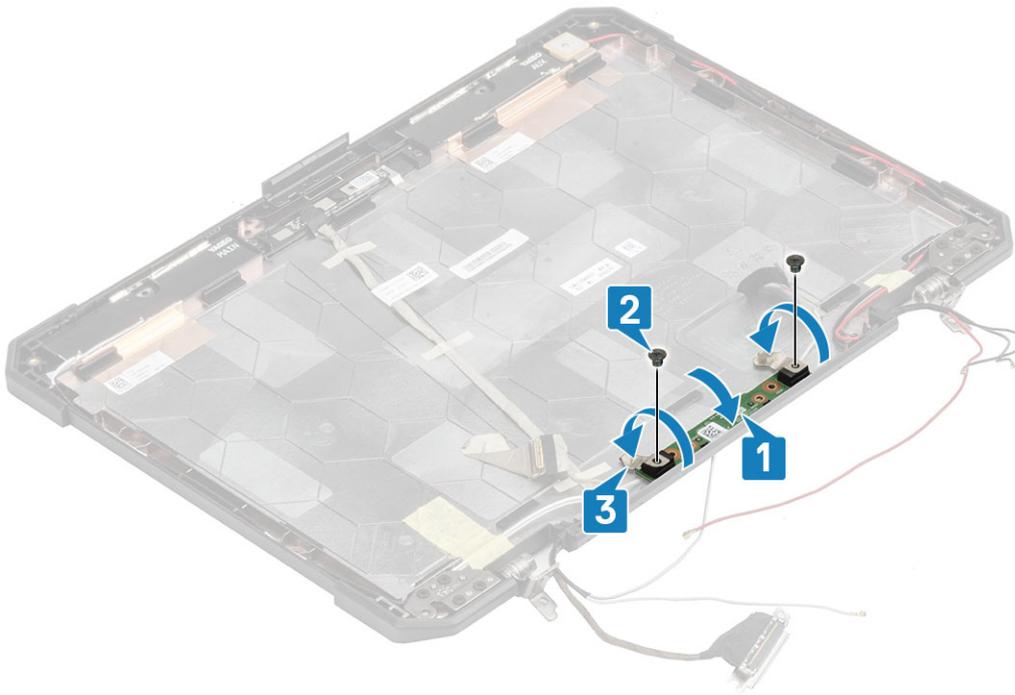


Installing the Microphone

1. Connect the EDP cable to the microphone daughterboard [1] and secure it using a piece of tape [2].



2. Turn over the microphone daughterboard on the back cover [1] and tighten the two 'M2*3' screws [2].
3. Secure the microphone daughterboard using a piece of reflective tape on either sides [3] to the LCD back cover.



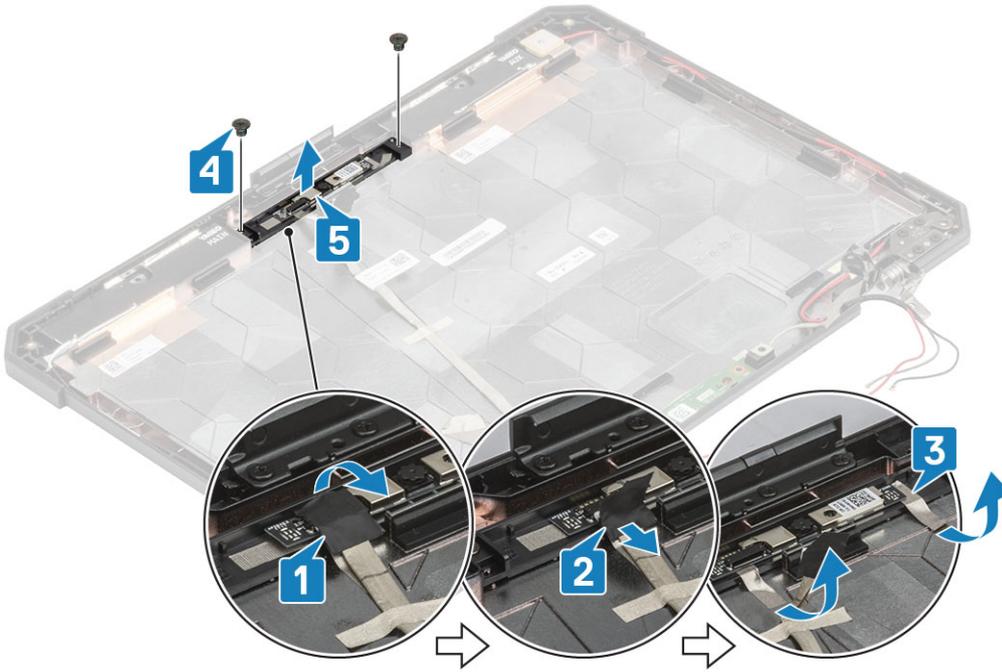
4. Install the:
 - a. LCD with bezel assembly.
 - b. Display assembly.
 - c. Hinge covers
 - d. Heatsink
 - e. PCIe heatsink assembly
 - f. Docking port assembly
 - g. WWAN card
 - h. WLAN card
 - i. Bottom chassis cover
 - j. Batteries
5. Follow the procedure in [After working inside your computer](#).

Camera

Removing the Camera

1. Follow the procedure in [Before working inside your computer](#).
2. Remove the:
 - a. Batteries
 - b. Bottom chassis cover
 - c. Memory
 - d. WLAN card
 - e. WWAN card
 - f. PCIe heatsink assembly
 - g. Docking port assembly
 - h. Heatsink
 - i. Hinge covers
 - j. Display assembly.
 - k. LCD Bezel and back cover assembly.
3. Peel off the reflective tape[1] on camera module and the insulation tape securing the EDP cable[2] to camera module.
4. Disconnect the EDP cable from the camera module [3] and remove the two 'M2*3' screws [4].

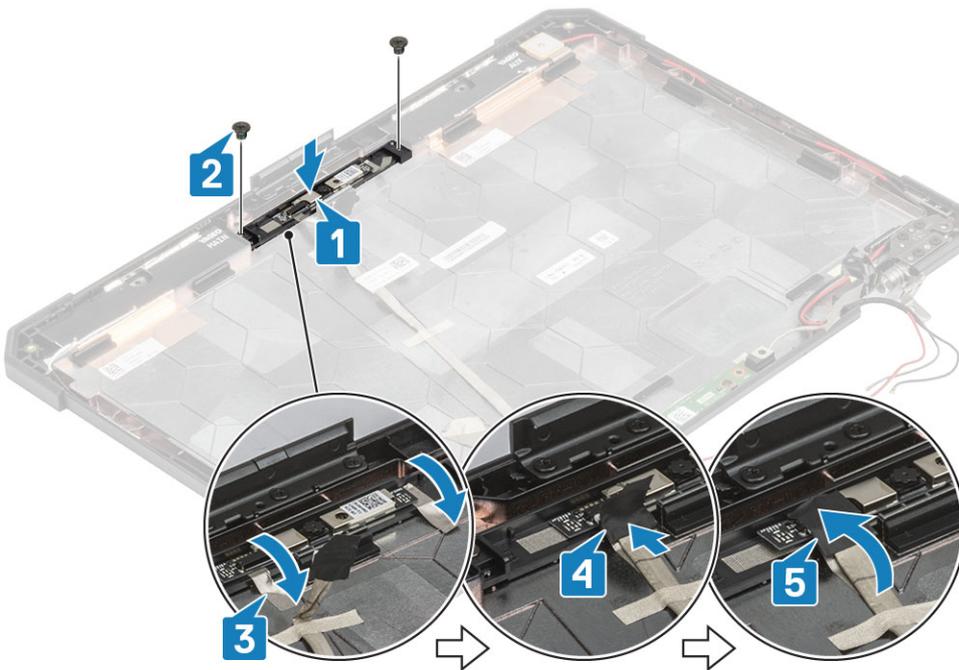
5. Lift the camera module away from the back cover [5] to remove it from the computer.



CAUTION: Do not touch the Camera Lens fused to the LCD with bezel assembly.

Installing the Camera

1. Install the camera module [1] on the back cover and install the two 'M2*3'. screws [2]
2. Connect the EDP cable to the camera module [3], stick a piece of insulation tape [4] on the EDP connectors.
3. Secure the camera module on the back cover using a piece of reflective tape [5].



4. Install the:
 - a. LCD with bezel assembly
 - b. Display assembly.
 - c. Hinge covers

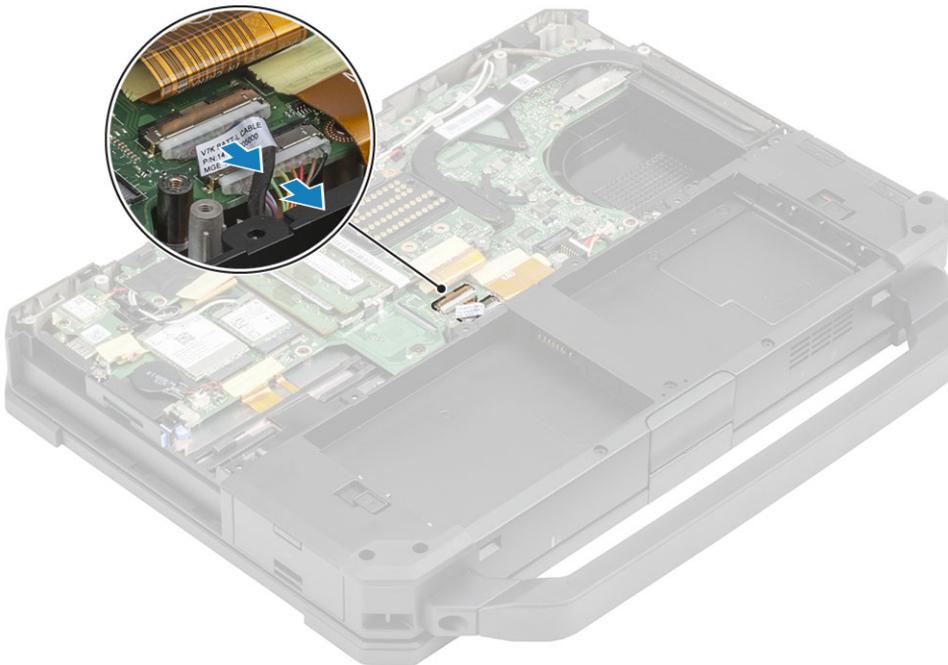
- d. Heatsink
 - e. PCIe heatsink assembly
 - f. Docking port assembly
 - g. WWAN card
 - h. WLAN card
 - i. Bottom chassis cover
 - j. Batteries
5. Follow the procedure in [After working inside your computer](#).

Battery Bay

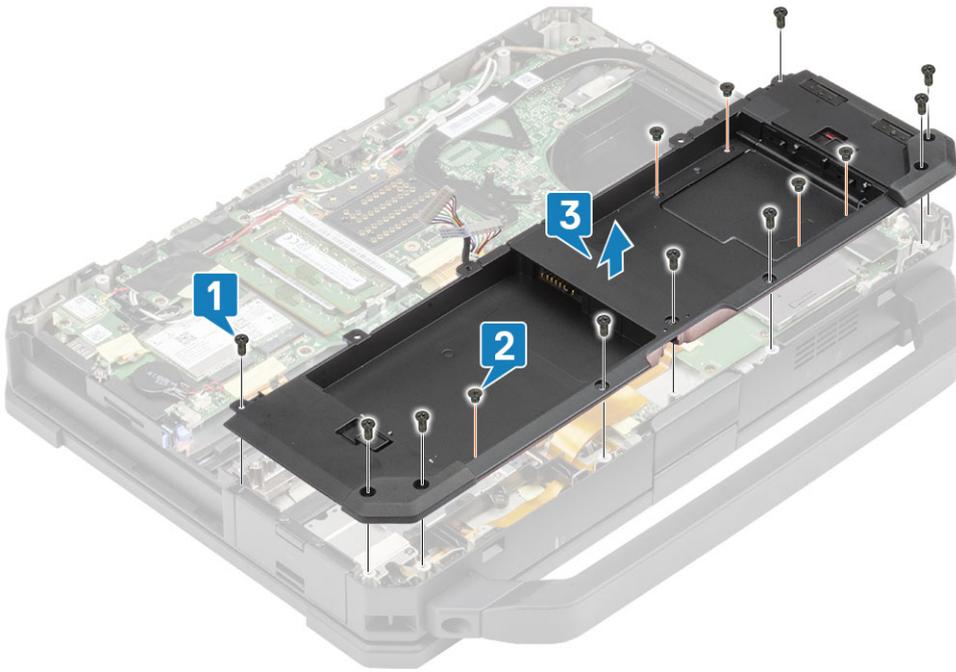
Removing the Battery bay

1. Follow the procedure in [Before working inside your computer](#).
2. Remove the:
 - a. Batteries
 - b. Bottom chassis cover
 - c. PCIe Heatsink assembly
3.  **CAUTION: Use extreme caution when removing cable due to the very limited space cable could be easily pinched or bent leading to cable damage.**

Disconnect both the battery connections from the system board.

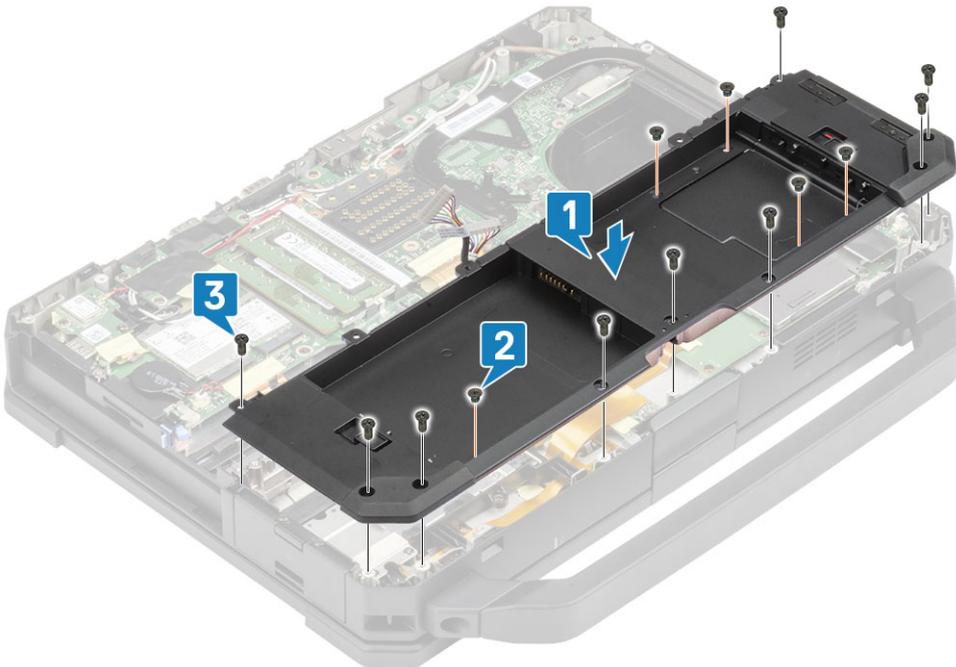


4. Remove the five 'M2.5*5' [1] and nine 'M2.5*3' [2] screws securing the battery bay to chassis and lift to separate the battery bay [3] from the computer.

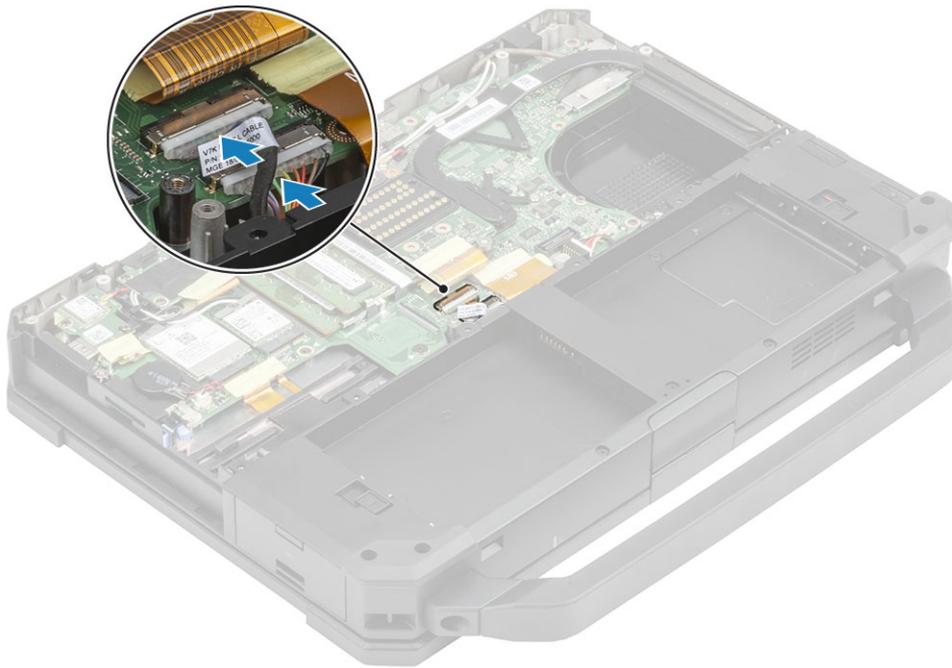


Installing the Battery bay

1. Install the battery bay [1] on the computer and tighten the five 'M2.5*5' [2] and nine 'M2.5*3' [3] securing it to the chassis.



