

HTC VIVE Ultimate Tracker Developer Guidelines Ver. 3.0

Version Control

Version Number	Date	Notes
1.0	2023.10.26	Initial public version for VIVE Ultimate Tracker
2.0	2024.12.04	Updated the Interface and Radio Frequency sections
3.0	2025.01.22	Updated the section order; updated the Architecture, Mounting, Components, and Software sections; added the Unity Integration section

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Introduction

This document describes the implementation guidelines for developers (VR accessory makers and content developers). It contains information on how to use the HTC VIVE Ultimate Tracker to enable position tracking and data transmission.

A VIVE Ultimate Tracker that is correctly attached to an accessory can simulate VIVE controller button interactions through pogo pins or send specific data through USB-C. Developers can then pair the VIVE Ultimate Tracker with a VIVE Wireless Dongle to transfer the accessory and tracking data to a PC or head-mounted display (HMD).

Architecture

Below are two conceptual architecture diagrams showing the configurations developers can apply to transmit data using the VIVE Ultimate Tracker.

Scenario 1: Pogo pin connection with accessory, wireless transmission to PC/HMD

Attach the VIVE Ultimate Tracker to the accessory and use pogo pins to trigger button events that are wirelessly transmitted to the VIVE Wireless Dongle connected to either a PC or an HMD.

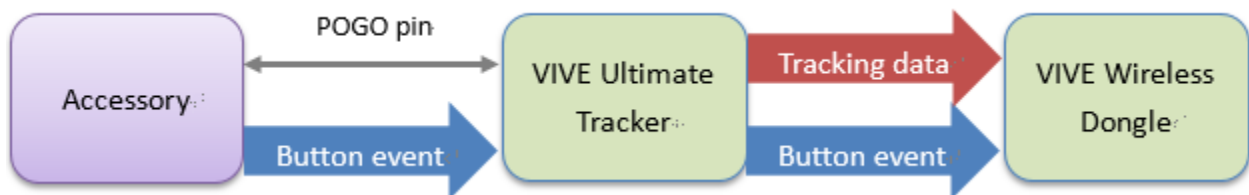


Fig. 1: Wirelessly transmit pogo pin interaction data to the VIVE Wireless Dongle connected to a PC or HMD

Scenario 2: USB-C connection with accessory, wireless transmission to PC/HMD

Attach the VIVE Ultimate Tracker to the accessory and directly transfer data through USB-C. This data is then wirelessly transmitted to the VIVE Wireless Dongle connected to either a PC or an HMD.



Fig. 2: Wirelessly transmit raw data via USB-C to the VIVE Wireless Dongle connected to a PC or HMD

Hardware requirements

This section describes the hardware requirements for accessories used with the VIVE Ultimate Tracker to ensure accurate position tracking and input of specific data for the VIVE VR system.

Interface

The VIVE Ultimate Tracker has a pogo pin pad and USB-C port that can be used to supply power to the device. Take note of the specifications below to ensure adequate power supply and prevent overloading or overcharging.

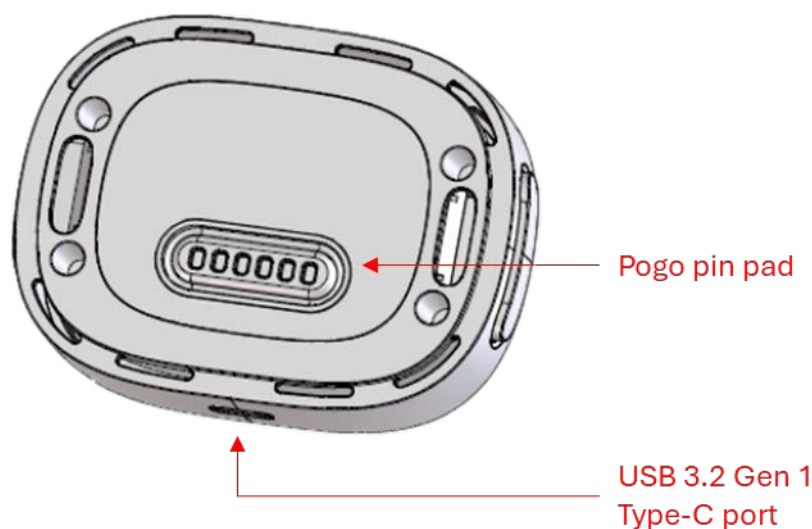


Fig. 3: Location of the pogo pin pad and USB-C port

GPIO Pin Absolute Maximum Rating

Symbol	Parameter	Min.	Max.	Unit
V_i	Input voltage	-0.3	4	V
V_{ESD}	Electrostatic discharge voltage, human-body model	--	4000	V

GPIO Pin Electrical Characteristics (Supply voltage $V_{DD} = 3.3\text{ V}$)

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
V_{OH}	High-level output voltage	$I_{OH} = -4\text{ mA}$	$V_{DD} - 0.9$	2.8	V_{DD}	V
		$I_{OH} = -16\text{ mA}$	$V_{DD} - 1.4$	2.3	V_{DD}	V
V_{OL}	Low-level output voltage	$I_{OH} = -4\text{ mA}$	--	0.2	0.4	V
		$I_{OH} = -16\text{ mA}$	--	0.7	0.9	V
V_{IH}	High-level input voltage	--	$V_{DD} * 0.7$	--	$V_{DD} + 0.3$	V
V_{IL}	Low-level input voltage	--	--	--	0.7	V
I_{OH}	High-level output current	--	--	--	-16	mA
I_{OL}	Low-level output current	--	--	--	16	mA
I_{IH}	High-level input current	--	-1	--	1	μA
I_{IL}	Low-level input current	--	-1	--	1	μA

Power

USB-C and Pogo Pin Indication

USB-C connector	Voltage requirement	Max. charging current	Charging time
AC	QC 3.0	1800 mA	$\approx 1.8\text{ hrs}$
PC	5 V $\pm 5\%$	500 mA	$\approx 8\text{ hrs}$
Pogo pin 3	Voltage requirement	Max. charging current	Charging time
PC	5 V $\pm 5\%$	500 mA	$\approx 8\text{ hrs}$

Note:

AC: D+ short to D-

PC: D+/D- communication

Radio frequency (RF)

To maintain a stable wireless connection between the VIVE Ultimate Tracker and the VIVE Wireless Dongle, you need to make sure that its wireless performance does not fall below 3 dB after attaching the tracker to an accessory.

