



System76

Serval WS (serw11)

Service Manual

Revision history

Author	Date	Version	Remarks
Aaron H / Nathaniel W	2019-11-15	Initial	

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Hardware overview

External overview

Ports overview

The Serval WS provides multiple connectivity options.

15"

Left side overview



Right side overview



Front side overview

Back side overview



17"

Left side overview



Right side overview



Front side overview

Back side overview



Bottom case screw sizes

The Serval WS has uniform size screws for securing the bottom case, battery and keyboard. M.2 drives and the GPU/Heat Sink fastenings have specialized screws.



Front LED overview



Icon	Color	Description
	Orange	DC power plugged in
	Green	Computer is on
	Blinking green	Computer is sleeping
	Orange	Battery charging
	Green	Battery fully charged
	Blinking orange	Battery critically low
	Green	Airplane mode is ON (WiFi/Bluetooth disabled)
	Green	Hard disk activity
	Green	The light will be on when Num Lock is enabled.
	Green	The light will be on when Caps Lock is enabled.
	Green	The light will be on when Scroll Lock enabled.
	Off	MSHYBRD Mode for GPU
	Green	Discrete Mode for GPU

Hardware keyboard shortcuts

Your Serval WS has several actions available using the Fn and numbered Function keys.

Key	Shortcut	Action
	Fn+F1	Toggle trackpad
	Fn+F2	Toggle built-in LCD
	Fn+F3	Mute
	Fn+*	Toggle keyboard backlight
	Fn+F5	Volume down
	Fn+F6	Volume up
	Fn+F7	Toggle displays
	Fn+F8	Brightness down
	Fn+F9	Brightness up
	Fn+F10	Toggle webcam
	Fn+F11	Toggle airplane mode
	Fn+F12	Suspend
	Fn+`	Play/Pause
	Fn+1	Toggle fan between max/automatic
	Fn+/-	Cycle Keyboard Color
	Fn+-	Decrease Keyboard Brightness
	Fn++	Increase Keyboard Brightness

External displays

The Serval WS has two standard Mini DisplayPorts (MiniDP) and one HDMI 1.4b.

Internal component overview

Below is a color-coded diagram of the Serval WS's internal components.