2. Connect the battery cables to the system board.

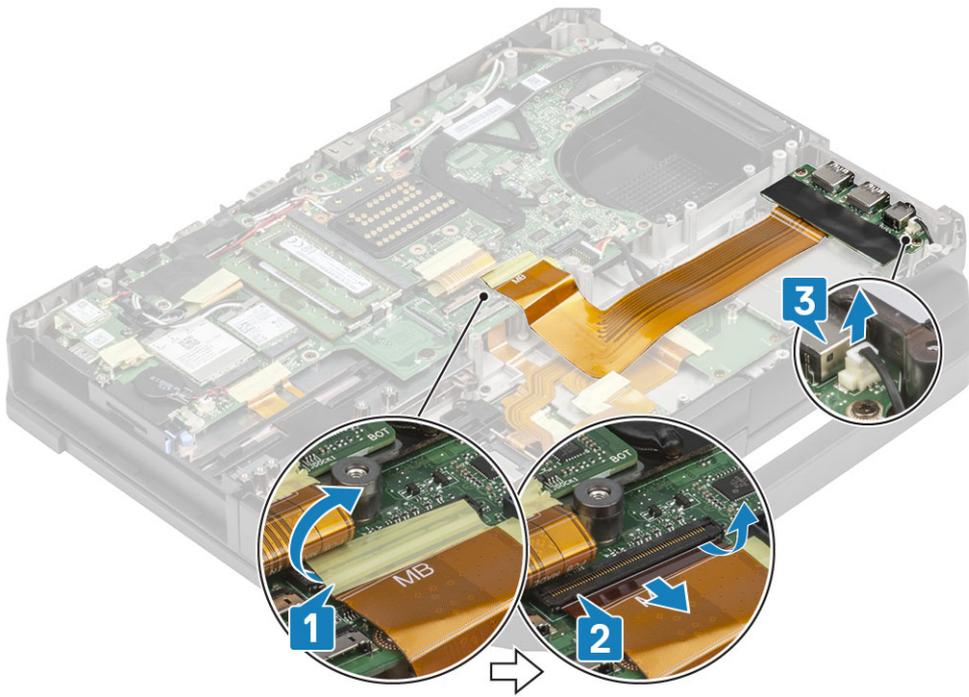


3. Install the:
 - a. [PCIe Heatsink assembly](#)
 - b. [Batteries](#)
 - c. [Bottom chassis cover](#)
4. Follow the procedure in [After working inside your computer](#).

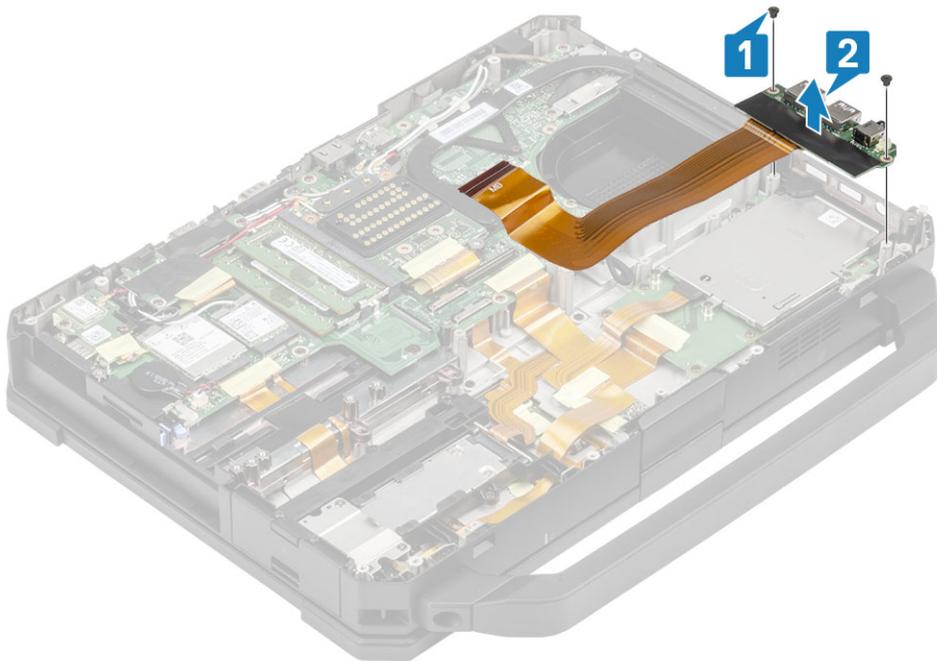
Left I/O board

Removing the Left I/O daughterboard

1. Follow the procedure in [Before working inside your computer](#).
2. Remove the:
 - a. [Batteries](#)
 - b. [Bottom chassis cover](#)
 - c. [PCIe Heatsink fan assembly](#)
 - d. [Battery bay](#)
3. Peel off the tape [1], disconnect the left I/O daughterboard FPC connector [2] from the system board.
4. Disconnect the speaker cable from the left I/O daughterboard [3].

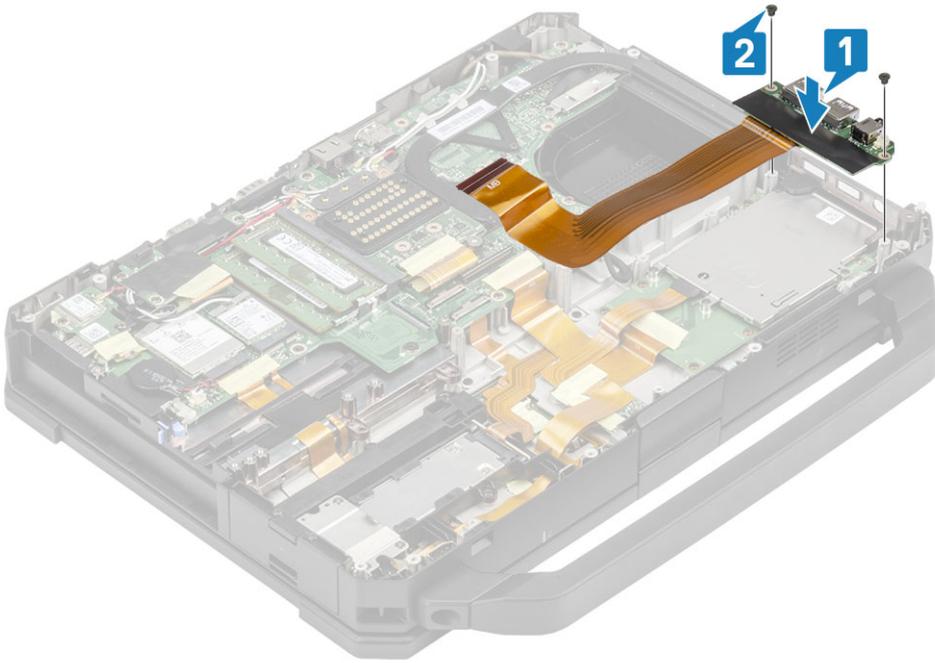


5. Loosen the two 'M2*5' screws [1] and lift the Left I/O daughterboard from the computer [2].

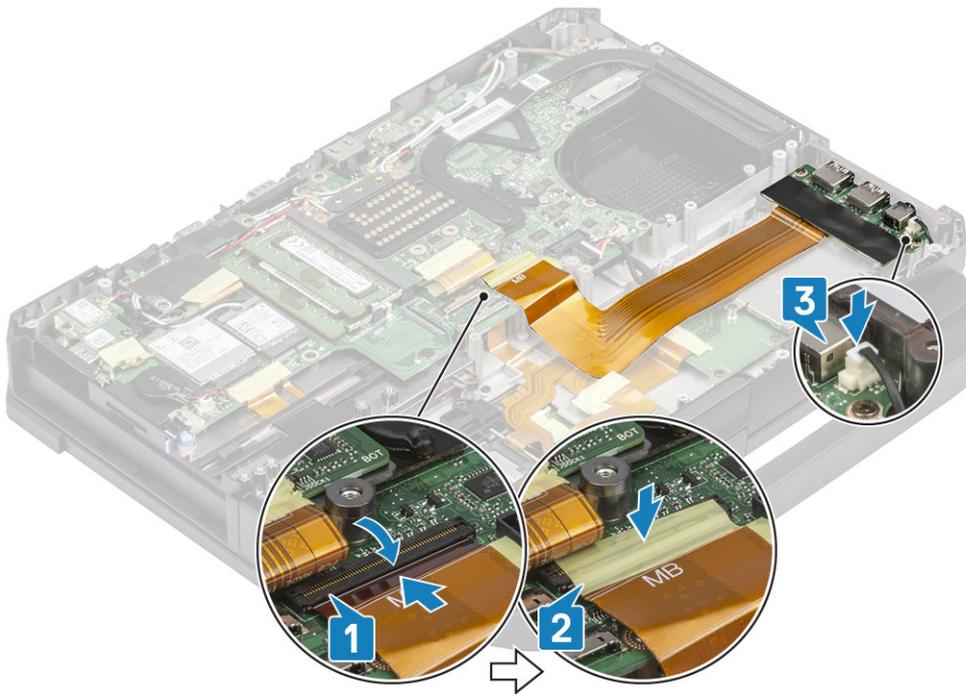


Installing the Left I/O Board

1. Install the left I/O daughterboard [1] and secure it using the two 'M2*3' screws [2] to the computer.



2. Connect the FPC to the system board [1] and secure it using a piece of insulation tape [2].
3. Connect the speaker cable to the left I/O daughterboard [3].

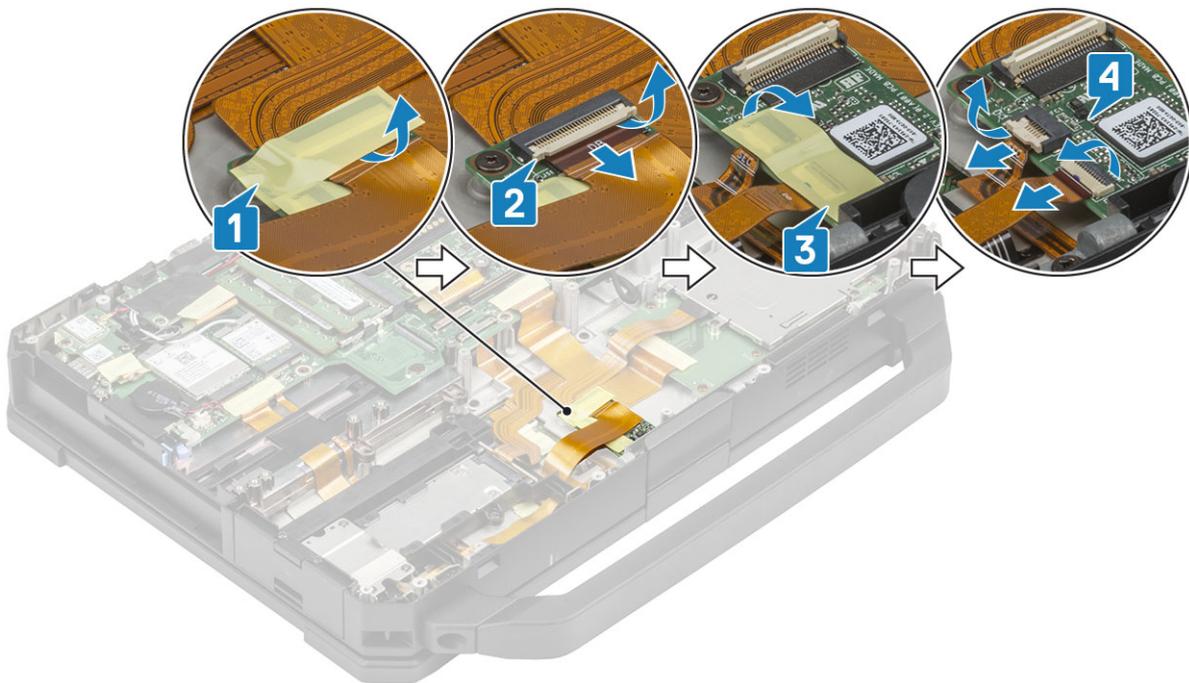


4. Install the:
 - a. Battery bay
 - b. PCIe Heatsink fan assembly
 - c. Bottom chassis cover
 - d. Batteries
5. Follow the procedure in [After working inside your computer](#).

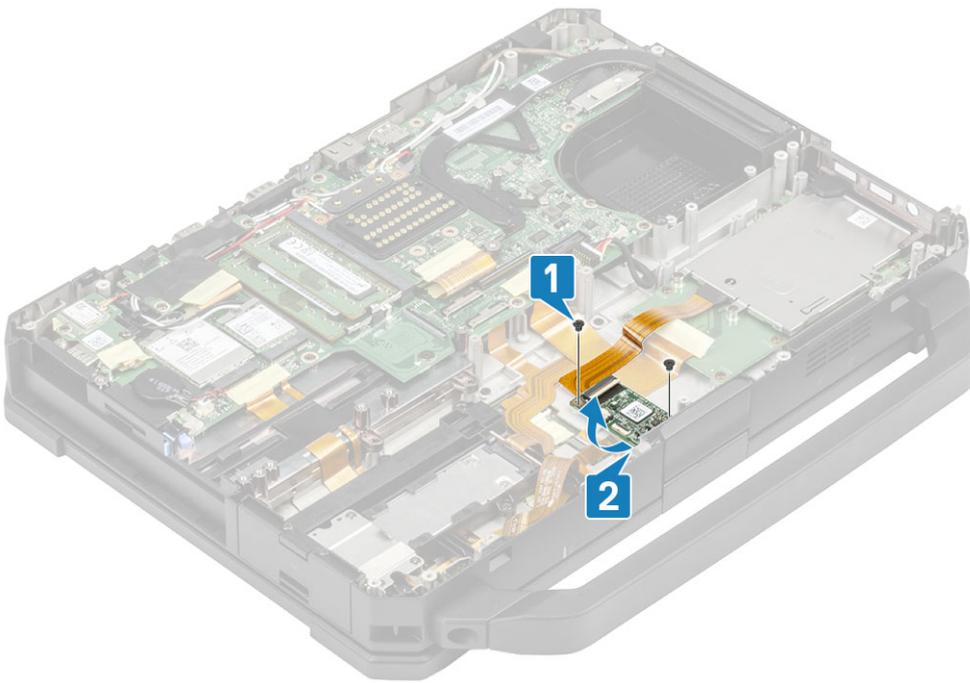
Smart Card

Removing the Smart Card Reader

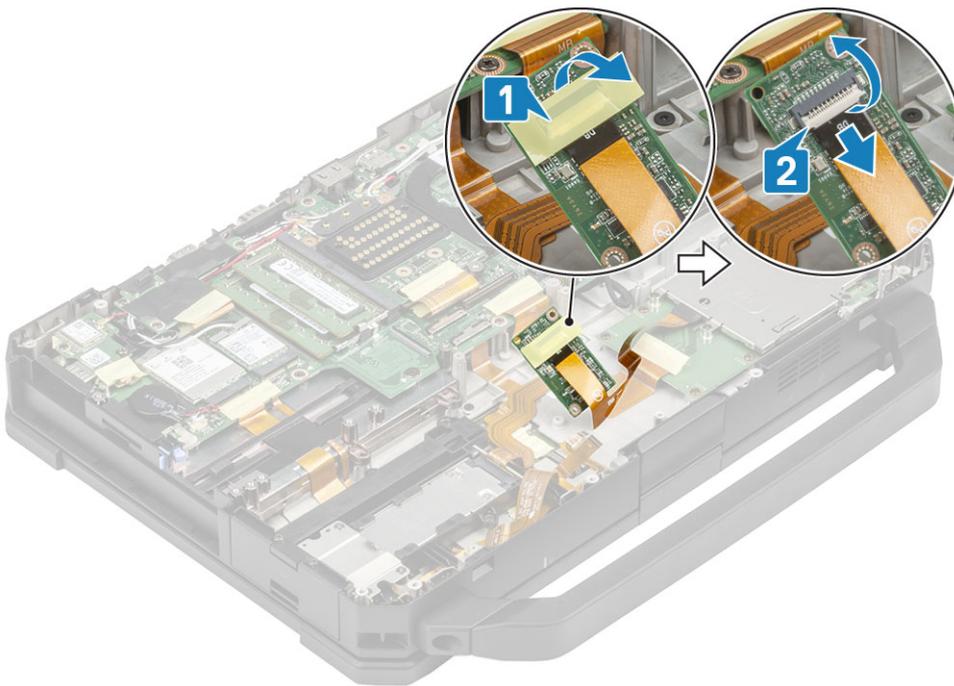
1. Follow the procedure in [Before working inside your computer](#).
2. Remove the:
 - a. Batteries
 - b. Bottom chassis cover
 - c. PCIe heatsink assembly
 - d. Battery bay
3. Remove the tape from the smart card reader connector [1] and disconnect it [2] from the USH board.
4. Remove the tape from the fingerprint reader connector [3] and disconnect it from the USH board [4].