As metal may interfere with the tracker's radio frequency, you must ensure that only nonmetallic parts of the accessory are within a 30 mm radius of the antenna feed point. This area is represented as a red sphere in the illustration below.

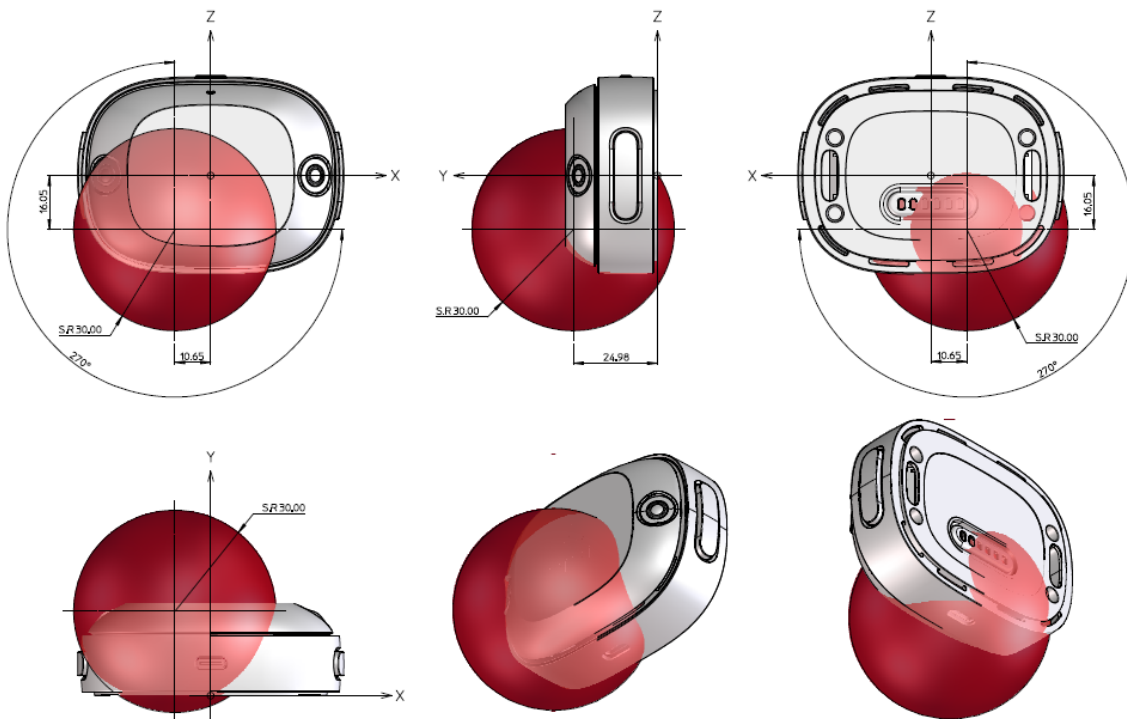


Fig. 4: Keep metallic objects away from the red area

Except for essential parts, such as the 1/4" screw that attaches to the tracker base and the pogo pins that interact with the pogo pin pad, any other metal components of the accessory must be outside of the 30 mm radius to prevent wireless transmission issues. For details, see [Components](#).

Optics

The horizontal and vertical fields of view (FOV) of the VIVE Ultimate Tracker are about 230 and 120 degrees, respectively. Avoid having any part of the accessory fall within the FOV as it will block the tracker's cameras. Maintaining a clear FOV improves tracking performance.

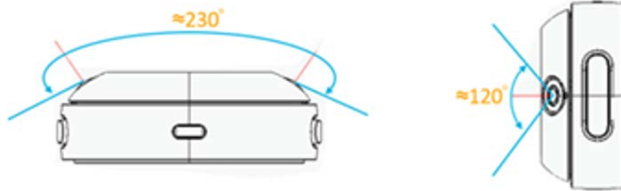


Fig. 5: VIVE Ultimate Tracker horizontal and vertical fields of view (FOV)

Below, you can see how the tracker placement can affect the FOV. In the left image, the tracker is placed near the middle of the barrel so the front end of the gun accessory blocks part of the vertical FOV. In the right image, the tracker is positioned at the end of the accessory, near the muzzle, giving the tracker an unobstructed FOV.



Fig. 6: Left: Camera field of view is partially blocked by the accessory. Right: Camera field of view is unobstructed.

Mounting

The following are notes and guidelines to consider when mounting the VIVE Ultimate Tracker to your accessory:

Mounting design

- The mounting design of the VIVE Ultimate Tracker follows ISO 1222:2010 tripod connection standards which means you can mount it on any standard tripod.
- Screws and bolts that are longer than this ISO standard may not be fully screwed in when attached to the tracker base.

Accessory guidelines

- The accessory should not block the cameras of the VIVE Ultimate Tracker to prevent affecting the tracking performance. For details, see [Optics](#).
- We strongly recommend that accessories use non-reflective material for their outer skin to prevent reflection interference with the tracking sensors, especially if the accessory needs to be placed close to the tracking sensors' FOV. For details, see [Optics](#).
- If the surface of the accessory is smooth, sturdy, and flat, then we recommend using strong adhesive tape (ex. 3M VHB) to attach the tracker base.
- If the surface of the accessory is rough, soft, and uneven, then we recommend using a strap to securely fasten the tracker base.