CPU fan is highlighted in **cyan**

GPU fan is highlighted in **light orange**

CMOS battery is highlighted in **red**

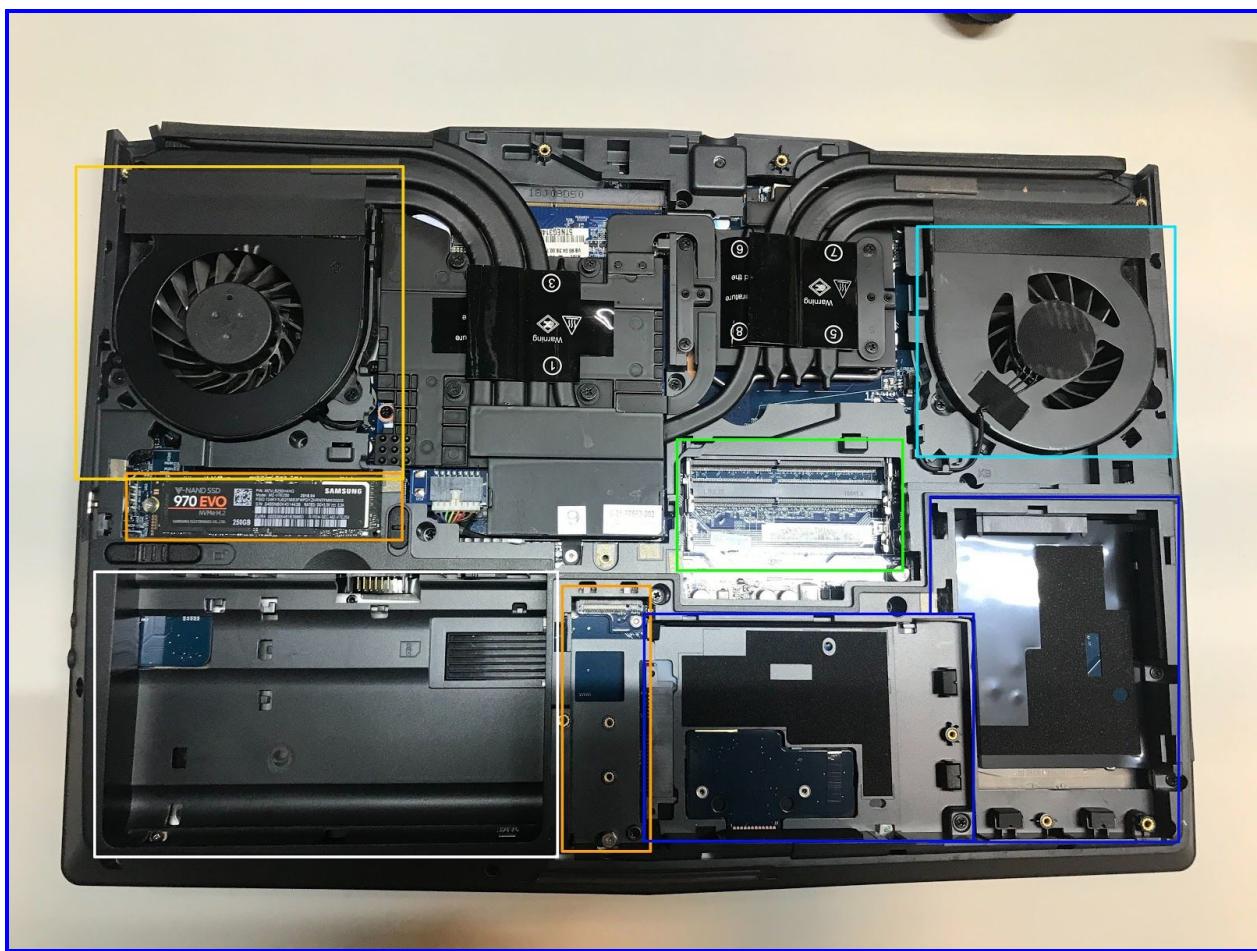
RAM is highlighted in **green**

M.2 SSD is highlighted in **orange**

Wireless/Bluetooth module is highlighted in **purple**

Battery is highlighted in **white**

2.5" Drive bay is highlighted in **blue**



User-serviceable parts and repairs

Many components on your Serval WS can be upgraded or replaced as necessary. Follow these step-by-step guides for instructions.

Removing the bottom cover

Removing the cover is required to access the internal components. There are two panels on the back of the Serval. The top-panel which covers most of the internal components. The bottom panel covers the additional drive bays. Unless otherwise noted these instructions refer to the top-panel.

Prior to removing the cover, ensure the AC power is unplugged, and all peripherals (including SD cards and USB drives) are unplugged or removed from the system.

Tools required: Cross-head (Phillips) screwdriver

Time estimate: 10 minutes

Difficulty: Low

Screws: 5 total:

- 5 small M2 perimeter, black

Steps to remove the cover

Photos are provided in order below these steps.

1. Find a surface suitable for work. A desk or table works well.
2. Place something soft on the table, like a towel or anti-static mat.
3. Place the Serval WS lid-side-down.
4. Remove the external battery.
5. Remove the 5 perimeter screws.
6. Slide the cover away (toward the exhaust vents) and then lift up and away.

Steps to replace the cover

1. Align the bottom cover over the case towards the back and hinges.
2. Set the bottom cover along the edges and confirm the bottom cover is seated.
3. Replace the 2 keyboard screws.
4. Place the bottom cover back on.
5. Replace the 5 perimeter screws.

Photo guide for bottom cover removal/replacement

1. Serval WS lid-side-down.



2. Slide the top bottom cover.



Replacing the keyboard

Keyboard replacement is simple and requires a cross-head (Phillips) screwdriver.

Tools required: Cross-head (Phillips) screwdriver

Time estimate: 10 minutes

Difficulty: Medium

Screws: 2 total

- 2 large M2, black (Keyboard M2)

Steps to replace the keyboard

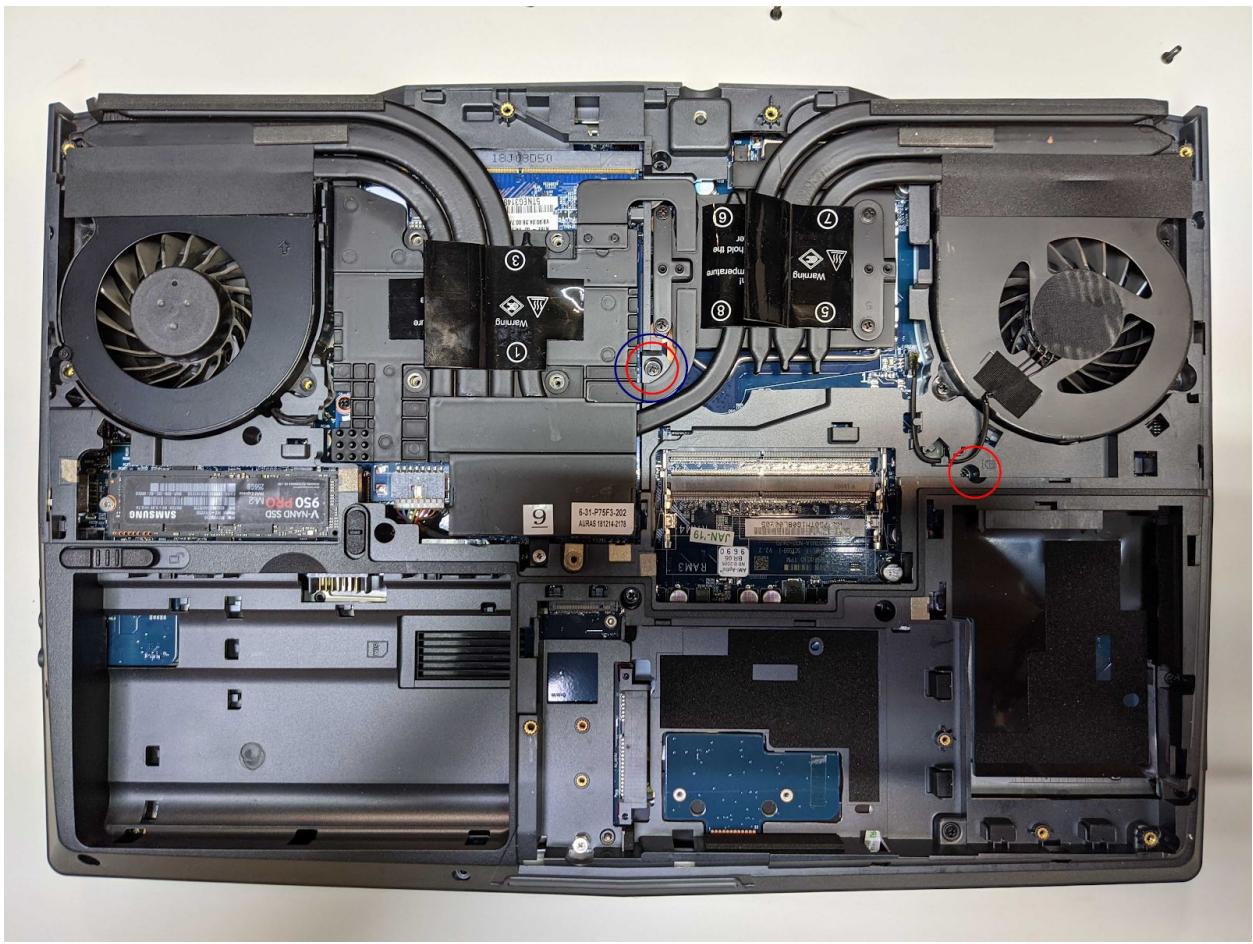
Photos are provided in order below these steps.