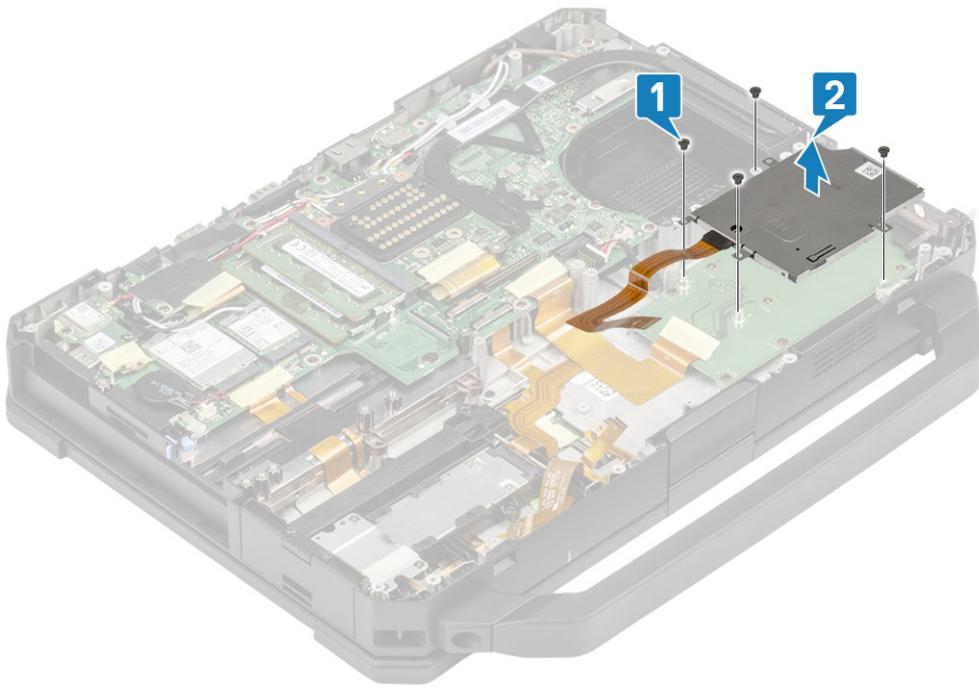
5. Remove the two 'M2*3' screws [1] securing the USH board to the bottom base and turn it up side down [2].



6. Remove the tape [1] and disconnect the Smartcard Reader FPC connector [2] from the USH board.

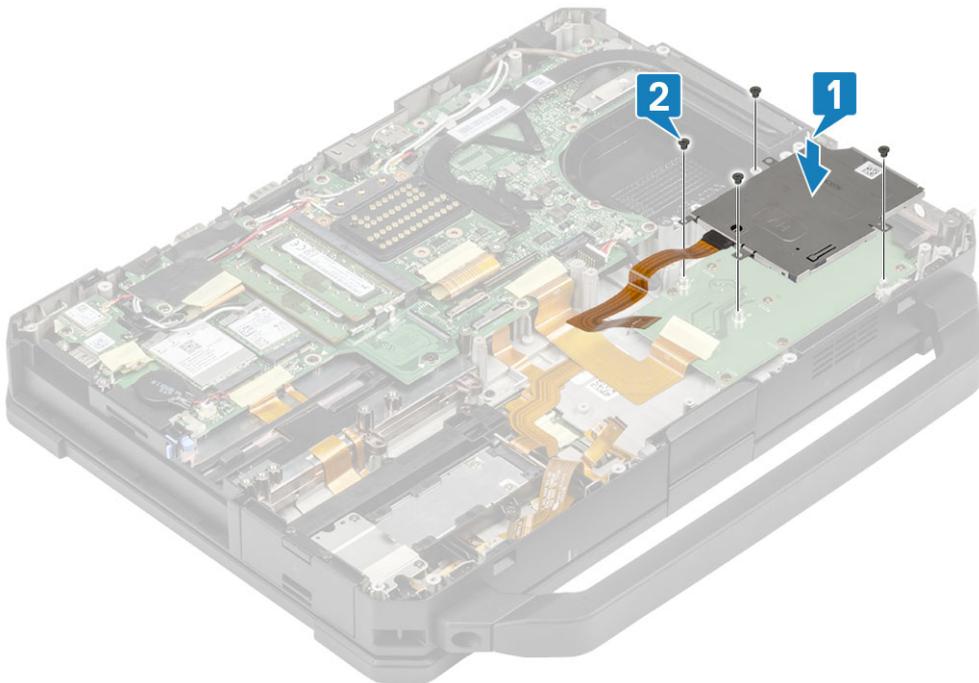


7. Loosen the four 'M2*3' screws [1] and remove the smart card [2] reader from the computer.

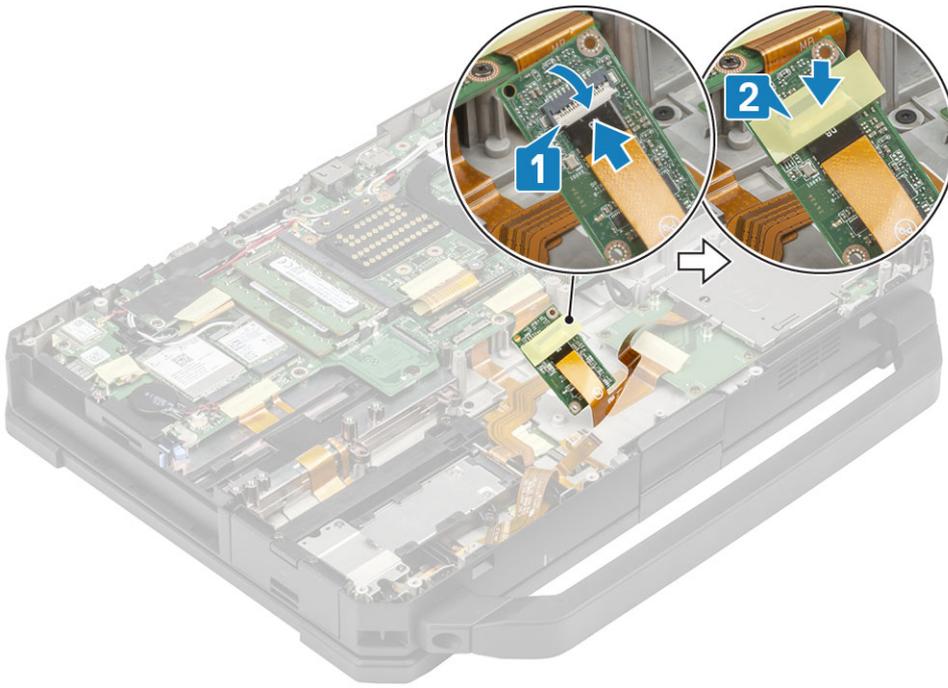


Installing the Smart Card Reader

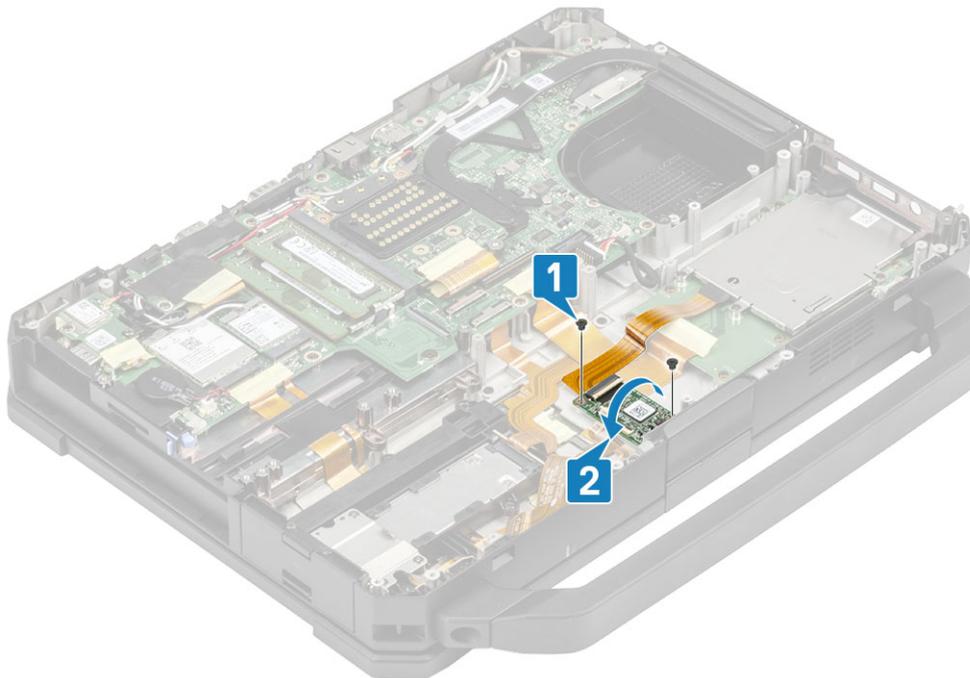
1. Insert the smart card reader through the I/O face plate [1] and install the four 'M2*3' screws to secure it to the bottom chassis [2].



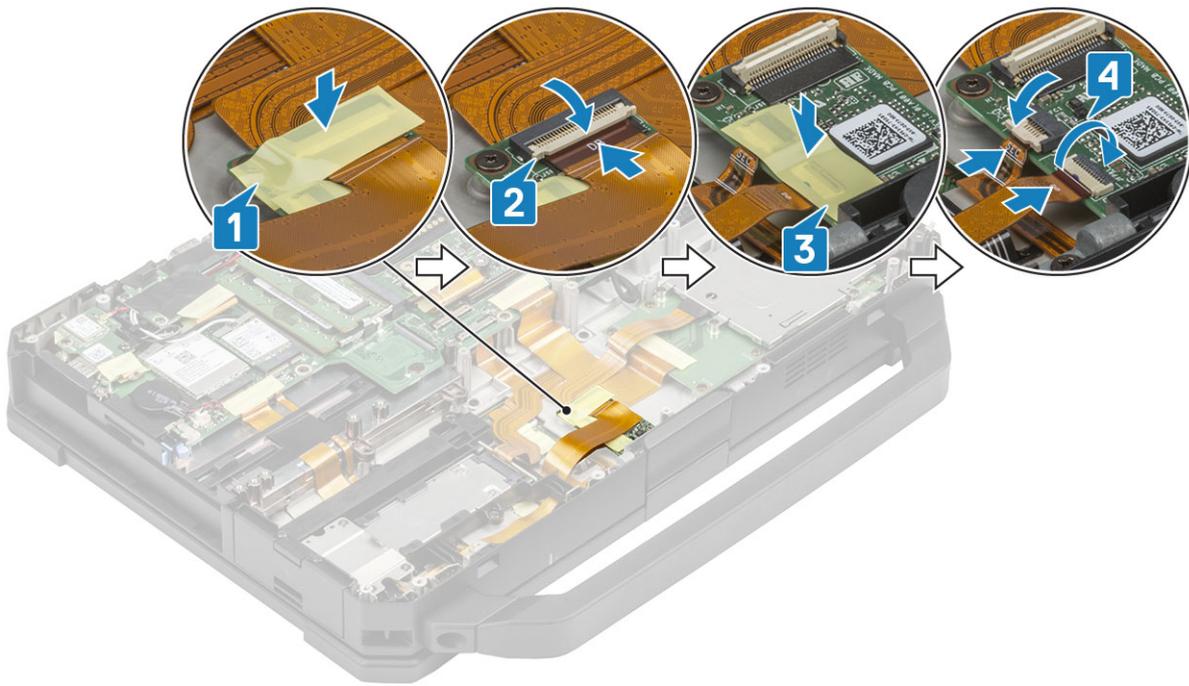
2. Connect the Smart Card FPC on the underside of the USH board [1] and secure it using a piece of tape [2].



3. Install the two 'M2*3' screws [1] and turn over the USH board to secure it to the chassis [2].



4. Connect the smart card FPC connector [1] and securing it with a piece of tape [2].
5. Connect the finger print reader FPC [3] and secure it using a piece of tap [4] to the USH board.

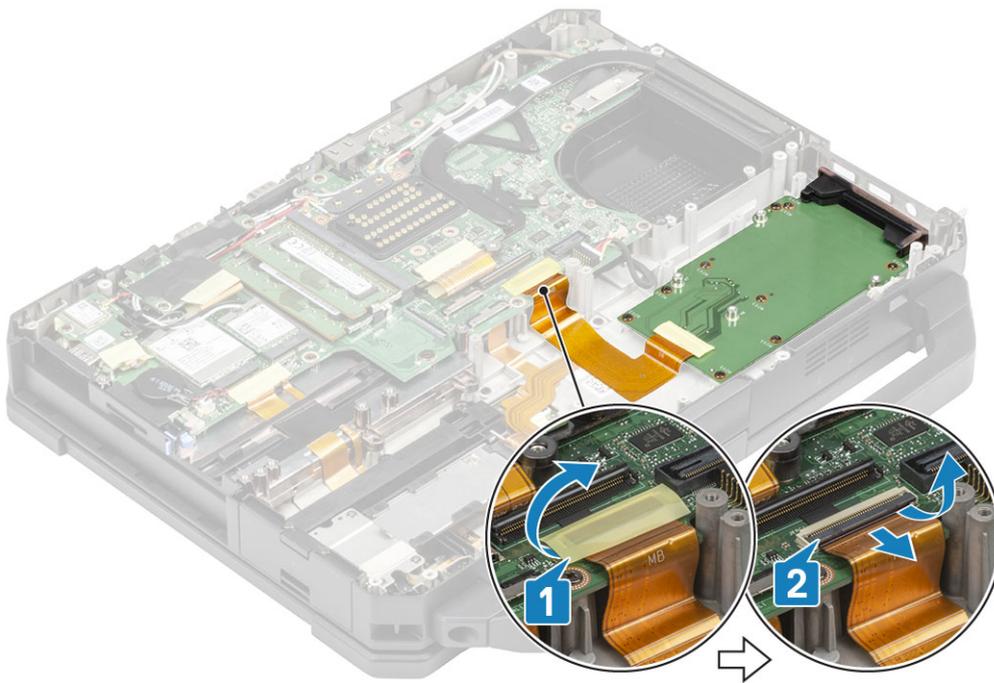


6. Install the:
 - a. [Battery bay](#)
 - b. [PCIe Heatsink assembly](#)
 - c. [Bottom chassis cover](#)
 - d. [Batteries](#)
7. Follow the procedure in [After working inside your computer](#).

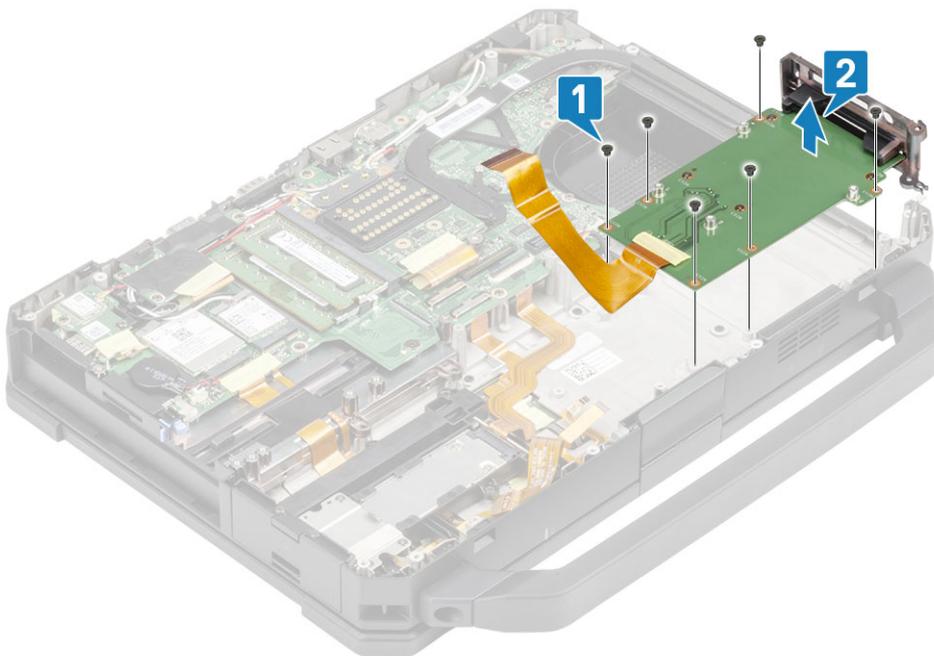
ExpressCard Reader

Removing the ExpressCard Reader

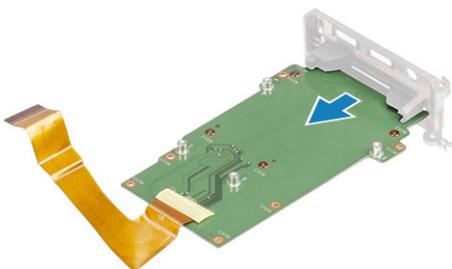
1. Follow the procedure in [Before working inside your computer](#).
2. Remove the:
 - a. [Batteries](#)
 - b. [Bottom chassis cover](#)
 - c. [PCIe heatsink assembly](#)
 - d. [Battery bay](#)
 - e. [Left I/O daughterboard](#)
 - f. [Smart card](#)
3. Peel off the tape on express card FPC connector [1] and disconnect it [2] from system board.