User comfort and safety

- Users should be able to easily attach and detach the VIVE Ultimate Tracker using two hands, with one hand holding the tracker, and the other holding the accessory.
- Users should not be at risk of physical harm while attaching or detaching the VIVE Ultimate Tracker.
- Users should be comfortable while attaching and detaching the VIVE Ultimate Tracker.

Mounting on a quick release plate

The VIVE Ultimate Tracker can be mounted on a quick release plate, which attaches to the main body of your accessory.

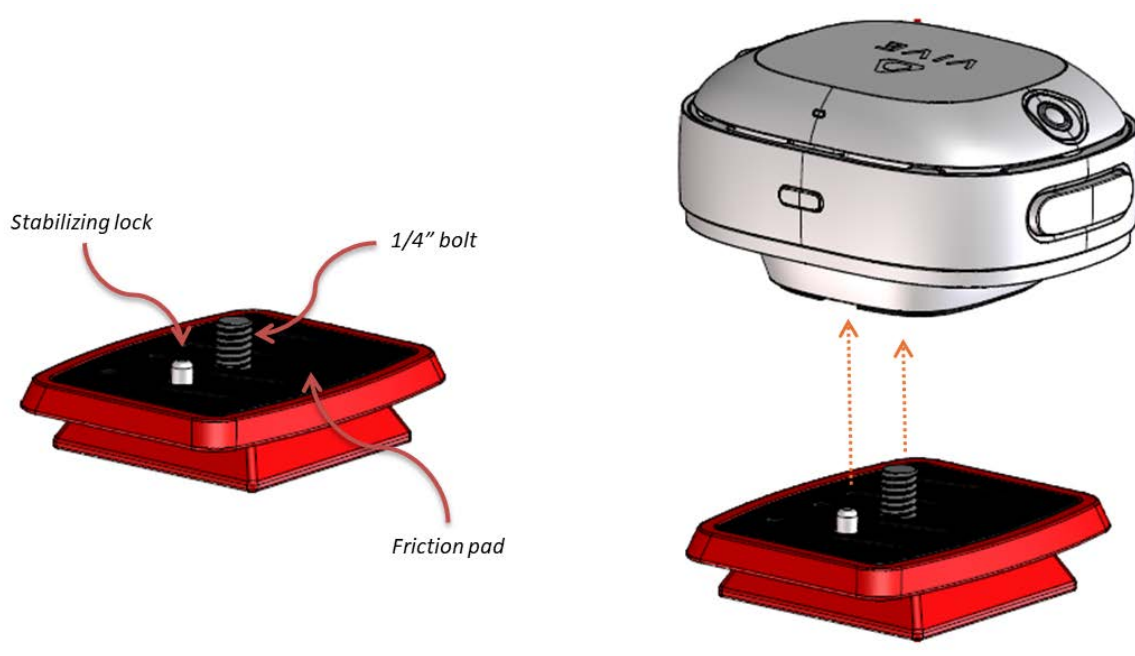


Fig. 7: Mounting the tracker base on a quick release plate

Mounting on a mount extender

The tracker can also be mounted on a mount extender, which allows you to tighten the mounting screw using the crank on the side. The diameter of the crank should be at least 25 mm for easier use.

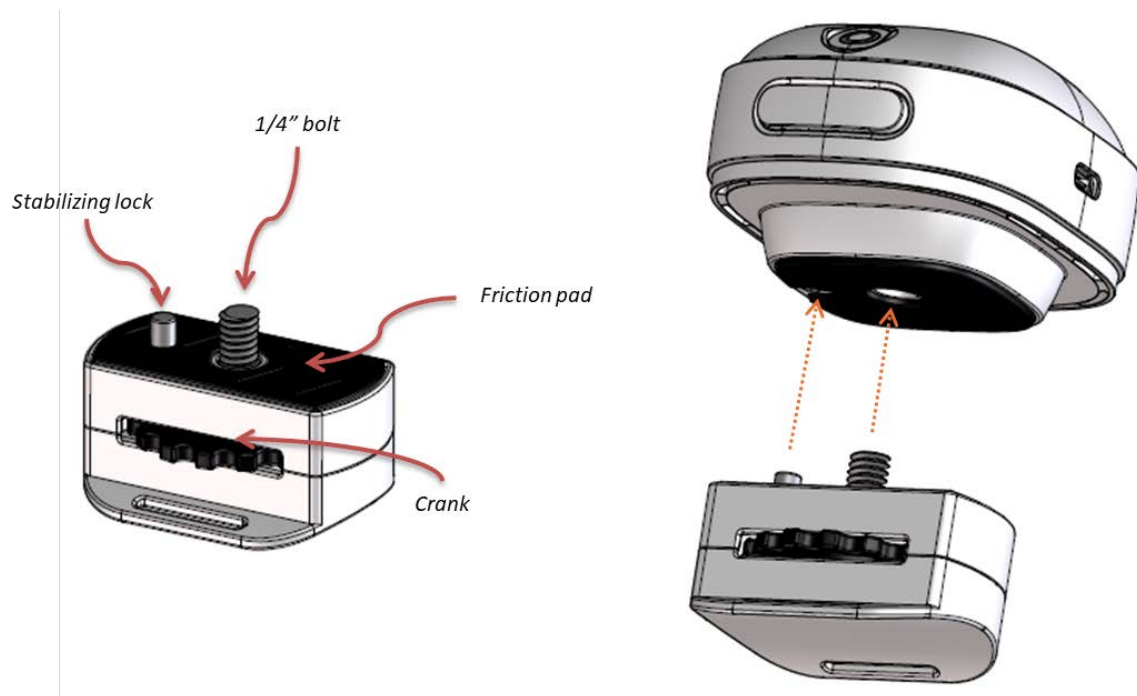


Fig. 8: Mounting the tracker base on a mount extender

Damping mechanism

When mounting the VIVE Ultimate Tracker on accessories and surfaces that produce continuous vibrations, we recommend using a damping system with your mounting mechanism to prevent a noticeable IMU drift.