1. Find a surface suitable for work. A desk or table works well.
2. Place something soft on the table, like a towel or anti-static mat.

3. Place the Serval WS lid-side-down.
4. Remove the 5 screws from the upper back-panel.
5. Remove the 2 keyboard screws.
6. Using a long screwdriver (or similar tool) gently but firmly push through one of the keyboard screw holes to lift the keyboard out of its tray. Once it is loosened it is easy to pull out by hand.
7. Flip the keyboard over onto the trackpad.
8. Pull the large ribbon cable out of the connector.
9. The small ribbon cables have latches. Gently pull the latches from both sides and remove the ribbon cables.
10. Remove the keyboard and replace it with the new one.
11. Insert the large ribbon cable into the connector.
12. Seat the small ribbon cables, then apply pressure equally to both sides of the connector to secure.
13. Flip the keyboard over and press the bottom tabs of the keyboard into the case.
14. Secure the keyboard by pressing down on the edges of the keyboard.
15. Flip the Serval WS over.
16. Replace the 2 screws holding the keyboard in place.
17. Replace the 5 top-panel screws.
18. Boot your Serval WS and confirm the keyboard is operational.

Photo guide for keyboard replacement

1. Serval WS lid-side-down. There are two keyboard screws and one has a red circle while the other one has a red and blue circle indicating the keyboard push point.



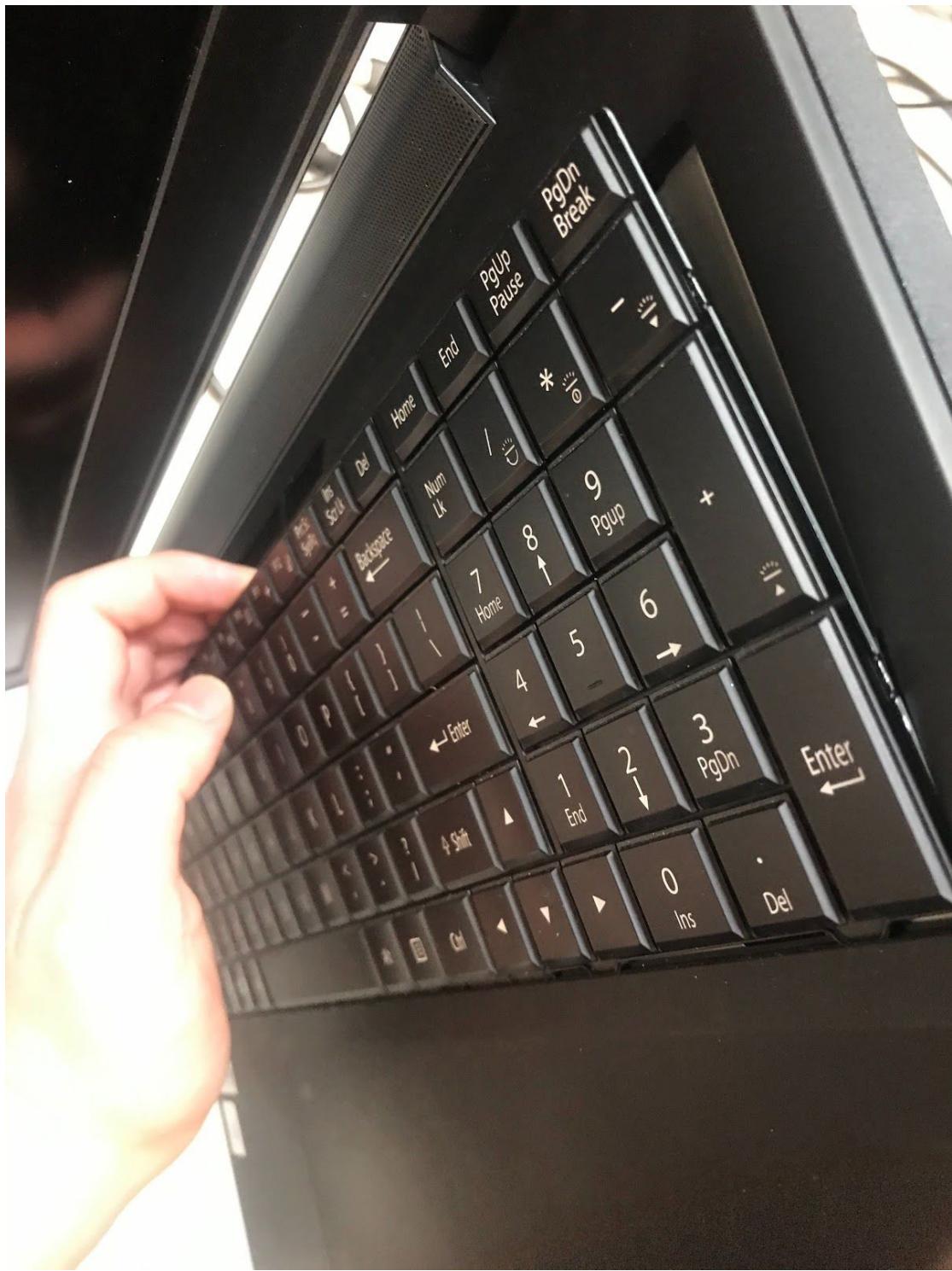
2. Serval WS on its side.