4. Remove the two screws securing the faceplate and the six 'M2*5' screws securing the Smart card to the computer [1]
5. Lift and remove the express card up to remove it from the computer [2].

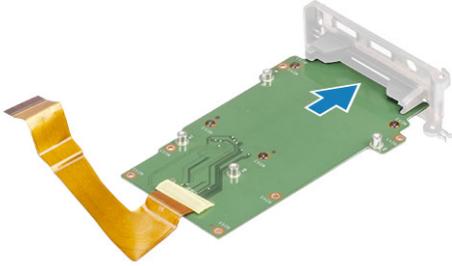


6. Separate the express card reader from the face plate.

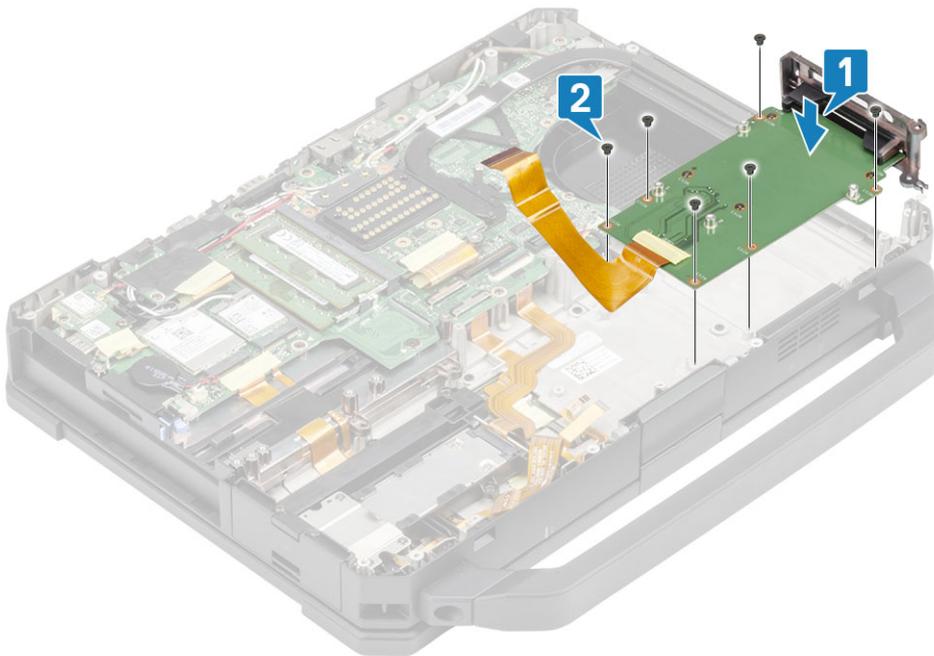


Installing the ExpressCard Reader

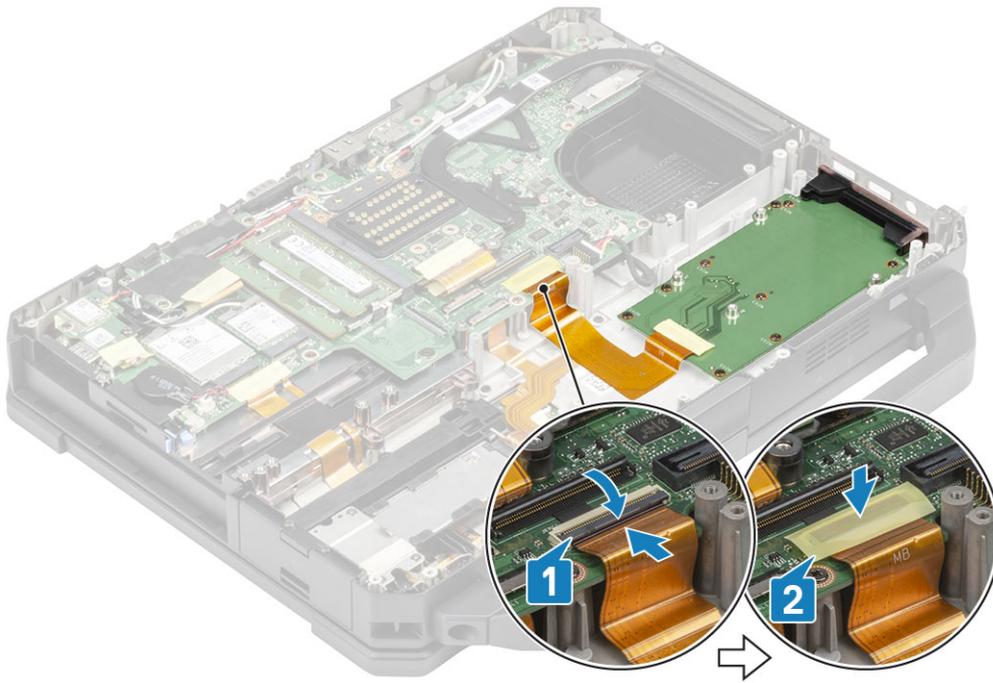
1. Insert the express card reader in the left I/O face plate.



2. Align and place the Express Card reader [1] on the computer and secure the face plate with two screws.
3. Install the four 'M2*5' screws securing the Express Card reader to the computer [2].



4. Connect the express card FPC cable to the system board [1] and secure it using a piece of tape [2].

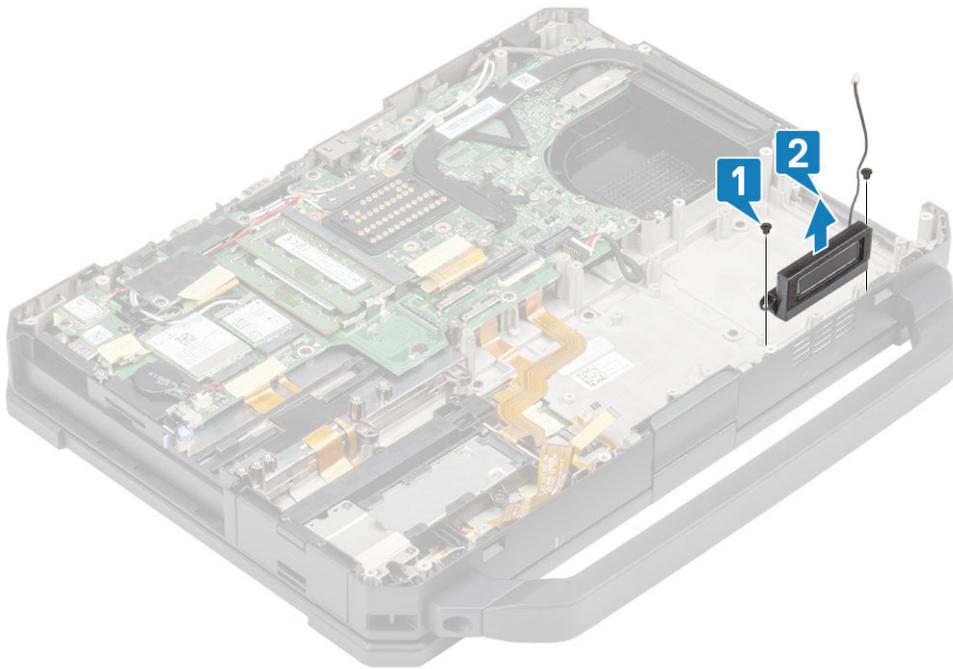


5. Install the:
 - a. [WWAN card](#)
 - b. [WLAN card](#)
 - c. [PCIe heatsink assembly](#)
 - d. [Batteries](#)
 - e. [Bottom chassis cover](#)
6. Follow the procedure in [After working inside your computer](#).

Speaker

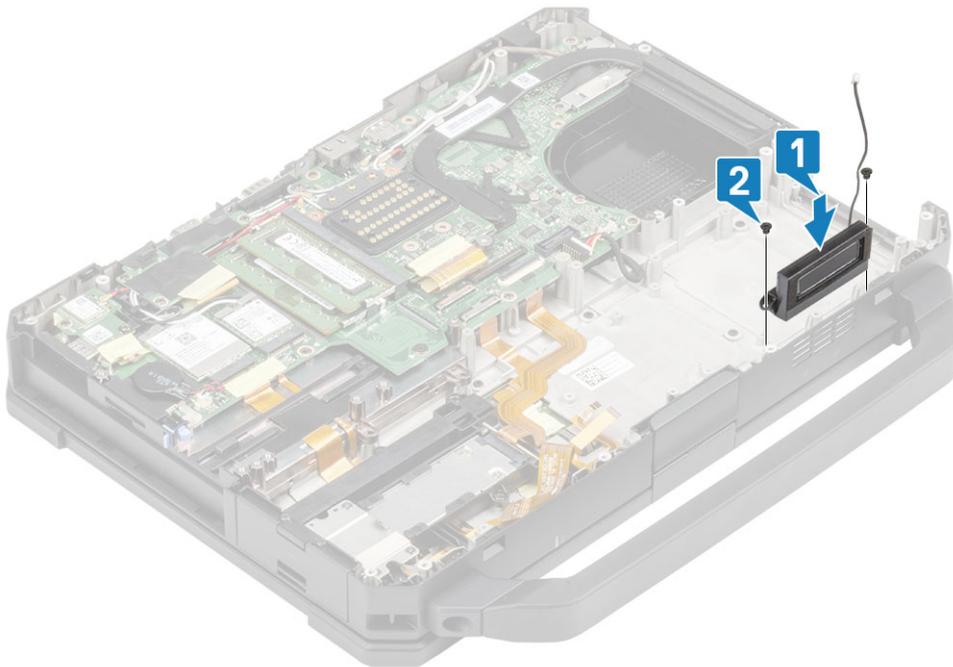
Removing the Speaker

1. Follow the procedure in [Before working inside your computer](#).
2. Remove the:
 - a. [Batteries](#)
 - b. [Bottom chassis cover](#)
 - c. [PCIe heatsink assembly](#)
 - d. [Left I/O daughterboard](#)
 - e. [Battery bay](#)
3. Remove the two 'M2.5*7' screws [1] and remove the speaker from the computer [2].



Installing the Speaker

1. Align and place the speakers [1] on the computer and install the two 'M2.5*7' screws to secure the speaker to the base [2].



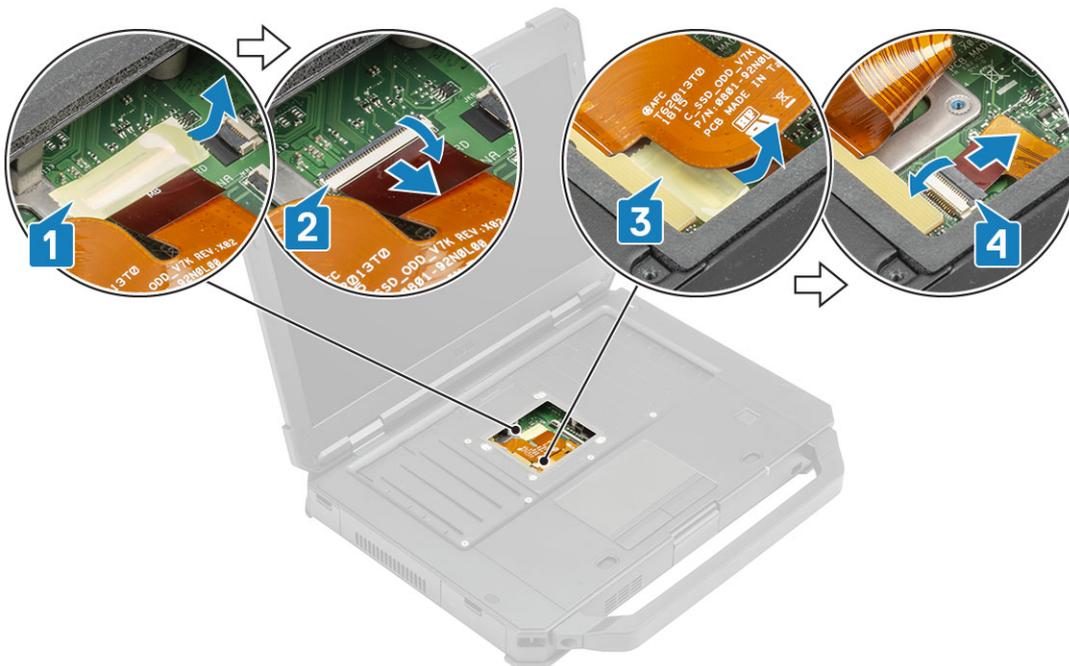
2. Install the:
 - a. [Battery Bay](#)
 - b. [Left I/O daughterboard](#)
 - c. [PCIe Heatsink assembly](#)
 - d. [Docking port assembly](#)
 - e. [Bottom Chassis Cover](#)
 - f. [Batteries](#)
3. Follow the procedure in [After working inside your computer](#).

System board

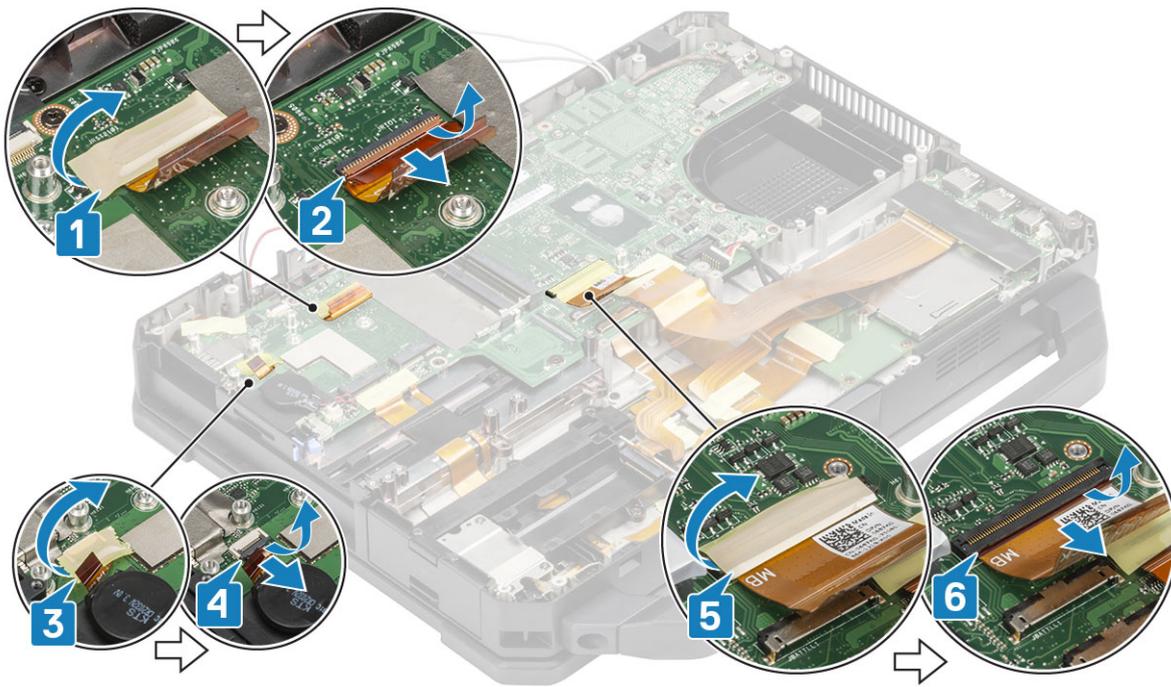
Removing the System board

NOTE: This system cannot be disassembled further. To access underlying components, replace the base assembly as per order details.