The illustration below gives an example of how you can use rubber dampers when mounting.



Fig. 9: Attaching a damping mechanism to the VIVE Ultimate Tracker

Also consider the following factors when mounting the tracker on vibrating accessories: mounting distance, mounting position, and durometer measurement of the rubber damper.

Mounting examples

Below are some examples of how the VIVE Ultimate Tracker can be mounted on different accessories, such as guns and swords.



Fig. 10: Mounting the VIVE Ultimate Tracker on a gun accessory

When mounting the tracker on long handheld accessories, such as swords, we recommend placing the mounting mechanism close to the handheld area and then setting up the length in the VR program. For details, see [Accessory integration](#).

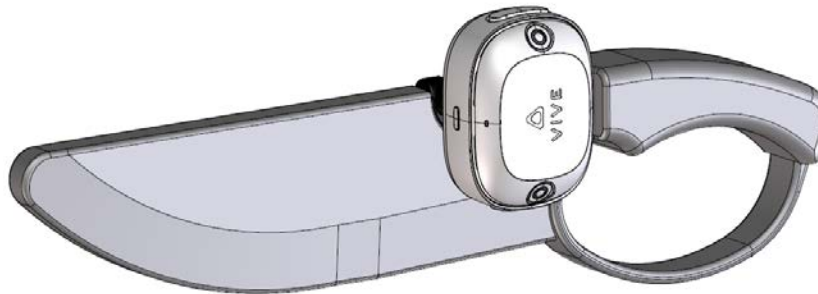


Fig. 11: Mounting the VIVE Ultimate Tracker on a sword accessory

When mounting the tracker on a sword accessory, consider its placement in relation to the user's body. Make sure that it is mounted on the side of the sword that allows the tracker's cameras to capture as much of the environment as possible.

The sword illustration above shows the tracker mounted on the left side of the sword. This mounting example is better suited for left-handed players. For right-handed players, it is ideal to mount the tracker on the right side of the sword to ensure optimal camera views of the environment.

Mechanical considerations

This section describes the mechanical specifications that developers need to consider when designing various accessories that are compatible with the VIVE Ultimate Tracker.

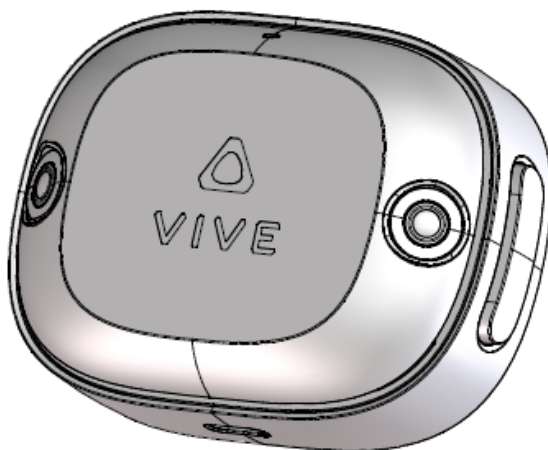


Fig. 12: VIVE Ultimate Tracker

Dimensions and weight

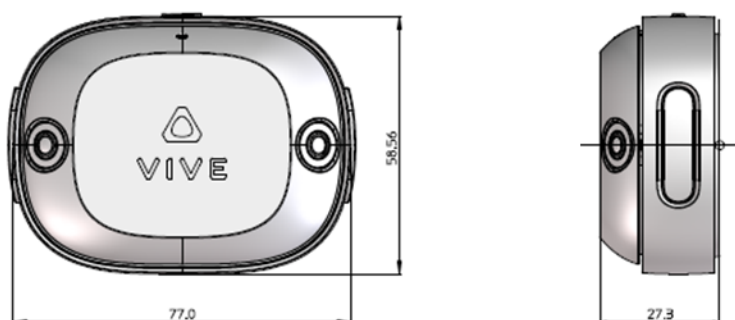


Fig. 13: VIVE Ultimate Tracker dimensions

Length	77 mm (3.03 in.)	Width	58.56 mm (2.31 in.)
Height	27.3 mm (1.07 in.)	Weight	95 g (0.21 lbs.)

Note: The dimensions listed above do not include the tracker base.

Components

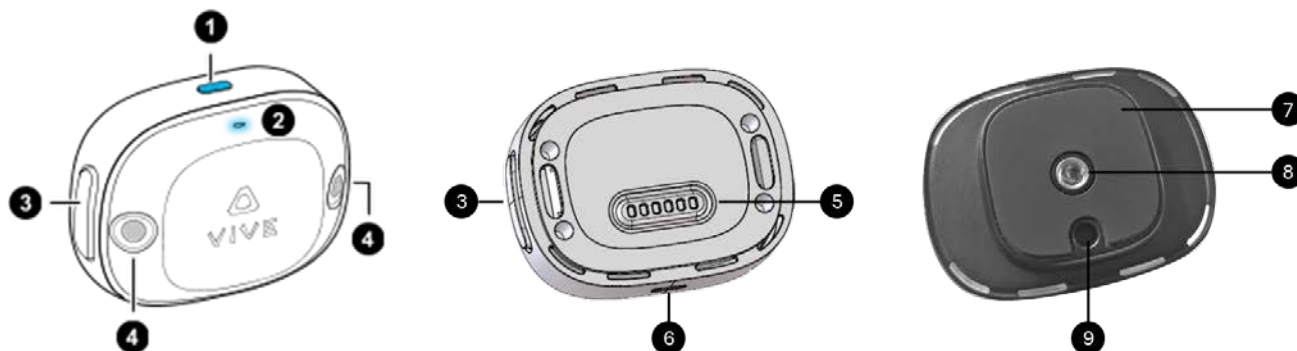


Fig. 14: VIVE Ultimate Tracker and tracker base components

No.	Component	Description
1	Power button	Use this button to power on or off the device or pair it with the VIVE Wireless Dongle. <ul style="list-style-type: none"> Power on: Press the button. Power off: Press and hold the button for five seconds. Pair with dongle: Press and hold the button for two seconds.
2	Status LED	This LED shows the status of the VIVE Ultimate Tracker. For details, see the VIVE Ultimate Tracker user manual .
3	Release buttons	Press both buttons to release the tracker base.
4	Cameras	These cameras track the position and movement of your accessories. For camera guidelines, see Optics .
5	Pogo pin pad	If your accessory has pogo pins, use this pad to transmit button events and supply power to the tracker. For details, see Pogo pin pad .
6	USB-C port	Use this USB 3.2 Gen 1 Type-C port to transfer data and supply power to the tracker.
7	Friction pad	This pad helps stabilize the tracker by providing additional friction when attached to your accessory.