3. Screwdriver in keyboard push point.



4. Gently lift the keyboard away from its slot, then slide the keyboard free of its grooves.



4. Flip the keyboard over and rest it on the trackpad. Pull the large ribbon cable out of the connector. The smaller ribbon cables have latches. Gently pull it forward to release the connector, then remove the ribbon cables.



Replacing the RAM

RAM acts as temporary storage for your computer. More RAM generally provides better performance. If you've purchased new RAM, need to replace your RAM, or are reseating your RAM, follow these steps.

Tools required: Cross-head (Phillips) screwdriver

Time estimate: 15 minutes

Difficulty: Medium

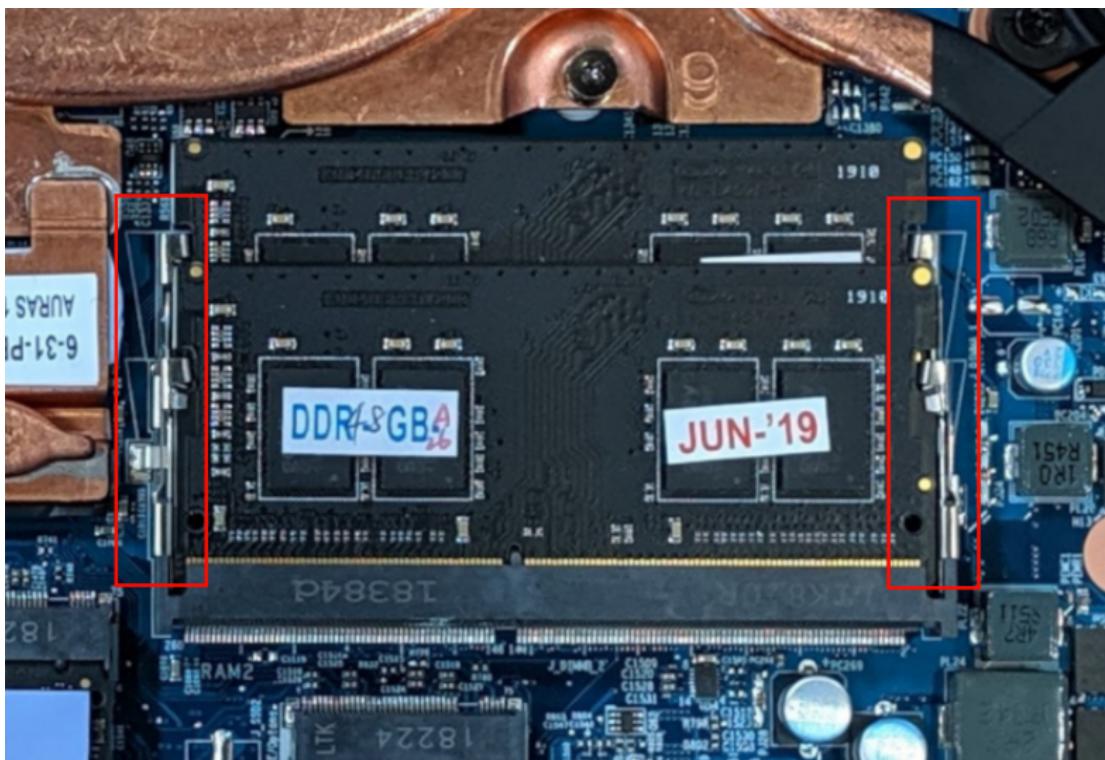
Steps to replace the RAM

1. Follow the steps above to remove the cover.
2. Press the small tabs on both sides of the RAM simultaneously.
3. Remove the RAM from the slot.

4. Insert the new RAM (or reseat the existing RAM) by placing it in the keyed slot and pressing down on the RAM until it clicks into place.

Photo guide for replacing the RAM

1. Press the tabs, indicated in red, outward to release the RAM from the slot.



Replacing an M.2/NVMe SSD

M.2 SSDs offer, at minimum, SATA3 speeds and performance in a package about the size of a stick of gum. NVMe M.2 SSDs offer even higher performance. The Serval WS supports two M.2 SSDs, size 2280, either M.2 SATA or NVMe M.2 PCIe Generation 4.