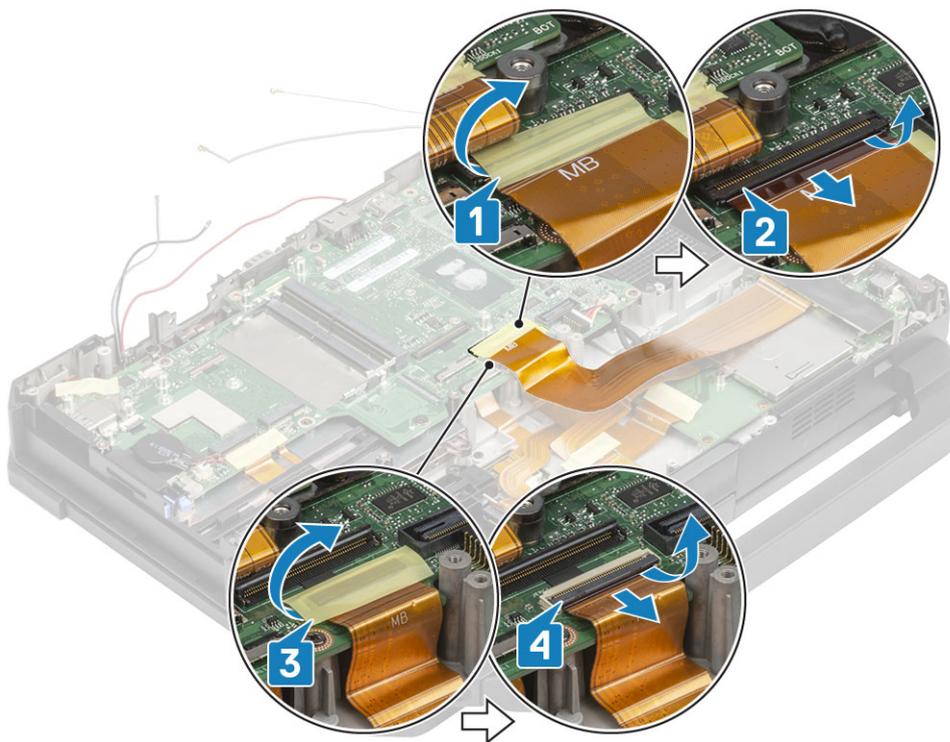
1. Follow the procedure in [Before working inside your computer](#).
2. Remove the:
 - a. Batteries
 - b. Bottom chassis cover
 - c. Keyboard
 - d. PCIe heatsink assembly
 - e. Docking port assembly
 - f. Primary SSD
 - g. Secondary SSD
 - h. Heat Sink
 - i. Memory
 - j. WLAN card
 - k. WWAN card
 - l. GPS module
 - m. Primary SSD rail
 - n. Battery bay
 - o. Rear I/O board
3. Peel off the tape [1], disconnect and lift the SSD-ODD assembly [2] from the system board.
4. Peel off the tape [3] from touch pad connectors and disconnect it from the system board [4].



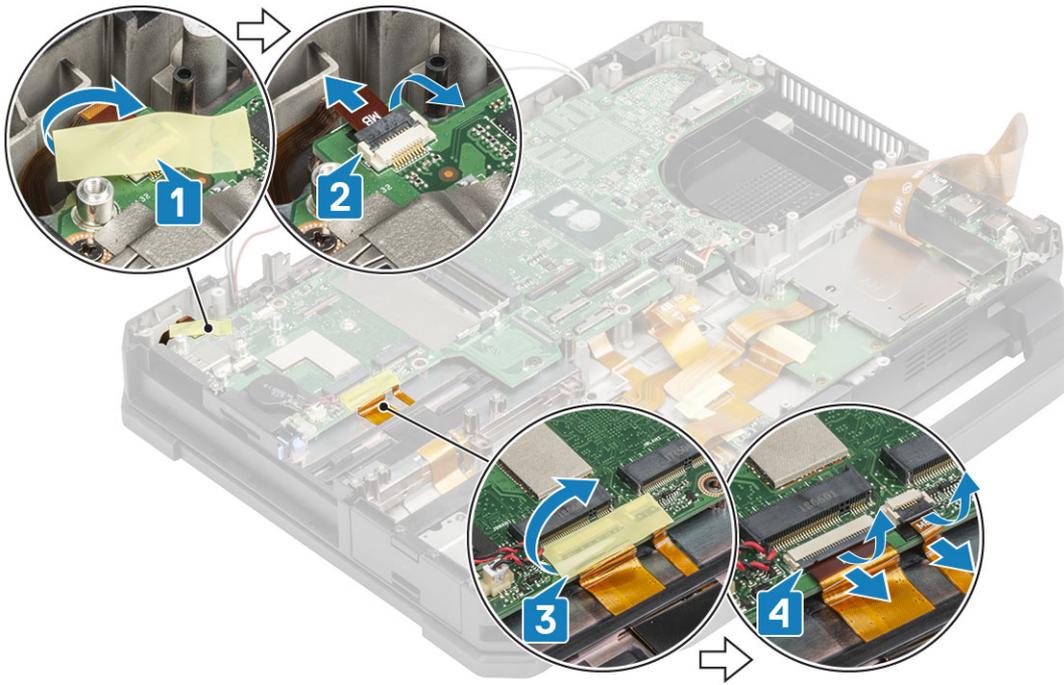
5. Peel off the tape [1] and disconnect the rear I/O board FPC connector [2] from the system board.
6. Peel off the tape [3] and disconnect the battery indicator LED cable [4].
7. Peel off the tape [5] and disconnect the dock board FPC connector [6] from the system board.



8. Peel off the tape [1] and disconnect the left I/O FPC [2] from the system board.
9. Peel off the tape [3] and disconnect the express card FPC [4] from the system board.

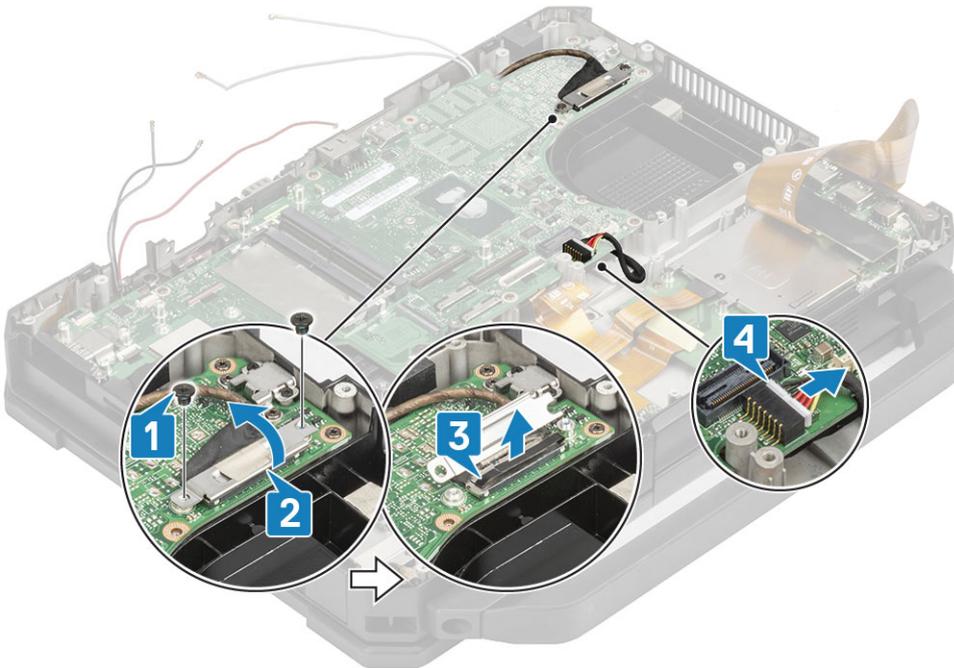


10. Peel off the tape [1] and disconnect the power button FPC connector [2] from the system board.
11. Peel off the tape [3] and disconnect the USH board FPC and touch pad connectors [4] from the system board.



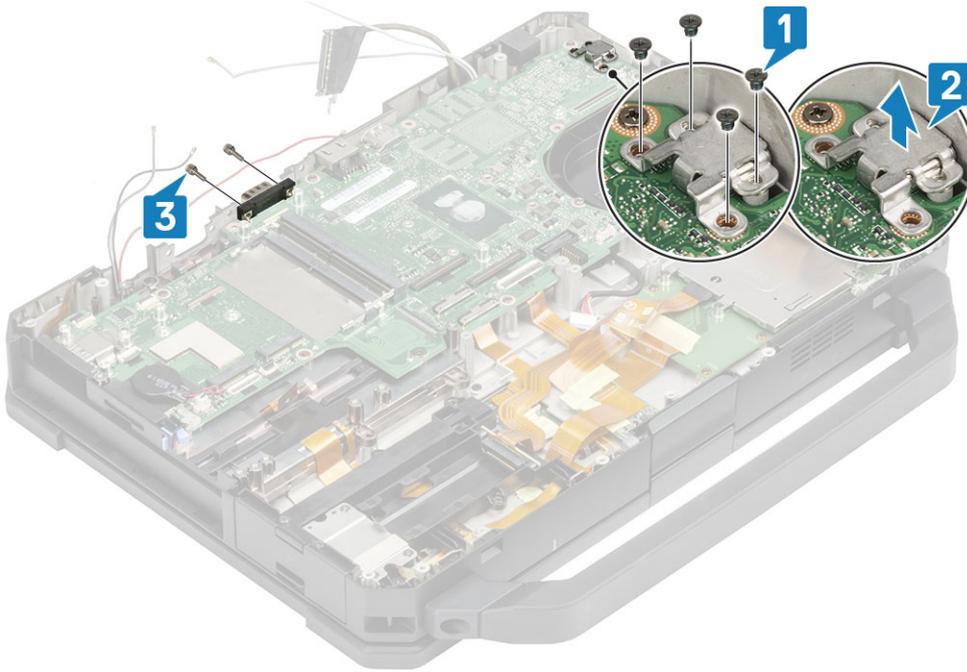
12. Remove the two 'M2*3' screws[1] on EDP bracket to remove the EDP bracket [2].

13. Disconnect the EDP cable [3] and disconnect the DC-In connector [4] from the system board.

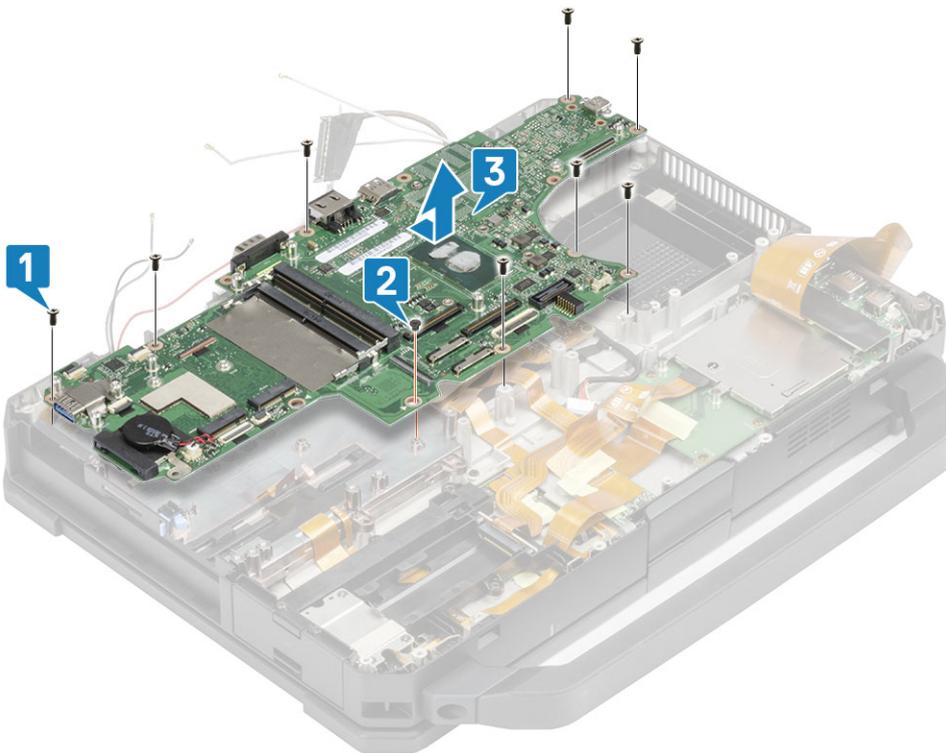


14. Remove the two 'M2.5*5' screws and two 'M1.6*3.0' screws [1] from the USB Type-C bracket.

15. Remove the USB Type-C bracket [2] and the two cap screws in the rear I/O space [3] from the system board.

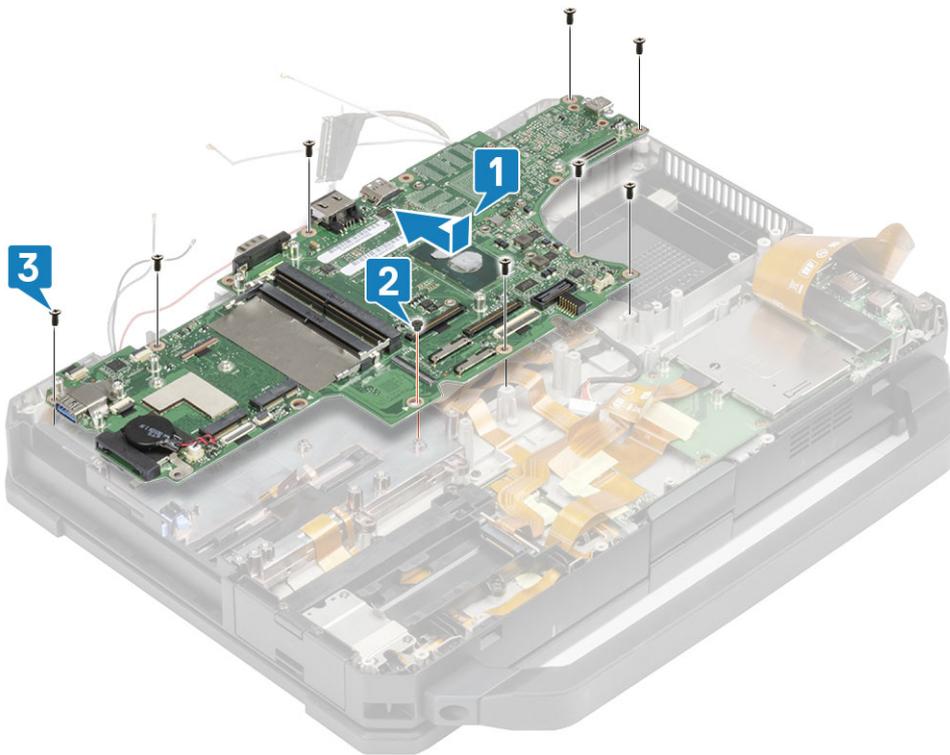


16. Remove the eight 'M2.5' screws [1] and single 'M2*3' screw epoxy screw [2] and remove the system board [3] from the computer.



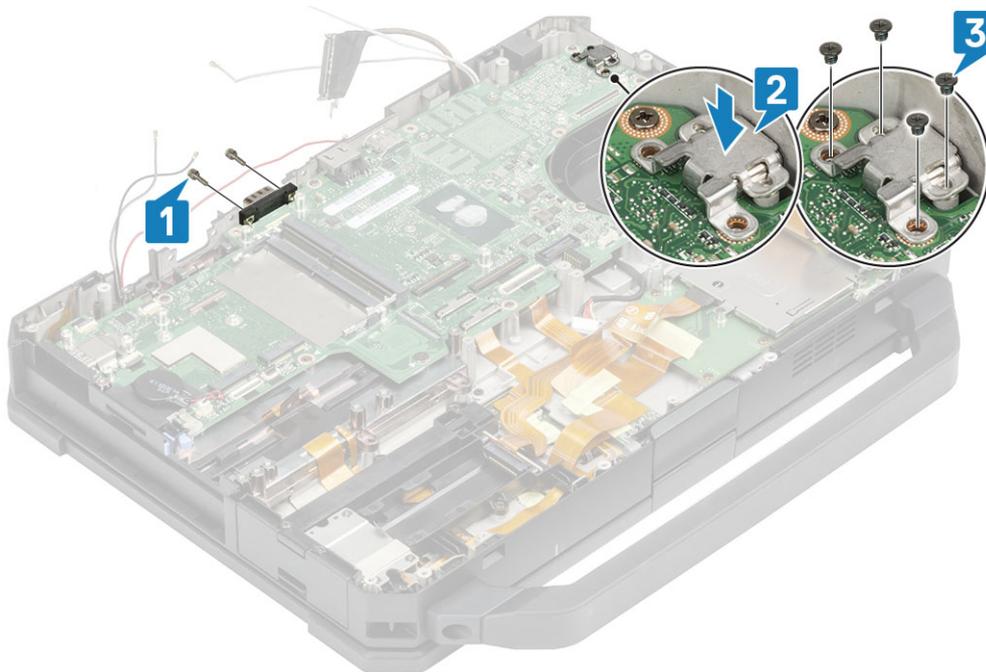
Installing the System board

1. Install the system board inserting the serial port on the system board through chassis [1] and install the eight 'M2.5' screws [2] and single 'M2*3' screw epoxy screw [3] on the system board.