8	1/4" tripod socket	This nut follows ISO 1222:2010 tripod connection standards. It can be used with 1/4" screws with a 1.27 mm pitch to attach the tracker to your accessory. For details, refer to ISO 1222-2010, figure 1 on page 1, and pages 3-5.
9	Stabilizing lock hole	This hole follows ISO 1222:2010 tripod connection standards. Align the hole with the lock on your quick release plate or accessory to help stabilize the tracker and improve the tracking performance. For details, refer to ISO 1222-2010, figure 5 on page 3, and pages 13-17.

Pogo pin pad

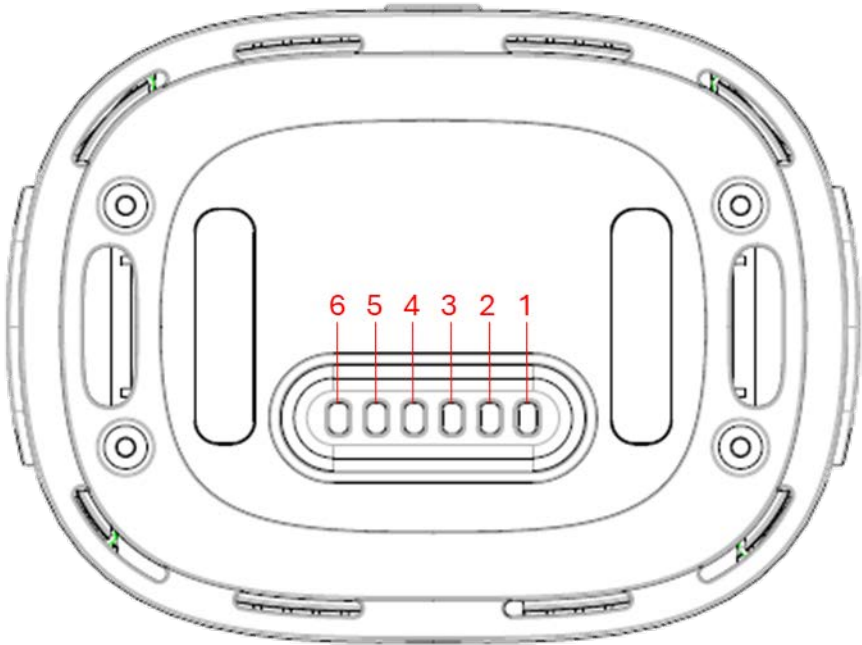


Fig. 15: Numbering of pogo pin targets

No.	Type	Description
1	Digital output	General purpose output pin
2	GND	Ground

3	Digital/power input	<ul style="list-style-type: none"> General purpose input pin: Internal pull-up resistor to V_{DD}, active -low (Grip button on VIVE VR controller) Power input pin
4	Digital input	General purpose input pin: Internal pull up resistor to V_{DD} , Active -low (Trigger button on VIVE VR controller)
5	Digital input	General purpose input pin: Internal pull up resistor to V_{DD} , Active -low (Trackpad button on VIVE VR controller)
6	Digital input	General purpose input pin: Internal pull up resistor to V_{DD} , Active -low (Menu button on VIVE VR controller)