Tools required: Cross-head (Phillips) screwdriver

Time estimate: 5 minutes

Difficulty: Medium

Steps to replace the M.2 drive

1. Follow the steps above to remove the cover.
2. Locate the M.2 drive (or drive slot).
3. Unscrew the retainer screw opposite the M.2 slot.
4. Remove the existing M.2 drive by sliding it sideways off the contact pins and then lifting it out of the slot.
5. Insert the new M.2 drive into the slot, connect the contact pins, and hold it in place.
6. Replace the retainer screw.

Replacing the CPU fan/heatsink/thermal paste

If the CPU fan becomes noisy and cleaning it out doesn't fix the issue, you may need a new CPU fan. Contact Support to start a warranty claim or parts purchase.

In rare cases, or after several years, it may be necessary to apply new thermal paste between the CPU and the heatsink. Thermal paste helps facilitate effective heat transfer between the CPU and the cooling equipment. These instructions can also be used in the unlikely event your heatsink needs replacing.

Tools required: Cross-head (Phillips) screwdriver

Time estimate: 15-20 minutes

Difficulty: High

Steps to replace the CPU/GPU heatsink/thermal paste

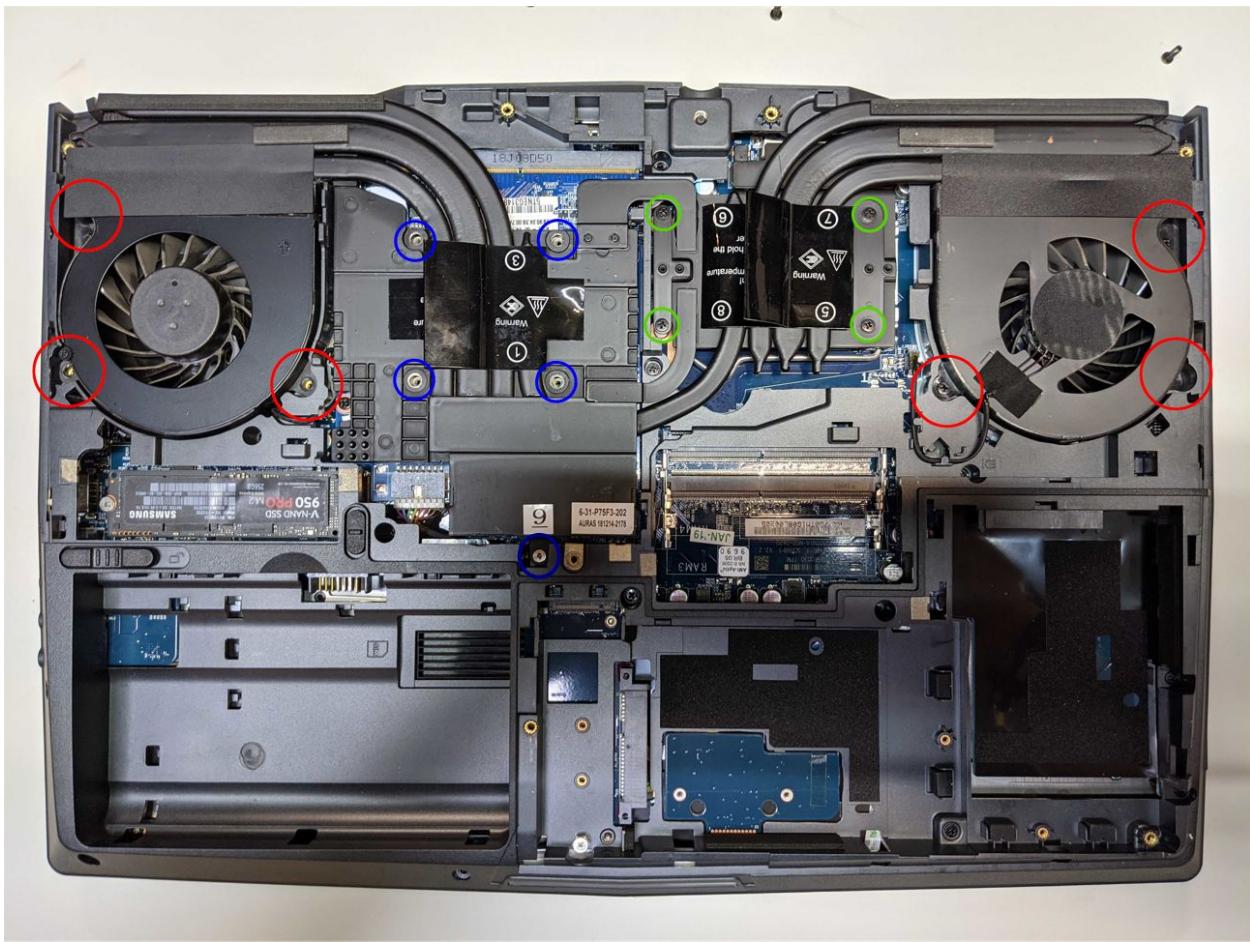
1. Remove the bottom cover using the steps under 'Removing the bottom cover'.
2. Unscrew the heat sink. There are 8 screws that hold the heat sink down on top of the CPU and GPU (they are numbered), and one additional, smaller screw to align the heat sink in the chassis.