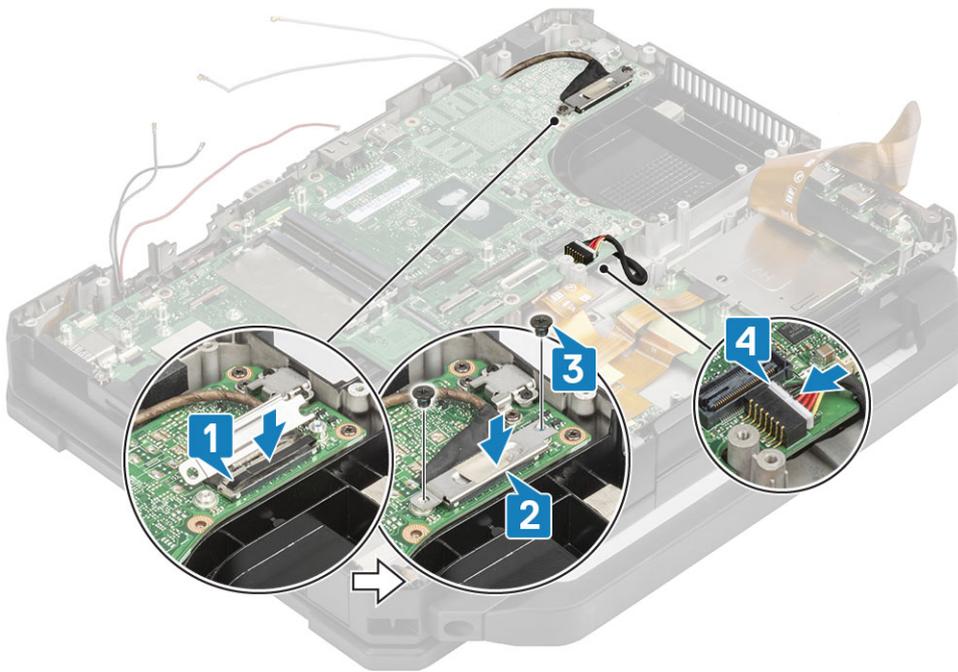


2. Install the two epoxy cap screws on the serial port of the system board [1].
3. ⓘ **NOTE:** When installing the System Board, technicians must ensure that both the battery cables (1st & 2nd Battery) and FPC cables (Left I/O FPC and Express Card reader FPC) are not pinched under the System Board.

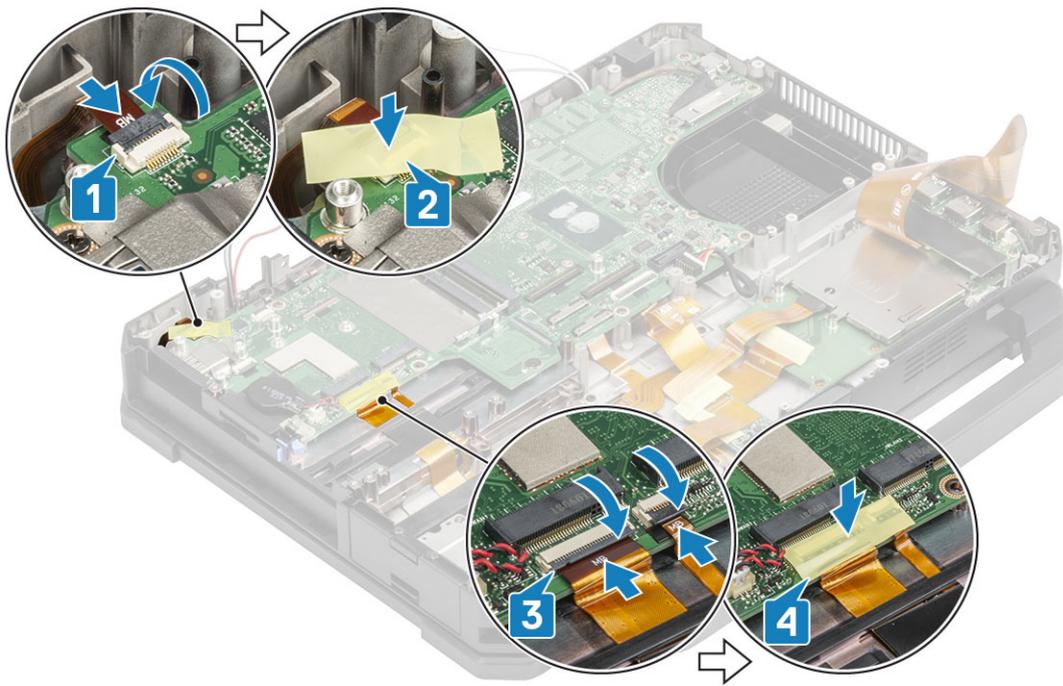
Install the USB Type-C bracket [2] and secure it with two 'M2.5*5' screws and two 'M1.6*3.0' screws on the system board [3].



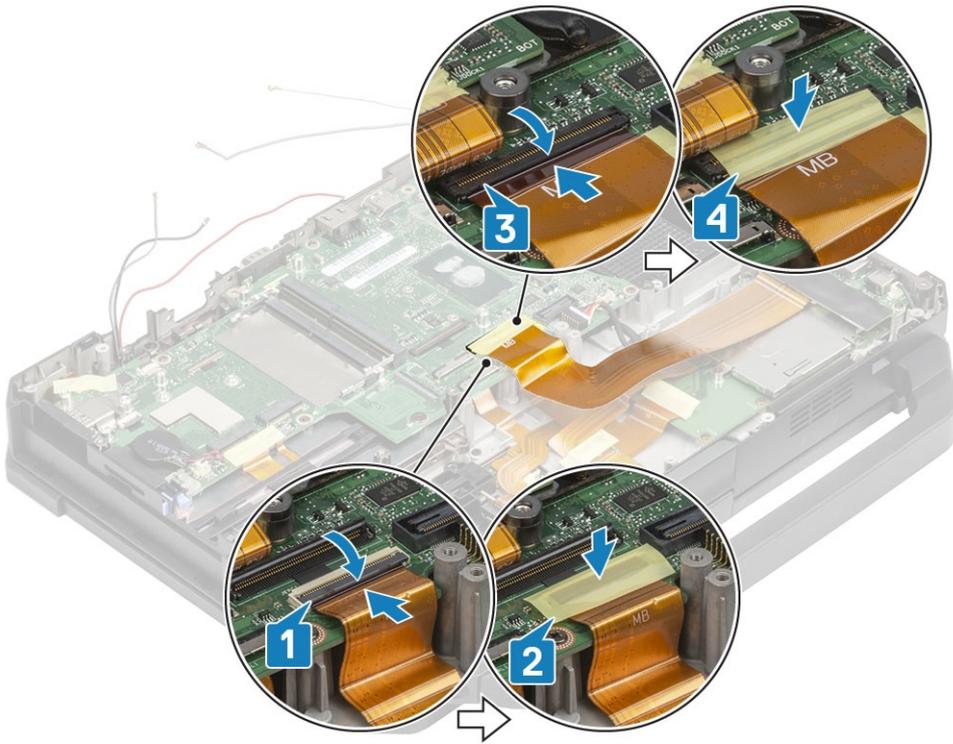
4. Connect the EDP cable [1] and install the EDP bracket on the system board [2].
5. Install the two 'M2*3' screws [3] on the EDP bracket and connect the DC-In cable to the system board [4].



6. Connect the power button cable [1] to the system board and secure it using a piece of tape [2].
7. Connect the USH board and touch pad cables [3] to the system board and secure it using a piece of tape [4].

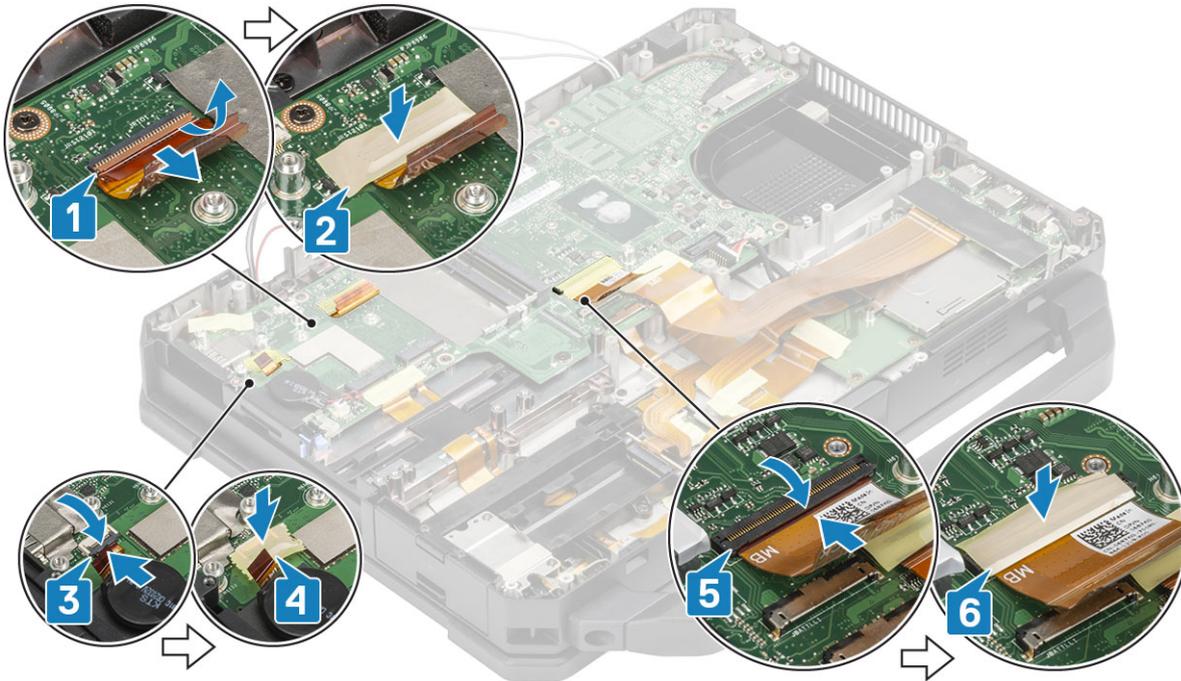


8. Connect the left I/O FPC cable [1] and secure it using a piece of tape [2].
9. Connect the express card FPC cable [3] and secure it using a piece of tape [4].

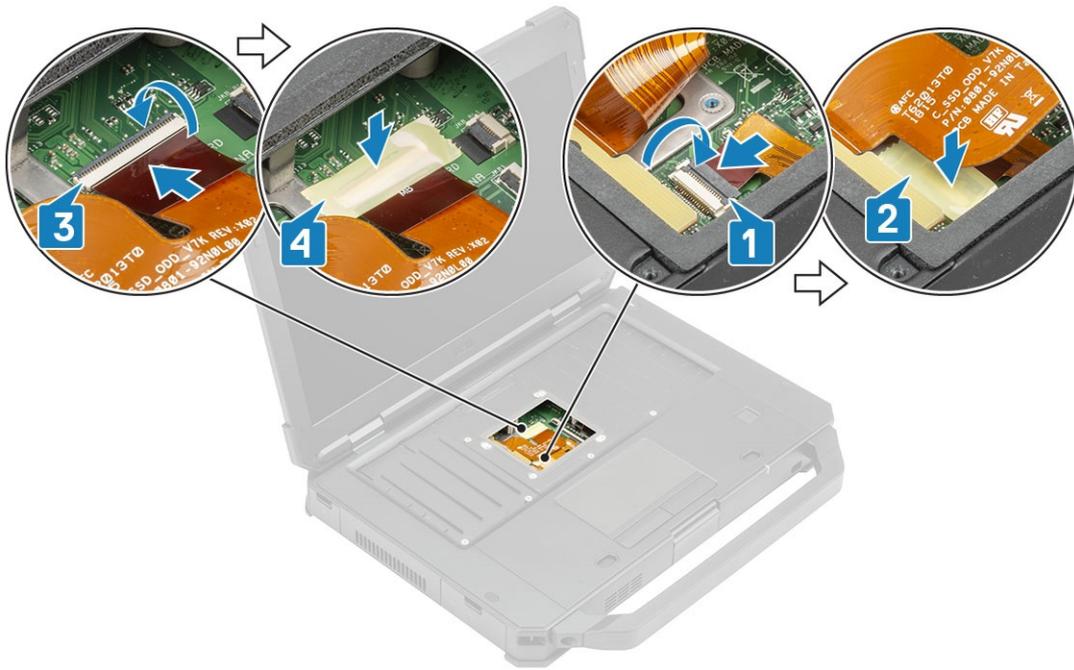


Motherboard

10. Connect the rear I/O FPC cable [1] and secure it using a piece of tape [2].
11. Connect the battery indicator FPC cable [3] and secure it using a piece of tape [4].
12. Connect the docking port FPC cable [5] and secure it using a piece of tape [6].



13. Connect the touch pad connectors to the system board [1] and secure it using a tape [2].
14. Connect the SSD-ODD assembly [3] and secure it using a piece of tape [4].



15. Install the:

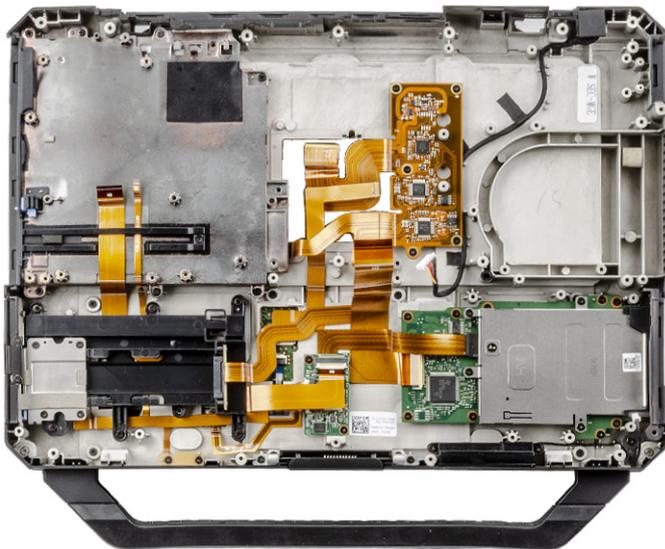
- a. Rear I/O board
- b. Battery bay
- c. Primary SSD rail
- d. GPS module
- e. WWAN card
- f. WLAN card
- g. Memory
- h. Heatsink
- i. Secondary SSD
- j. Primary SSD
- k. Docking port assembly
- l. PCIe heatsink assembly
- m. Keyboard
- n. Bottom chassis cover
- o. Batteries

16. Follow the procedure in [After working inside your computer](#).

Bottom Base Assembly

1. Follow the procedure in [Before working inside your computer](#).
2. To replace the bottom base assembly, remove the following components from old base:
 - a. Handle
 - b. Latched Doors
 - c. Batteries
 - d. Secondary SSD
 - e. Primary SSD
 - f. Hard Drive carrier
 - g. Bottom chassis cover
 - h. Keyboard
 - i. WWAN card
 - j. WLAN card
 - k. GPS module
 - l. Memory

- m. Coin cell
 - n. PCIe heatsink assembly
 - o. Primary SSD rail
 - p. Docking port assembly
 - q. Heatsink assembly
 - r. Rear I/O board
 - s. Display assembly
 - t. Primary SSD rail
 - u. Battery bay
 - v. Left I/O board
 - w. Smart card
 - x. Express Card
 - y. System board
3. Reconnect the:
- Power Button
 - Speakers
 - DC-In cable
 - USH Board
 - Touchpad



i **NOTE:** See the order details to determine the exact specifics of subcomponents defined in the Bottom Chassis Assembly.

i **NOTE:** The Latitude 5424, shipped with no ODD, has the blank fused to the chassis. Replace the 'Base Assembly' for any issues with the power button or ODD or secondary SSD.

4. Install the following components to the new base:
- a. System board
 - b. Express Card
 - c. Smart card
 - d. Left I/O board
 - e. Battery Bay
 - f. Primary SSD rail
 - g. Display assembly
 - h. Rear I/O board
 - i. Heatsink assembly
 - j. Docking port assembly
 - k. Primary SSD rail
 - l. PCIe heatsink assembly
 - m. Coin cell

- n. [Memory](#)
 - o. [GPS module](#)
 - p. [WLAN card](#)
 - q. [WWAN card](#)
 - r. [Keyboard](#)
 - s. [Bottom chassis cover](#)
 - t. [Hard Drive carrier](#)
 - u. [Primary SSD](#)
 - v. [Secondary SSD](#)
 - w. [Batteries](#)
 - x. [Latched doors](#)
 - y. [Handle](#)
5. Follow the procedure in [After working inside your computer](#).

Diagnostics

This chapter details the built in troubleshooting features to diagnose the Dell systems. It also lists the invoking instructions along with related information for each diagnostics method.

Topics:

- [ePSA Diagnostics](#)
- [LCD Built-in Self Test \(BIST\)](#)
- [Battery Status Lights](#)
- [Diagnostic LED](#)
- [WiFi power cycle](#)
- [BIOS recovery](#)
- [Updating the BIOS](#)
- [Self-Heal](#)

ePSA Diagnostics

The ePSA diagnostics (also known as system diagnostics) performs a complete check of your hardware. The ePSA is embedded with the BIOS and is launched by the BIOS internally. The embedded system diagnostics provides a set of options for particular devices or device groups allowing you to:

- Run tests automatically or in an interactive mode
- Repeat tests
- Display or save test results
- Run thorough tests to introduce additional test options to provide extra information about the failed device(s)
- View status messages that inform you if tests are completed successfully
- View error messages that inform you of problems encountered during testing

 **NOTE:** The **Enhanced Pre-boot System Assessment** window displays, listing all devices detected in the computer. The diagnostics starts running the tests on all the detected devices.