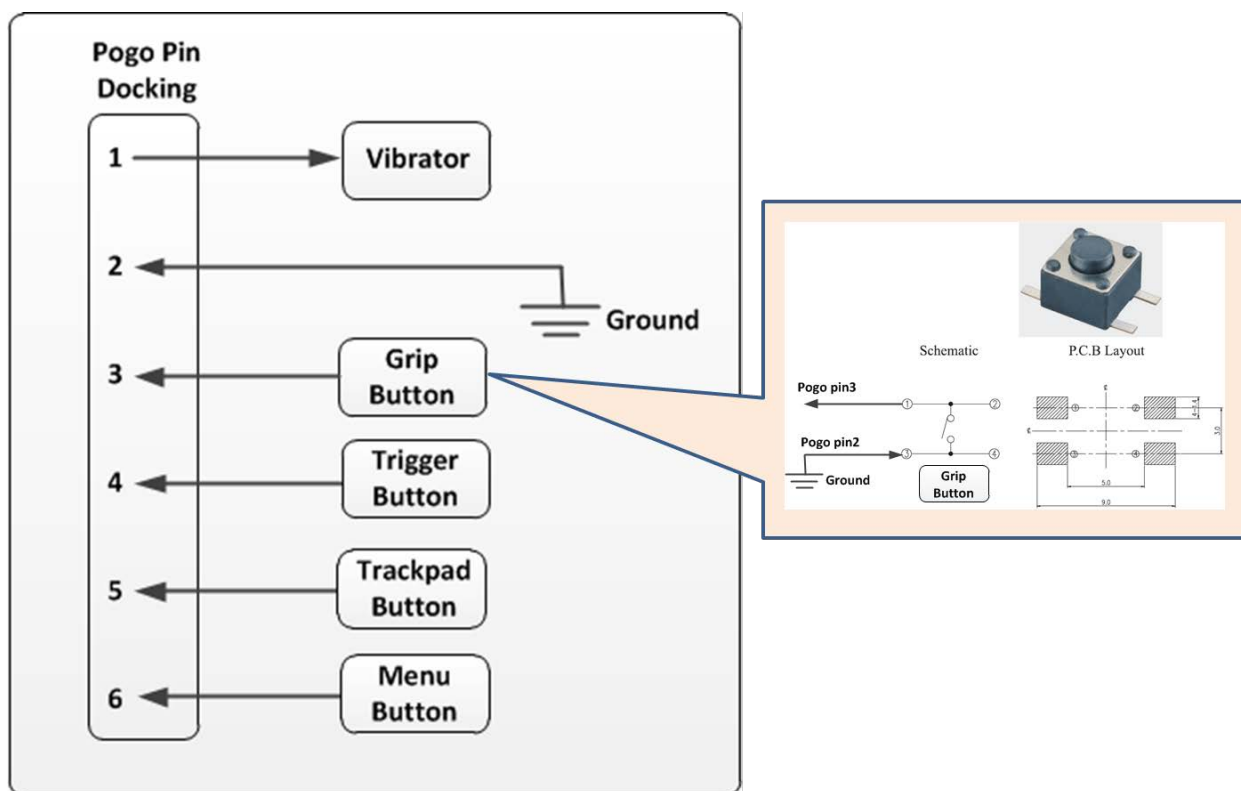


Fig. 16: pogo pin pad reference design

Coordinate system

The VIVE Ultimate Tracker follows the left-handed coordinate system in Unity.

For more information, visit <https://developer.vive.com/resources/openxr/unity/tutorials/tracker-overview/vivextracker/>.

VIVE Ultimate Tracker

- Datum A is set at the bottom surface of the tracker.
- Datum B is the origin point. It is set at the intersection of the centerline of the tracker's bottom surface and datum A.
- The coordinate system is constructed by the datum frame of datum A and datum B itself.

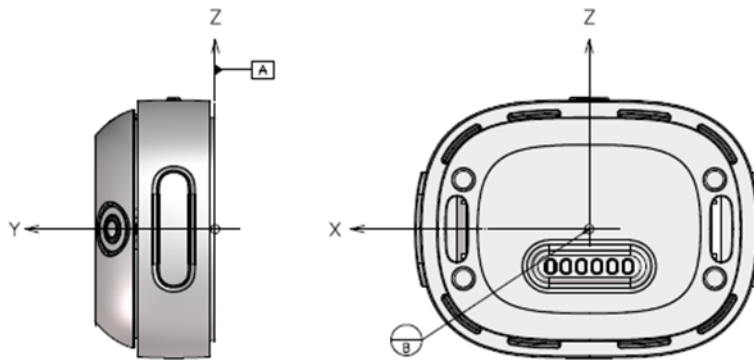


Fig. 17: Datum positions on the tracker

Software components

This section describes the software components for the VIVE Ultimate Tracker.

System requirements

To test hardware accessories or VR content with VIVE Ultimate Tracker, you'll need a VIVE Focus 3, VIVE XR Elite, or VIVE Focus Vision in addition to the hardware and software required for your accessory or content. For more information, visit www.vive.com.

If your accessory needs to pass data through the VIVE Ultimate Tracker, it must support either of the following interfaces:

- **Pogo pins**
For details, see the following sections:
 - [Architecture](#)
 - [Hardware requirements](#)
 - [Pogo pin pad](#)
- **USB-C (USB full speed host and HID class)**
The VIVE Ultimate Tracker acts as a USB device that can transfer data to and from the attached accessory. For details, see the following sections:
 - [Architecture](#)
 - [Hardware requirements](#)
 - [Data formats](#)

Data formats

This section describes the data formats that you can use to transfer data between your accessory and the VIVE Ultimate Tracker when using USB-C.

Hardware accessories must be able to send data to the VIVE Ultimate Tracker using the HID protocol. This data is packaged as a USB HID feature report, which the tracker interprets. Note that the data transfer interval should be longer than 10 ms. To learn more about USB HID specifications, visit <https://www.usb.org/hid>.

The VID/PID USB combination for the VIVE Ultimate Tracker is **0BB4/06A3**. The accessory will use this ID combination to find the drivers for the USB device.

The following code samples outline the USB command flow between the accessory and the VIVE Ultimate Tracker. The maximum data payload is 10 bytes.

Accessory to tracker

Depending on the platform you're using, the data sent from the accessory to the tracker follows different formats.

VIVE Focus 3

Data sent to VIVE Focus 3 via **USB setFeature** in **interface 0** uses the following format:

[0xB4] [0x00] [Data size N] [Data 1] [Data 2] [Data N] (Max N = 10)

The code sample below can be used to send the setFeature command to the VIVE Ultimate Tracker. However, your system must be able to reference the correct API in order to send the command.

JAVA: (example)

```
// Take 0xB4 command for example
data1[0] = (byte)180; //0xB4
data1[1] = 0; //dummy byte
data1[2] = 4; //Means there are 4 bytes follow
data1[3] = 1; //Raw Byte 0
data1[4] = 1; //Raw Byte 1
data1[5] = 1; //Raw Byte 2
data1[6] = 1; //Raw Byte 3

int result = mDeviceConn.controlTransfer(0x21, 0x09, 0x0300, 2, data1, data1.length, 0);
```

VIVE Business Streaming

Data sent to VIVE Business Streaming uses the **setFeature 0xB4** data format:

Byte Index	Data	Remark
0	Tag Index	Indicates the version of the data being sent out. In this version, the default value is zero.
1	Button	<div> <div>TRIGGER</div> <div>0x01</div> </div> <div> <div>BUMPER</div> <div>0x02</div> </div> <div> <div>MENU</div> <div>0x04</div> </div> <div> <div>STEAM</div> <div>0x08</div> </div> <div> <div>PAD</div> <div>0x10</div> </div> <div> <div>PAD_FINGERDOWN</div> <div>0x20</div> </div>