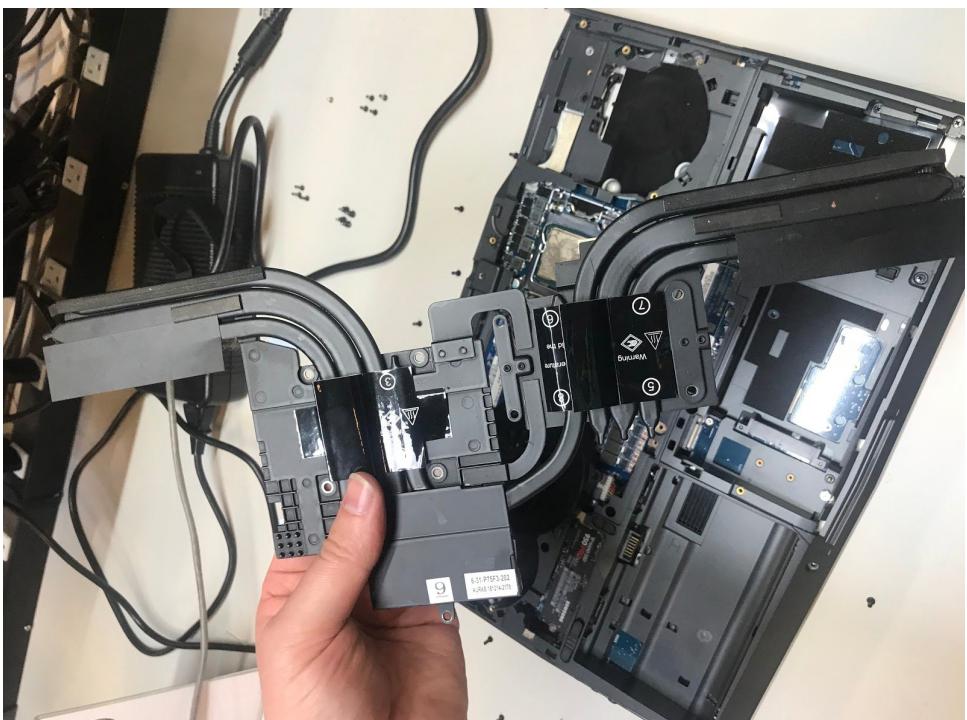
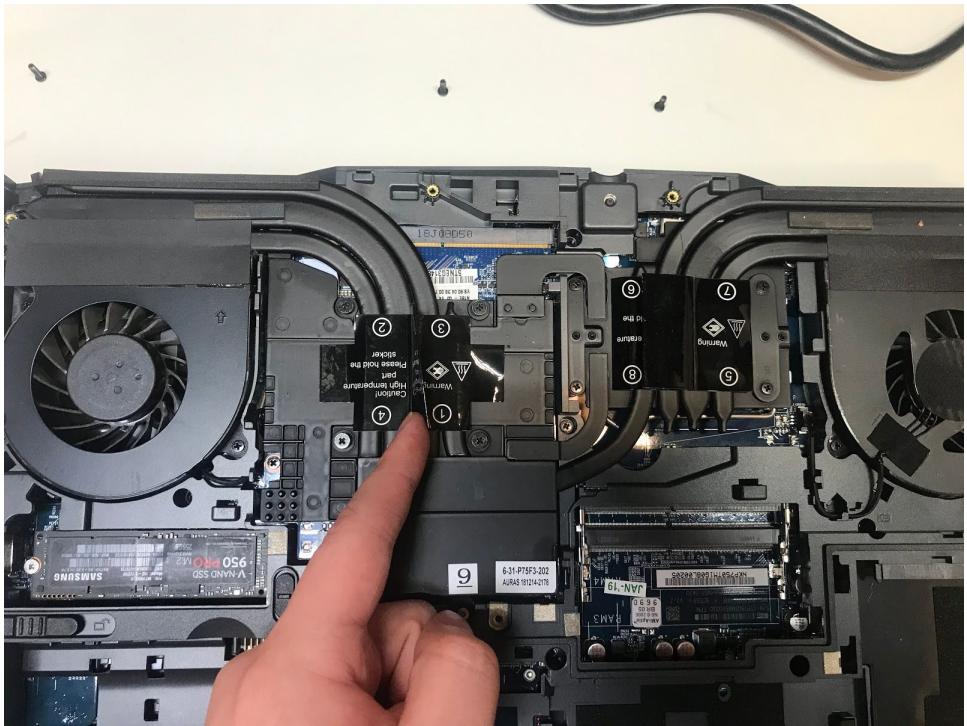
Removing the fans for the CPU and GPU make the removal of the heat sink easier but it is not strictly required.

Each fan is secured with 3 screws, the same size as the laptop-case screws, and is connected to power on the board with a small cable. Remove the screws and unplug the fans to lift them clear of the case.

3. Remove the screws, starting with #9, then #8, and continue until you have removed #1.
4. Carefully remove the heatsink/fans from the case.
5. Using a paper towel, remove the existing thermal paste. You may also use a small amount of rubbing alcohol to remove excess or difficult-to-remove paste.
6. After cleaning the CPU, GPU and heatsink, apply a small line of thermal paste directly onto the CPU and GPU core.
7. Carefully replace the heatsink.
8. Replace the screws, starting with #1, then #2, and lastly #9. Do not fully tighten sets #1-#4 and #5-#8 until all are in place, then fully tighten all screws for each set (#1-#4 and #5-#8)

There are 15 Screws in total securing the fans and heat sink.





Replacing the GPU

The GPU in the Serval is replaceable and the below steps (and photos) can be used to replace this component.