Running ePSA diagnostics

Invoke diagnostics by either of the methods that are suggested below:

- **Tap F12** key on keyboard, as the Dell splash screen appears, until you get the message **Diagnostic Boot Selected**.
 - On the one-time boot menu screen, use the Up/Down arrow key to select the **Diagnostics** option and then press **Enter**.
- Press and Hold **Function (Fn)** key on the keyboard and press the **Power button** to power on the system.

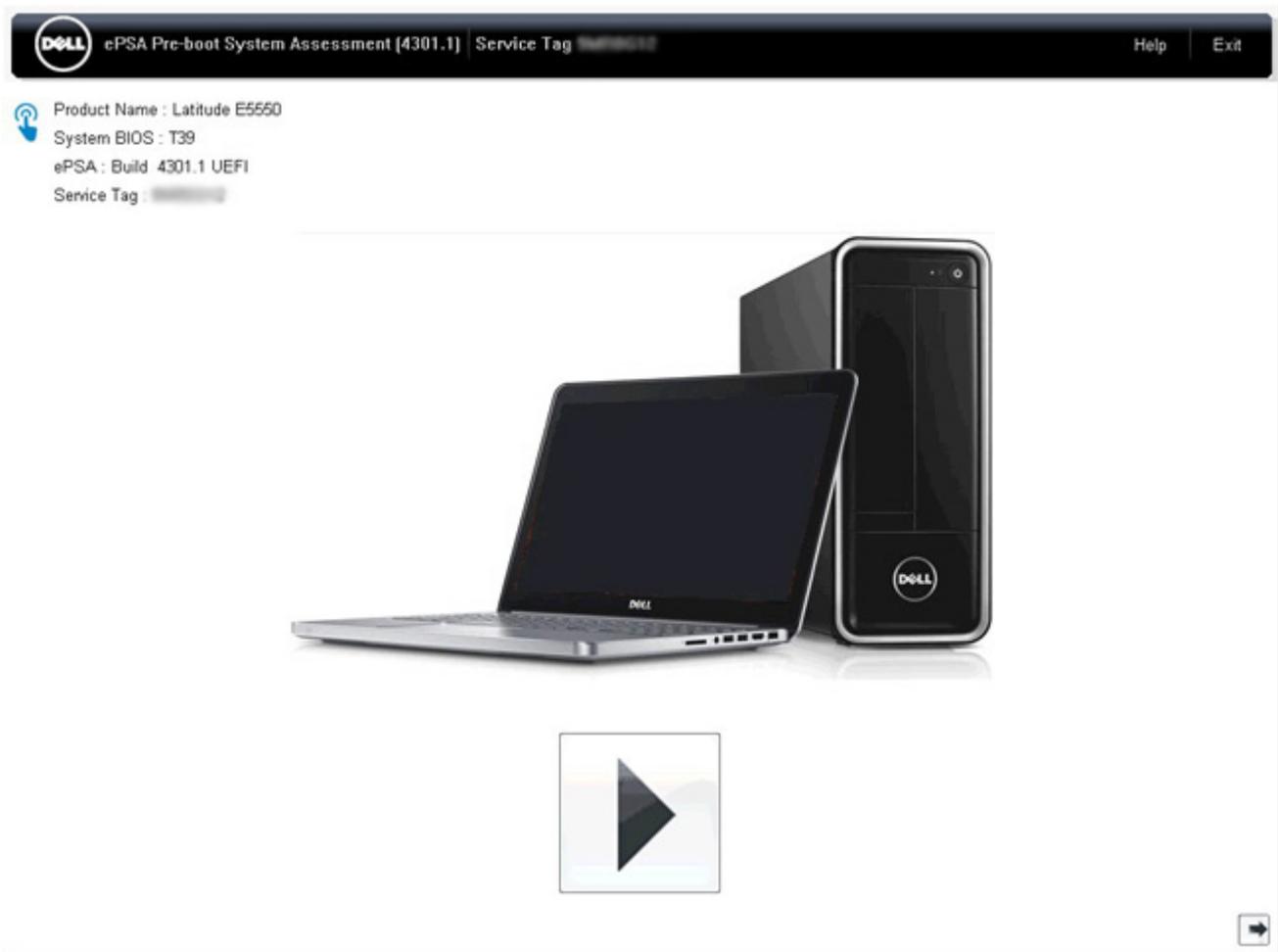
ePSA User Interface

This section contains information on ePSA 3.0's Basic and Advanced Screen.

ePSA opens the basic screen on start. You can switch to the advanced screen using the arrow icon at the bottom of the screen. The advanced screen shows detected devices on the left column. Specific test can be included or excluded only in the interactive mode.

ePSA Basic Screen

The Basic Screen has minimal controls which allows easy navigation for the user to start or stop the diagnostics.



ePSA Advanced Screen

The advanced screen allows more directed testing and contains more detailed information about the overall health of the system. The user can get to this screen by simply swiping a finger to the left on touchscreen systems or clicking the next page button on the lower right hand side of the basic screen.

Dell ePSA Pre-boot System Assessment (4301.1) Service Tag

Help Exit

Configuration | Results | System Health | Event Log

Battery and AC Adapter

Sensor	Current	High	Low
Primary Battery Charge	96%	96%	89%
Primary Battery Health	80%	80%	80%
Primary Battery Voltage	8455 mV	8455 mV	8390 mV
Primary Battery Current Flow	935 mA	2247 mA	935 mA
Primary Battery Charging State	Charging	n/a	n/a
AC adapter	65 watt adapter	n/a	n/a

Fans

Sensor	Current	High	Low
Processor Fan	2704 RPM	3352 RPM	0 RPM

Thermals

Sensor	Current	High	Low
Hard Drive 0	34 C	36 C	34 C
Primary Battery Thermistor	31 C	32 C	31 C
CPU Thermistor	58 C	61 C	57 C
Ambient Thermistor	49 C	50 C	48 C
SODIMM Thermistor	43 C	44 C	43 C
Other Thermistor	36 C	36 C	35 C
Video Thermistor	53 C	57 C	53 C

Thorough Test Mode [Advanced Options](#)

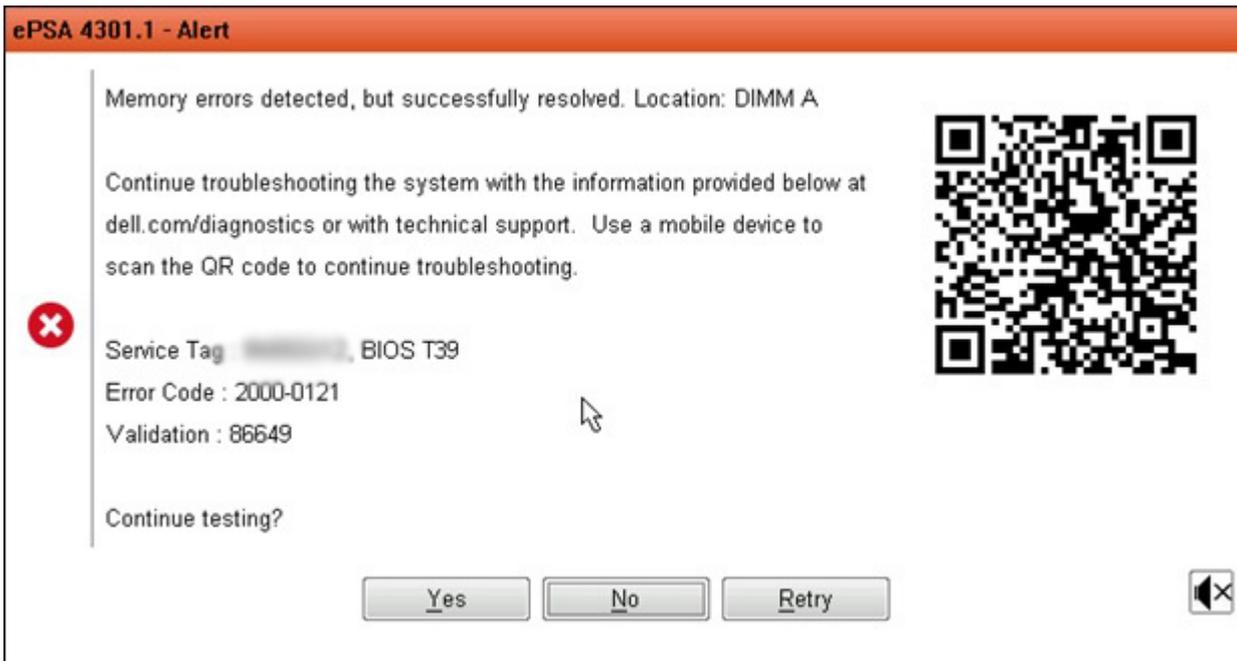
0%

To run the test on specific device or run a specific test

1. To run a diagnostic test on a specific device, press Esc and click **Yes** to stop the diagnostic test.
2. Select the device from the left pane and click **Run Tests** or use **Advanced Option** to include or exclude any test.

ePSA Error Messages

When the Dell ePSA Diagnostic detects an error while running, it will pause the test and the following window is displayed:



- By responding **Yes**, the diagnostic will continue testing the next device and the error details will be available in the summary report.
- By responding **No**, the diagnostic will stop testing the remaining untested device.
- By responding **Retry**, the diagnostic will ignore the error and rerun the last test.

Capture the error code with Validation code or Scan QR code and Contact Dell.

i **NOTE:** As part of the new feature, user can now mute the beeping sound code when there is an error by clicking on  at the bottom right side of the error window.

i **NOTE:** Some tests for specific devices require user interaction. Always ensure that you are present before the computer when the diagnostic tests are performed.

Validation Tools

This section contains information on how to validate the SupportAssist ePSA, ePSA or PSA error codes.

Error code verification can be done using below two methods :

- [Online Enhanced Preboot System Assessment Validation Tool](#).
- QR scanning using QR APP on Smart Phone.

Online SupportAssist On-board Diagnostics, ePSA or PSA Error Codes Validation Tool

Usage Guide

1. User to obtain information from SupportAssist error windows.



2. Navigate to <https://www.dell.com/support/diagnose/Pre-boot-Analysis>.
3. Enter error code, validation code, and service tag. Part serial number is optional.

Error Code (without 2000-prefix) *	<input type="text" value="Error Code (without 2000-prefix)"/>
Validation Code *	<input type="text" value="Validation Code"/>
Service Tag ⓘ *	<input type="text" value="Service Tag"/>
Part Serial # (optional)	<input type="text" value="Part Serial # (optional)"/>
<input type="submit" value="Submit"/>	

[View System Requirements and Privacy And Legal Information](#)

NOTE: For error code, use only the last 3 or 4 digits of the code. (user can enter 0142 or 142 instead of 2000-0142.)

4. Click on **Submit** once all the necessary information is entered.

Error Code (without 2000-prefix) *

Validation Code *

Service Tag  *

Part Serial # (optional)

Submit

[View System Requirements and Privacy And Legal Information](#)

Valid Error Code Example



Vostro 20 All-in-One 3055

Service Tag: XXXXXXXXXX | Express Service Code: XXXXXXXXXX

[Add to My Products List](#)

[View a different product](#)

Manuals
Warranty
System configuration

Diagnostics

Support topics & articles

Drivers & downloads

General maintenance

Parts & accessories

 Your system is currently Out of Warranty. Please contact Dell Technical Support for further assistance.

Result: Issues Found.

Your result requires attention. Review the affected hardware below and follow the instructions to troubleshoot problems or you may be presented with a request to replace parts. [Clear results](#)

 Needs Attention: System maintenance —

Needs Attention

A potential error has been found. [Click here](#) to view a list of steps that can help resolve your issue.

See full scan results.

Diagnostics Completed —

Hardware

Diagnostic Name	Error Code	Serial #	Result
EPSA	141		 Failed

After entering the correct information, the online tools will direct the user to the above screen which contains information on :

- Confirmation of the error code and result outcome
- Suggested Part Replacement

- If customer is still covered under Dell Warranty
- Case reference number if there is an open case under the service tag

Invalid Error Code Example

Error Code (without 2000-prefix) *	<input type="text" value="0141"/>
Validation Code *	<input type="text" value="123456"/>
Service Tag  *	<input type="text" value="N024802"/>
Part Serial # (optional)	<input type="text" value="Part Serial # (optional)"/>

 You have entered an invalid ePSA request, please check your details and try again.

Submit

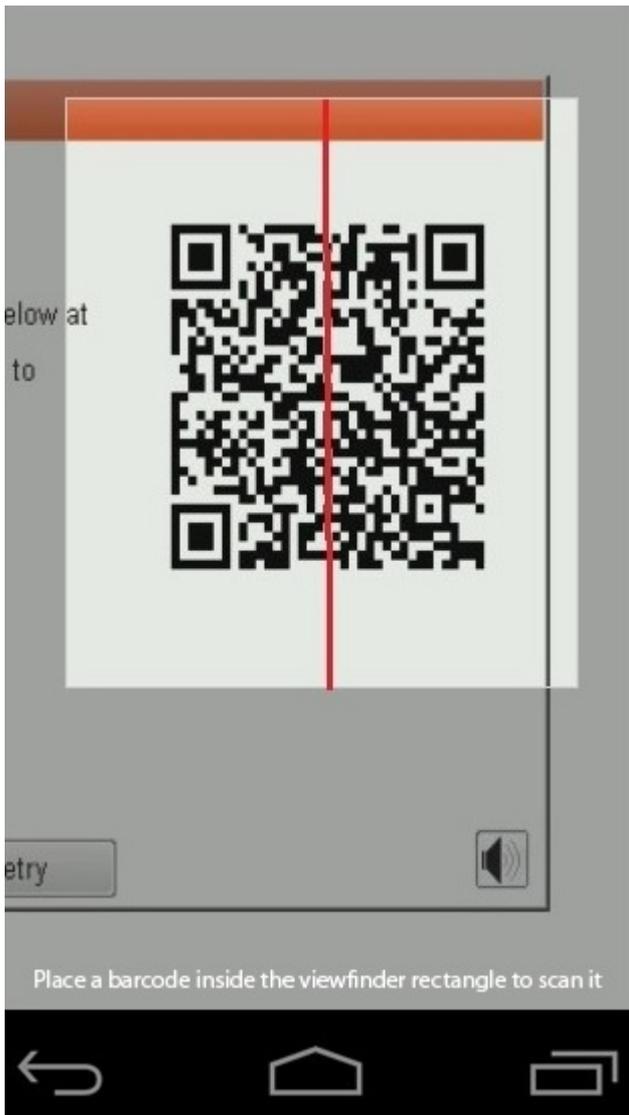
QR APP Validation Tool

Besides using the online tool, customers can also validate the error code by scanning the QR code with a QR APP on a smartphone.

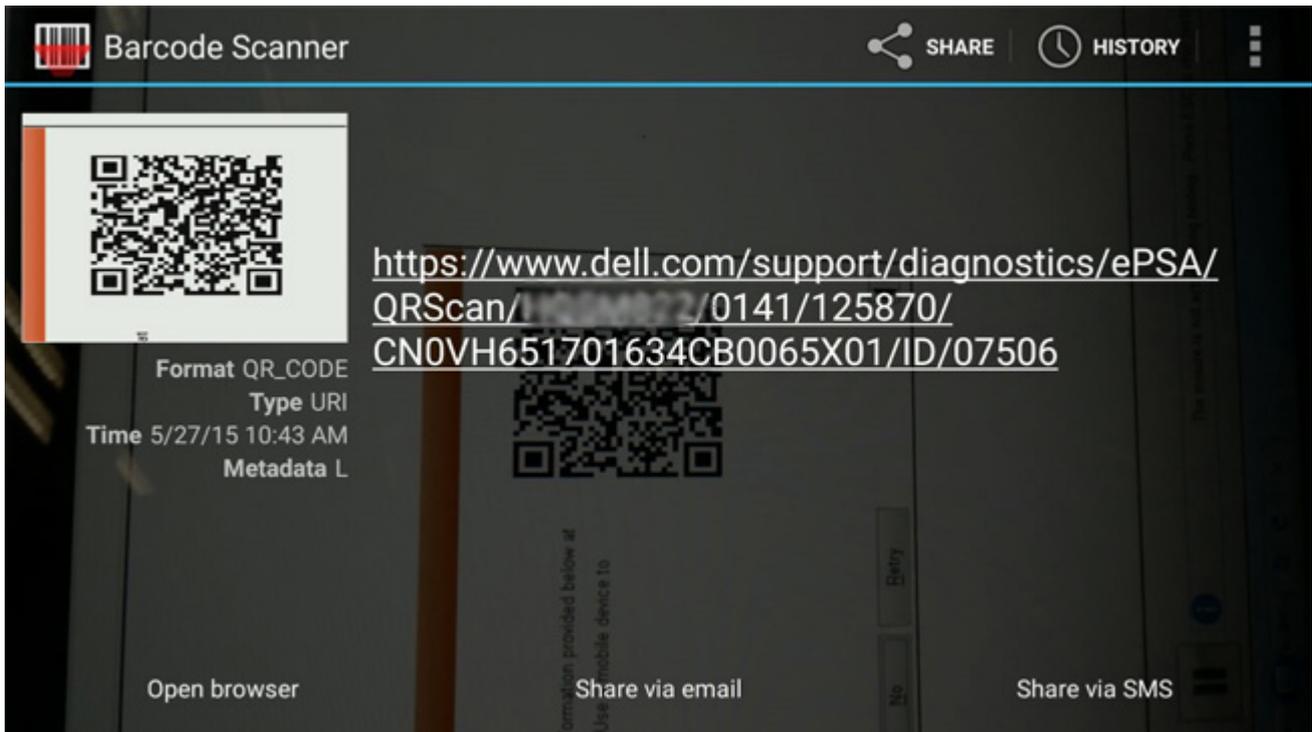
1. User to obtain the QR code from SupportAssist On-board Diagnostics error screen.