		Reserved	0x40
		Reserved	0x80
2	Pad X value	-32768 to 32767 BYTE 2 is LSB	
3			
4	Pad Y value	-32768 to 32767 BYTE 4 is LSB	
5			
6	Trigger Raw	Value: 0 to 65535 BYTE 6 is LSB	
7			
8		Reserved	
9		Reserved	

Tracker to accessory

Data sent to the accessory from VIVE Focus 3 via **USB input report** in **interface 0** uses the following format:

[0x42] [Data size N] [Data 1] [Data 2] ... [Data N] (**Max N 10**)

Content device (PC or standalone VR) to tracker

Use the following format to transfer data to the accessory:

```
var result = Interop.WVR_StartNotifyDeviceInfo(WVR_DeviceType.WVR_DeviceType_HMD, 64);
```

Use the following format to transfer the data to a specific tracker:

```
Interop.WVR_UpdateNotifyDeviceInfo(TrackerId.Tracker2, ptrParameterName);
```

Notes:

- For this example, the connected tracker is Tracker2.
- ptrParameterName is a string which follows the format: "OUTDATA_v2-0FFFFFFFFF"
 - "OUTDATA_v2-" is fixed.
 - "2" is Tracker2.
 - "FFFFFFFF" is 10 bytes of raw data that you can define.

Sample code:

```
string TextExtend()  
{  
    var extData = TrackerManager.Instance.GetTrackerExtData(TrackerId.Tracker2, out ulong timestamp);  
    string extStr = "";  
    for (int i = 0; i < extData.Length; i++) { extStr += extData[i].ToString(); }  
    return extStr;  
}
```

Accessory integration

This section provides details on the position transformation between the VIVE Ultimate Tracker and an accessory. As a content developer, you can set the correct rotation and translation results of the content used with the attached accessory in a game engine such as Unity.

It is assumed that the accessory that the VIVE Ultimate Tracker is attached to follows the left-handed coordinate system. Below is an example showing the coordinates on a gun accessory with the VIVE Ultimate Tracker.

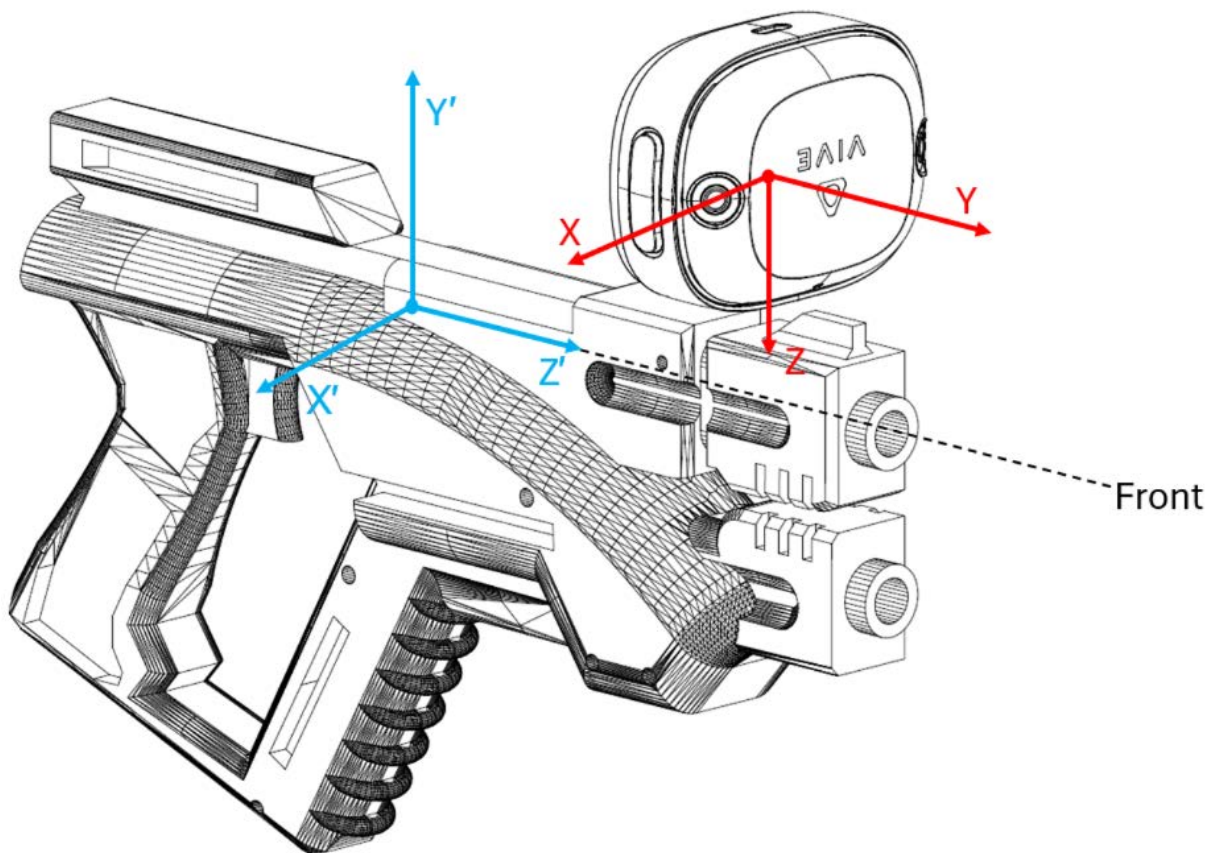


Fig. 18: VIVE Ultimate Tracker coordinates transformed on a gun accessory

When designing your accessory, you must first define the center so you can measure the degrees and distance based on actual integration conditions. To find the center of the VIVE Ultimate Tracker, see [Coordinate system](#).

The degrees of rotation and the translation distance of an accessory—relevant to the VIVE Ultimate Tracker—are described in roll, yaw, pitch and Dx, Dy, Dz respectively.