Tools required: Cross-head (Phillips) screwdriver

Time estimate: 20 minutes

Difficulty: High

1. Remove the bottom cover using the steps under 'Removing the bottom cover'.
2. Follow the steps above for Steps to replace the CPU/GPU heatsink/thermal paste.
3. Remove the GPU card. Once the fans and heat sink are removed the GPU can be pulled out similar to removing RAM (without the clips) and then the power and data cable can be disconnected from the GPU.



Replacing the CMOS battery

The CMOS battery supplies power to the Serval WS's CMOS chip. Changes you make to the BIOS and the computer's hardware clock are stored on the CMOS. If your Serval WS doesn't boot, you can reset the CMOS to force a low-level hardware reset. If your clock is constantly resetting, it's likely your CMOS battery needs replacing.

Tools required: Cross-head (Phillips) screwdriver

Time estimate: 5 minutes

Difficulty: Medium

Steps to replace the CMOS battery

1. Follow the steps above to remove the keyboard.
2. Locate the CMOS battery. Disconnect the battery from the motherboard and then reconnect it after 30 seconds.
3. Power up the Serval WS. The system may power itself off and on after initial boot, this is normal.
4. Press F2 to enter the BIOS
5. Choose the "Setup Utility"
6. Press F9 to load Setup Defaults
7. Click on Advanced on the left
8. Choose Advanced Chipset Control
9. Choose ME State and set to Disabled
10. Press F10 to save and resume normal boot.

Replacing the external battery

The battery provides primary power whenever the system is unplugged.

Tools required:

Time estimate: 1 minute

Difficulty: Easy

Steps to replace the external battery

1. Move the locks that hold the battery and then remove the battery.
2. Place the new battery in and then place the locks in the locked position.

Replacing the WiFi/Bluetooth module

Your Serval WS's WiFi and Bluetooth are both handled with the same module. It is a standard M.2 2230 slot with PCIe & USB Interfaces (A Key).

Tools required: Cross-head (Phillips) screwdriver

Time estimate: 5 minutes

Difficulty: Medium

Steps to replace the WiFi/Bluetooth module

1. Follow the steps above to remove the cover.
2. Locate the wireless module.
3. Gently remove the two antennas by pulling them up and away from the wireless module.
4. Remove the retaining screw opposite the M.2 slot.
5. Remove the existing M.2 chip by sliding it sideways off the contact pins and then lifting it out of the slot.
6. Insert the new wireless module.
7. Replace the retaining screw.
8. Attach the two antennas by aligning the circular fitting and pressing onto the wireless card. The connector will snap into place. **Use caution when attaching the connectors, the pins can bend, break, or snap.**

BIOS utilities

When starting your Serval WS, it takes a few seconds to conduct a quick check of the components. As it proceeds, it will notify you if anything is wrong. Any issues that prevent the system from booting will be displayed and you will be prompted to enter the Setup. If no problems are detected, your Serval WS will load GRUB for Ubuntu or Systemd-boot for Pop!_OS.

For Setup/BIOS, hold F2 while booting.

For boot options, hold F7 while booting and choose your preferred boot device.

Updating the BIOS

BIOS updates and instructions are sent out as needed. System76 will notify you if a BIOS update is available for your Serval WS.

BIOS overview

The Setup/BIOS utility allows you to make low-level changes to your Serval WS. It's not recommended to make changes unless the settings are provided by Support, or if you understand what you're changing.

Setup Utility

Option	Description
SATA Port #	Pressing Enter opens the sub-menu to show the configuration of a SATA device on the SATA ports.
OffBoard SATA/NVMe Controller Configuration	Pressing Enter opens the sub-menu to show the configuration of any devices on the offboard SATA/NVMe controller, if installed.
System Date/Time	Set the system date/time using the hardware clock.
System/Extended Memory	Information on the amount of RAM installed.
ME FW/ MB Series/ BIOS Version/ KB/EC Firmware Rev.	Information on the BIOS version(s) and network adapter address.

System Memory/ Extended Memory/ MB Series/ BIOS Version/ KBC/EC/ MAC Address	
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Advanced

Option	Description
Advanced Chipset Control	Options for FlexiCharger, GPU Performance Scaling, Intel Speed Shift Technology, VT-d, UEFI OS Fast Boot, Software Guard Extensions (SGX), ME State, HeadPhone PC Beep Sound Support
> FlexiCharger	<p>The sub-menu here allows you to enable/disable the FlexiCharger. The FlexiCharger can be set to automatically start charging your battery when the battery reaches a certain capacity level (e.g. you could start the battery charge level at 40%).</p> <p>You can then set the level to stop charging (e.g. 100%), but the stop charge level must be higher than the start charge level. Use of FlexiCharger for extended periods of time will decrease the battery reading accuracy.</p>
> GPU Performance Scaling	Nvidia GPU Performance Scaling Support. Disabling may cause issues with booting.
> Intel Speed Shift Technology	Enabling will expose the CPPCv2 interface to allow for hardware controlled P-states (power states)
> VT-d	Enable/disable Intel Virtualization Technology for Directed I/O. Extends Intel Virtualization Technology (VT) by providing hardware assets for virtual hypervisors.
UEFI OS Fast Boot	When enabled the system firmware does not initialize the keyboard or check for firmware menu key
> Software Guard Extensions (SGX)	Enable or disable Intel SGX (Software Guard Extensions.)
ME State	Intel Management Engine. Recommended to Disable.