2. User can use any QR code scanner application through the smartphone to scan the QR code.



3. The QR code scanner application will scan the code and automatically generate a link. Click the link to proceed.



The link generated will take the customer to the Dell Support website which contains information on:

- Confirmation of the error code and result outcome
- Suggested Part Replacement
- If customer is still covered under Dell Warranty
- Case reference number if there is an open case under the service tag

Vostro 20 All-in-One 3055
Service Tag: [XXXXXXXXXX](#) | Express Service Code: [XXXXXXXXXX](#)
Add to My Products List
[View a different product](#)

Manuals Warranty System configuration

Diagnostics

- Support topics & articles
- Drivers & downloads
- General maintenance
- Parts & accessories

Warning: Your system is currently Out of Warranty. Please contact Dell Technical Support for further assistance.

Result: Issues Found.

Your result requires attention. Review the affected hardware below and follow the instructions to troubleshoot problems or you may be presented with a request to replace parts.

[Clear results](#)

Needs Attention: System maintenance

Needs Attention

A potential error has been found. [Click here](#) to view a list of steps that can help resolve your issue.

[See full scan results.](#)

Diagnostics Completed

Hardware			
Diagnostic Name	Error Code	Serial #	Result
EP5A	141		❌ Failed

LCD Built-in Self Test (BIST)

Dell laptops have a built-in diagnostic tool that helps you determine if the screen abnormality you are experiencing is an inherent problem with the LCD (screen) of the Dell laptop or with the video card (GPU) and PC settings.

When you notice screen abnormalities like flickering, distortion, clarity issues, fuzzy or blurry image, horizontal or vertical lines, color fade etc., it is always a good practice to isolate the LCD (screen) by running the Built-In Self Test (BIST).

How to invoke LCD BIST Test

1. Power off the Dell laptop.
2. Disconnect any peripherals that are connected to the laptop. Connect only the AC adapter (charger) to the laptop.
3. Ensure that the LCD (screen) is clean (no dust particles on the surface of the screen).
4. Press and hold **D** key and **Power on** the laptop to enter LCD built-in self test (BIST) mode. Continue to hold the D key, until you see color bars on the LCD (screen).
5. The screen will display multiple color bars and change colors on the entire screen to red, green, and blue.
6. Carefully inspect the screen for abnormalities.
7. Press **Esc** key to exit.

NOTE: Dell SupportAssist Pre-boot diagnostics upon launch, initiates an LCD BIST first, expecting a user intervention confirm functionality of the LCD.

Battery Status Lights

If the computer is connected to an electrical outlet, the battery light operates as follows:

- Alternately blinking amber light and green light** An unauthenticated or unsupported non-Dell AC adapter is attached to your laptop.
- Alternately blinking amber light with steady green light** Temporary battery failure with AC adapter present.
- Constantly blinking amber light** Fatal battery failure with AC adapter present.
- Light off** Battery in full charge mode with AC adapter present.
- green light on** Battery in charge mode with AC adapter present.

Diagnostic LED

This section details the diagnostic features of the battery LED in a laptop.

Instead of beep codes errors are indicated via the bicolor Battery Charge LED. A specific blink pattern is followed by flashing a pattern of flashes in green, followed by white. The pattern then repeats.

NOTE: The diagnostic pattern will consist of a two digit number being represented by a first group of LED blinks (1 through 9) in green, followed by a 1.5 second pause with the LED off, and then a second group of LED blinks (1 through 9) in white. This is then followed by a 3 second pause, with the LED off, before repeating over again. Each LED blink takes 0.5 seconds.

The system will not shutdown when displaying the Diagnostic Error Codes. Diagnostic Error Codes will always supersede any other use of the LED. For instance, on laptops, battery codes for Low Battery or Battery Failure situations will not be displayed when Diagnostic Error Codes are being displayed:

Table 25. LED pattern

Blinking pattern		Problem Description	Suggested Resolution
Green	White		
2	1	processor	Processor failure
2	2	system board, BIOS ROM	System board, covers BIOS corruption or ROM error
2	3	memory	No memory/no RAM detected
2	4	memory	Memory failure/RAM failure
2	5	memory	Invalid memory installed
2	6	system board; chipset	System board/ chipset error
2	7	display	Display failure
3	1	RTC power failure	Coin-cell battery failure
3	2	PCI/Video	PCI/Video card/chip failure
3	3	BIOS recovery 1	Recovery image not found

Table 25. LED pattern (continued)

Blinking pattern		Problem Description	Suggested Resolution
Green	White		
3	4	BIOS recovery 2	Recovery image found but invalid
3	5	Power Rail Failure	EC ran into power sequencing failure
3	6	SBIOS Flash Corruption	Flash corruption detected by SBIOS
3	7	ME Error	Timeout waiting on ME to reply to HECI message

WiFi power cycle

If your computer is unable to access the Internet due to WiFi connectivity issues, a WiFi power cycle procedure may be performed. The following procedure provides the instructions on how to conduct a WiFi power cycle:

i **NOTE:** Some ISPs (Internet Service Providers) provide a modem/router combo device.

1. Turn off your computer.
2. Turn off the modem.
3. Turn off the wireless router.
4. Wait for 30 seconds.
5. Turn on the wireless router.
6. Turn on the modem.
7. Turn on your computer.

BIOS recovery

The BIOS recovery is designed to fix the main BIOS, and cannot work if the boot is damaged. The BIOS recovery will not work in the event of EC corruption, ME corruption, or a hardware related issue. The BIOS recovery image should be available on the unencrypted partition on the drive for BIOS recovery feature.

Rollback BIOS feature

Two versions of the BIOS recovery image are saved on the hard drive:

- Current running BIOS (old)
- To-be-updated BIOS (new)

The old version is already stored on the hard drive. The BIOS adds new version to the hard drive, maintains the old version, and deletes other existing versions. For example, A00 and A02 versions are already on the hard drive, A02 is the running BIOS. The BIOS adds A04, maintains A02, and deletes A00. Having two BIOS version enables the Rollback BIOS feature.

If the recovery file cannot be stored (hard drive is out of space), the BIOS sets a flag to indicate this condition. The flag is reset in the event it later becomes possible to store the recovery file. The BIOS notifies the user during POST and in BIOS Setup, the BIOS recovery is degraded. BIOS recovery through hard drive may not be possible, however BIOS recovery through USB flash drive is still possible.

For USB key: root directory or "\"

BIOS_IMG.rcv: the recovery image stored on the USB key.

BIOS recovery using hard drive

NOTE: Ensure that you have the previous version and the latest version of the BIOS from the Dell support site available to use.

NOTE: Ensure that you have the file type extensions visible in the operating system (OS).

1. Browse to the location of the BIOS update executable (.exe) files.
2. Rename the BIOS executable files to **BIOS_PRE.rcv** for the earlier version of the BIOS and **BIOS_CUR.rcv** for the latest version of the BIOS.
For example, if the latest version's file name is **PowerEdge_T30_1.0.0.exe**, rename it to **BIOS_CUR.rcv** and if the previous version's file name is **PowerEdge_T30_0.0.9.exe**, rename it to **BIOS_PRE.rcv**

NOTE:

- a. If the hard drive is new, there will be no operating system installed.
- b. If the hard drive has been partitioned at the Dell factory, there will be a **Recovery Partition** available.

3. Disconnect the hard drive and install the hard drive into another system that has a full operational operating system.
4. Start up the system and in the Windows operating system environment follow these steps to copy the BIOS recovery file to the **Recovery Partition**.
 - a. Open a Windows Command Prompt window.
 - b. At the prompt, type **diskpart** to start the **Microsoft DiskPart**.
 - c. At the prompt, type **list disk** to list out the available hard drives.
Select the hard drive that was installed in Step 3.
 - d. At the prompt, type **list partition** to view the available partitions on this hard drive.
 - e. Select **Partition 1** which is the **Recovery Partition**. The size of the partition will be 39 MB.
 - f. At the prompt, type **set id=07** to set the partition ID.

NOTE: The partition will be visible to the operating system as **Local Disk (E)** to read and write data.

- g. Create the following folders in **Local Disk (E)**, **E:\EFI\Del\BIOS\Recovery**.
 - h. Copy both the BIOS files **BIOS_CUR.rcv** and **BIOS_PRE.rcv** to the recovery folder on **Local Disk (E)**.
 - i. In the **Command Prompt** window, at the **DISKPART** prompt, type **set id=DE**.
After the executing this command, the partition **Local Disk (E)** will not be accessible by the OS.
5. Shut the system down, remove the hard drive, and install the hard drive into the original system.
 6. Start the system up and boot to System Setup, in the **Maintenance** section ensure that **BIOS Recovery from Hard Drive** is enabled in the **BIOS Recovery** section of the setup.
 7. Press the power button to shut the system down.
 8. Holding the **Ctrl and Esc** keys, press the power button to start the system up. Keep holding the **Ctrl and Esc** keys until the **BIOS Recovery Menu** page is displayed.
Ensure that the **Recover BIOS** radio button is selected and click **Continue** to start the BIOS recovery.

BIOS recovery using USB drive

NOTE: Ensure that you have the file type extensions visible in the operating system.

NOTE: Ensure that you have downloaded the latest BIOS from the Dell support site and save it on your system.

1. Browse to the location of the downloaded BIOS update executable (.exe) file.
2. Rename the file to BIOS_IMG.rcv.
For example, if the file name is PowerEdge_T30_0.0.5.exe, rename it to BIOS_IMG.rcv
3. Copy the BIOS_IMG.rcv file to the root directory of the USB key.
4. If not plugged in, plug in the USB drive, restart the system, press F2 to enter the System Setup, and then press power button to shut down the system.
5. Start the system.
6. While the system is starting up, press the **Ctrl+Esc** keys while holding the power button until the **BIOS Recovery Menu** dialog box is displayed.

7. Click **Continue** to start the BIOS recovery process.

 **NOTE:** Ensure that the **Recovery BIOS** option is selected in the **BIOS Recovery Menu** dialog box.

8. Select the path on the USB drive where BIOS recovery file is stored(root directory or "\\") and follow the on-screen instructions.

Updating the BIOS

Updating the BIOS in Windows

1. Go to www.dell.com/support.

2. Click **Product support**. In the **Search support** box, enter the Service Tag of your computer, and then click **Search**.

 **NOTE:** If you do not have the Service Tag, use the SupportAssist feature to automatically identify your computer. You can also use the product ID or manually browse for your computer model.

3. Click **Drivers & Downloads**. Expand **Find drivers**.
4. Select the operating system installed on your computer.
5. In the **Category** drop-down list, select **BIOS**.
6. Select the latest version of BIOS, and click **Download** to download the BIOS file for your computer.
7. After the download is complete, browse the folder where you saved the BIOS update file.
8. Double-click the BIOS update file icon and follow the on-screen instructions.

For more information, see knowledge base article [000124211](https://www.dell.com/support/000124211) at www.dell.com/support.

Updating the BIOS in Linux and Ubuntu

To update the system BIOS on a computer that is installed with Linux or Ubuntu, see the knowledge base article [000131486](https://www.dell.com/support/000131486) at www.dell.com/support.

Updating the BIOS using the USB drive in Windows

1. Follow the procedure from step 1 to step 6 in [Updating the BIOS in Windows](#) to download the latest BIOS setup program file.
2. Create a bootable USB drive. For more information, see the knowledge base article [000145519](https://www.dell.com/support/000145519) at www.dell.com/support.
3. Copy the BIOS setup program file to the bootable USB drive.
4. Connect the bootable USB drive to the computer that needs the BIOS update.
5. Restart the computer and press **F12**.
6. Select the USB drive from the **One Time Boot Menu**.
7. Type the BIOS setup program filename and press **Enter**.
The **BIOS Update Utility** appears.
8. Follow the on-screen instructions to complete the BIOS update.

Updating the BIOS from the F12 One-Time boot menu

Update your computer BIOS using the BIOS update.exe file that is copied to a FAT32 USB drive and booting from the F12 One-Time boot menu.

BIOS Update

You can run the BIOS update file from Windows using a bootable USB drive or you can also update the BIOS from the F12 One-Time boot menu on the computer.

Most of the Dell computers built after 2012 have this capability, and you can confirm by booting your computer to the F12 One-Time Boot Menu to see if BIOS FLASH UPDATE is listed as a boot option for your computer. If the option is listed, then the BIOS supports this BIOS update option.

 **NOTE:** Only computers with BIOS Flash Update option in the F12 One-Time boot menu can use this function.

Updating from the One-Time boot menu

To update your BIOS from the F12 One-Time boot menu, you need the following:

- USB drive formatted to the FAT32 file system (key does not have to be bootable)
- BIOS executable file that you downloaded from the Dell Support website and copied to the root of the USB drive
- AC power adapter that is connected to the computer
- Functional computer battery to flash the BIOS

Perform the following steps to perform the BIOS update flash process from the F12 menu:

 **CAUTION:** Do not turn off the computer during the BIOS update process. The computer may not boot if you turn off your computer.

1. From a turn off state, insert the USB drive where you copied the flash into a USB port of the computer.
2. Turn on the computer and press F12 to access the One-Time Boot Menu, select BIOS Update using the mouse or arrow keys then press Enter.
The flash BIOS menu is displayed.
3. Click **Flash from file**.
4. Select external USB device.
5. Select the file and double-click the flash target file, and then click **Submit**.
6. Click **Update BIOS**. The computer restarts to flash the BIOS.
7. The computer will restart after the BIOS update is completed.

Self-Heal

Course Introduction

Self-Heal is an option that helps recover a Dell Latitude system from a No Post, No Power, No Video situation.

Self-Heal Instruction

1. Remove the primary battery and the AC adapter.
2. Disconnect the CMOS battery.
3. Release the flea power. Press and hold the power button down for 10 seconds or leave the system idle for 45 seconds.
4. Make sure the CMOS and primary battery are not plugged into the system.
5. Plug in the AC adapter. The system will auto power-on when the AC adapter inserted.
6. The system will start with a blank screen for a while and will shut down automatically. Watch for the LED lights (power, Wi-Fi, and HDD). It will turn on.
7. The system will try to restart twice and will boot on the third attempt.
8. Place the CMOS battery and the AC adapter back in the system.
9. If self-heal recovers the failure, update the system with the latest BIOS, and perform ePSA to ensure proper functionality of the system.

 **NOTE:**

- During installation or removal of any hardware, always ensure all data is backed up properly.
- For instructions on how to remove or replace parts, visit the [Assembly Disassembly](#).
- Before beginning to work on the computer, follow the [Safety Instructions](#).

Supported Latitude Models

 **NOTE:**

- Before replacing the system board, perform self-heal as a mandatory step.

- Latitude Self-Heal can be avoided when complete system tear-down is required to access the coin-cell battery.
- For the Latitude E7 Series (XX70), BIOS Recovery 2.0 should be performed as the primary step.
- In order to reduce troubleshooting time associated with Self-Heal, there is no mandatory requirement to reassemble the system. Technicians can initiate Self-Heal even with the system board exposed.
- **Do not touch** any of the exposed components or the system board to avoid shorting and static.
- If Self-Heal is unable to recover the failure, proceed with replacing the system board.

 **NOTE:**

Front-line Agent Action: Front-line agents must encourage the customer to perform this step before isolating the issue as a motherboard failure. If the customer is not comfortable performing the Self-Heal procedure, then please document the dispatch being created in 5GL. Advise the onsite engineers to perform the Self-Heal procedure as one of the mandatory initial steps. Advise them that if the Self-Heal procedure is unsuccessful, to continue with the regular troubleshooting before part replacement.

Onsite Engineer Action: The Latitude Self-Heal procedure has to be a mandatory initial step. If the Self-Heal procedure is unsuccessful, continue with the regular troubleshooting before part replacement. Document Self-Heal results in the call closure log (Self-Heal Pass or Fail).

Getting help

Topics:

- [Contacting Dell](#)

Contacting Dell

 **NOTE:** If you do not have an active Internet connection, you can find contact information on your purchase invoice, packing slip, bill, or Dell product catalog.

Dell provides several online and telephone-based support and service options. Availability varies by country and product, and some services may not be available in your area. To contact Dell for sales, technical support, or customer service issues:

1. Go to **Dell.com/support**.
2. Select your support category.
3. Verify your country or region in the **Choose a Country/Region** drop-down list at the bottom of the page.
4. Select the appropriate service or support link based on your need.