> Headphone PC Beep Sound Support	If disabled there will be no alarm beep sound in boot time though headphones.
Thunderbolt™ Configuration	[what goes here?]
> Discrete Thunderbolt™ Support	Enable or disable Thunderbolt™ Support
> Security Level	Security level selection
OverClocking Performance Menu	Memory
> Memory	Select the DIMM timing profile. Use XMP1 profile with 3000MHz memory
SATA Mode	The SATA (Serial ATA) controller is designed to operate in AHCI (Advanced Host Controller Interface) mode only.
Power on boot beep	Enable/disable a beep as the computer starts up.
Battery low alarm beep	Enable/disable a beep when the battery is critically low.

Security

Option	Description
Set Supervisor Password	Sets a password for the Setup Utility. This does not affect access to the computer or installed OS only the BIOS.
TPM Configuration	Trusted Computing Settings
> Security Device Support	Enable or Disable BIOS support for TPM 2.0 security device.

Administer Secure Boot

Option	Description
Secure Boot	Enables support for Secure Boot. This is not recommended or required for Ubuntu/Pop!_OS.

Boot

Option	Description
EFI	EFI Boot Order Settings
> EFI	Enable or disable drives/network boot options.
> Network Stack	Enable or disable support for Intel PXE network boot.
>> Ipv4 PXE Support	Allow PXE booting using IPv4.
>> Ipv6 PXE Support	Allow PXE booting using IPv6.

Boot Manager

Option	Description
Boot Option Priorities	Determine the boot order for system devices. Boot option #1 will be tried first. It's recommended to set your boot drive as the 1st option and use the F7 key when temporarily booting from an external device or PXE booting

Specifications

Component	Specification
Processors	Intel® Core™ i5-9600K (4.6GHz) 3.7 up to 4.6GHz - 9 MB Cache - 6 Cores - 12 Threads Intel® Core™ i7-9700K (4.9GHz) 3.6 up to 4.9GHz - 12 MB Cache – 8 Cores – 16 Threads Intel® Core™ i9-9900K (5GHz) 3.6 up to 5GHz - 16 MB Cache – 8 Cores – 16 Threads
Display	15.6" or 17.3" FHD (1920x1080) 144Hz refresh rate Matte Finish 17.3" 4K QFHD (3840x2160) Matte Finish
Memory	Dual Channel DDR4 Four 260 Pin SO-DIMM Sockets Supporting DDR4 2400 MHz Memory (With support up to 3000 MHz) Modules (real operational frequency depends on the FSB of the processor)

	Memory Expandable up to 64GB Compatible with 8GB/16GB Modules
Graphics	NVIDIA GeForce RTX 2060 NVIDIA GeForce RTX 2070 NVIDIA GeForce RTX 2080
Storage	Two M.2 SSD 2280, SATA/PCIe Gen3 x4 Interface Two 2.5" 7mm SATA Drive (up to 12TB total)
Audio	High Definition audio interface S/PDIF Digital output Built-in Array Microphone Built-in two Speakers SoundBlasterX® Pro-Gaming 360°

Component	Specification
Touchpad & Keyboard	ClickPad with Multi-Gesture and Scrolling Functionality A4 Size Isolated Keyboard Multi-Color Backlit Chicklet US QWERTY Keyboard
Webcam	1080p HD Video Camera Module with USB interface
Interfaces	1 HDMI output Port (with HDCP) 2 Mini DisplayPort 1.3 1 USB 3.1 Gen 2 / Thunderbolt™ 3 Port (Type-C) 3 USB 3.0 Ports (Type A, 1 x powered USB port, AC/DC) 1 2-in-1 Audio Jack (Headphone / S/PDIF Optical output) 1 Microphone Jack 1 RJ-45 LAN (10/100/1000Mbps)
Card reader	Embedded Multi-In-1 Card Reader - MMC/ RS MMC - SD/ Mini SD / SDHC/ SDXC up to UHS-II
M.2 Slots	Three M.2 Card Slots: Slot 1 for M.2 2230 WLAN Combo Module with PCIe & USB Interfaces (A Key) Slot 2 for SSD M.2 2280 Card with SATA/PCIe Gen3 x4 Interface (M Key) Slot 3 for SSD M.2 2280 Card with SATA/PCIe Gen3 x4 Interface (M Key)

Network	Built-In 10/100/1000Mb Base-TX Ethernet LAN Intel® Dual Band Wireless-AC 9260 (2*2 802.11 a/c) WLAN + Bluetooth M.2 2230 Combo Module (867Mbps)
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Component	Specification
Power and battery	Full Range AC/DC Adapter AC input 100 - 240V, 50 - 60Hz, DC Output 19.5V, 16.9A (330Watts) Removable 8 cell Smart Lithium Ion Battery Pack 82WH
Security	Security (Kensington® Type) Lock Slot Disabled ME BIOS Password Trusted Platform Module 2.0 (disabled by default)
Operating System	Ubuntu/Pop!_OS
Indicators	LED Indicators - Power/Suspend, Battery, HDD, Airplane Mode, Camera
Environmental	Temperature Operating: 5°C - 35°C Non-operating: -20°C - 60°C Relative humidity Operating: 20% - 80% Non-operating: 10% - 90%
Dimensions & Weight	Height x Width x Depth 15.6" : 15.2" x 10.32" x 1.5" (286.1 x 262.1 x 38.1mm) 15.6" : 7.5 lbs. (3.40 kg.) 17.3" : 16.46" x 11.63" x 1.61" (418.1 x 295.4 x 40.9mm) 17.3" : 8.6 lbs. (3.9 kg.) base weight, varies with configuration.