- **Pitch:** The angle of rotation around the x axis
- **Yaw:** The angle of rotation around the y axis
- **Roll:** The angle of rotation around the z axis

- **D_x:** The distance between the centers of the accessory and the tracker along the x axis
- **D_y:** The distance between the centers of the accessory and the tracker along the y axis
- **D_z:** The distance between the centers of the accessory and the tracker along the z axis

You can collect the listed information above and transform the tracker pose to the accessory pose.

Assume that:

- Tracker rotation matrix is $R_{Tracker}$
- Accessory rotation matrix is $R_{Accessory} = R_{Pitch_Yaw_Roll} * R_{Tracker}$
- Accessory position is $V_{Accessory} = V_{Tracker} + R_{Accessory} * Distance$

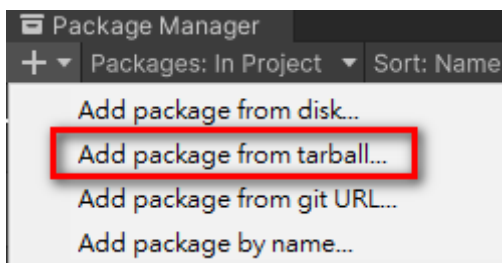
Unity integration

This section provides an example of how you can use the Unity game engine to enable the VIVE Ultimate Tracker in VR.

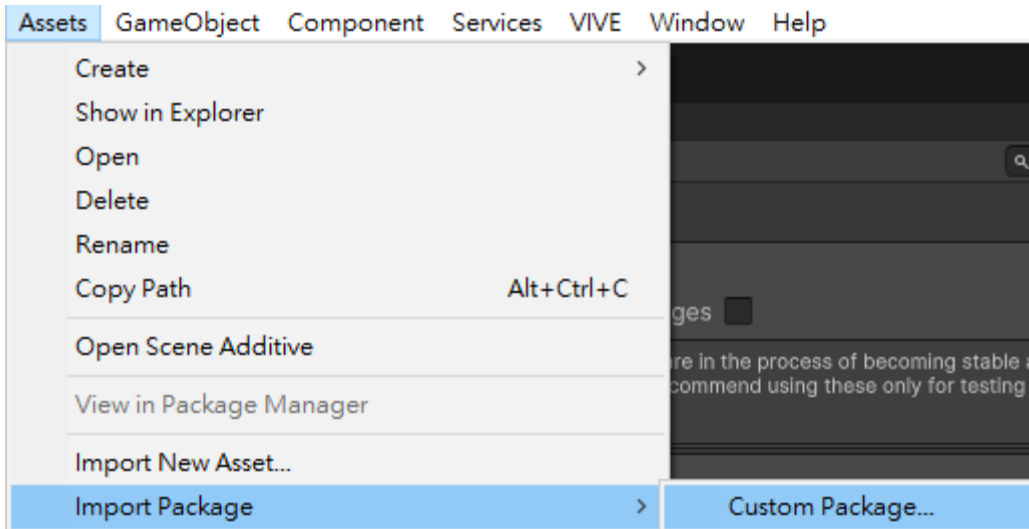
Using VIVE OpenXR plugin 2.5.0 or later versions

1. Download the .tgz file from [GitHub](#) or import [ViveOpenXRInstaller.unitypackage](#).
2. Open the file.

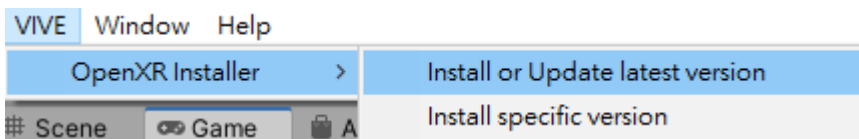
If you are using the .tgz file, go to **Window > Package Manager > + > Add package from tarball...**, and then locate and select the file from your local folders.



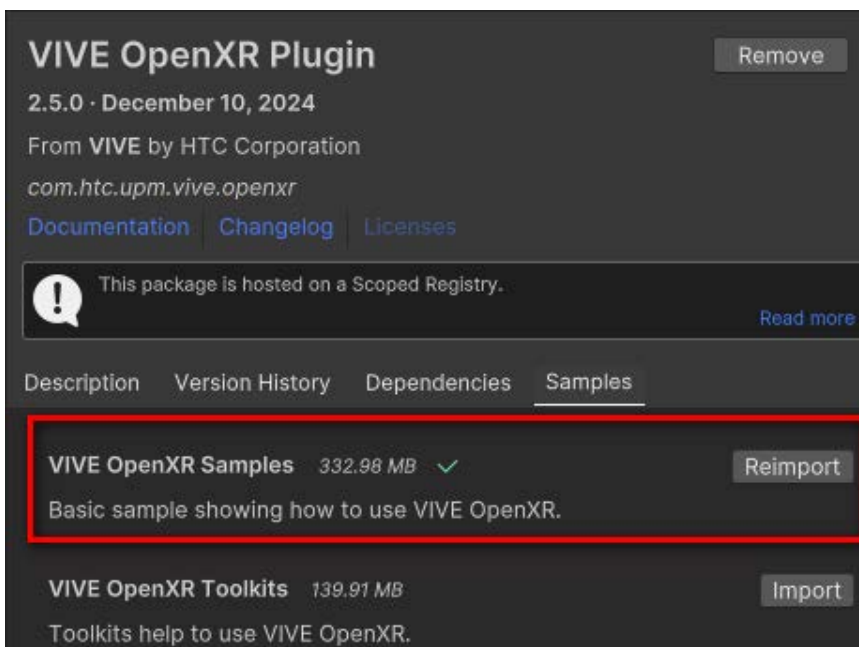
If you are importing the unitypackage file, go to **Assets > Import package > Custom Package**, and then locate and select **VIVEOpenXRInstaller** from your local folders.



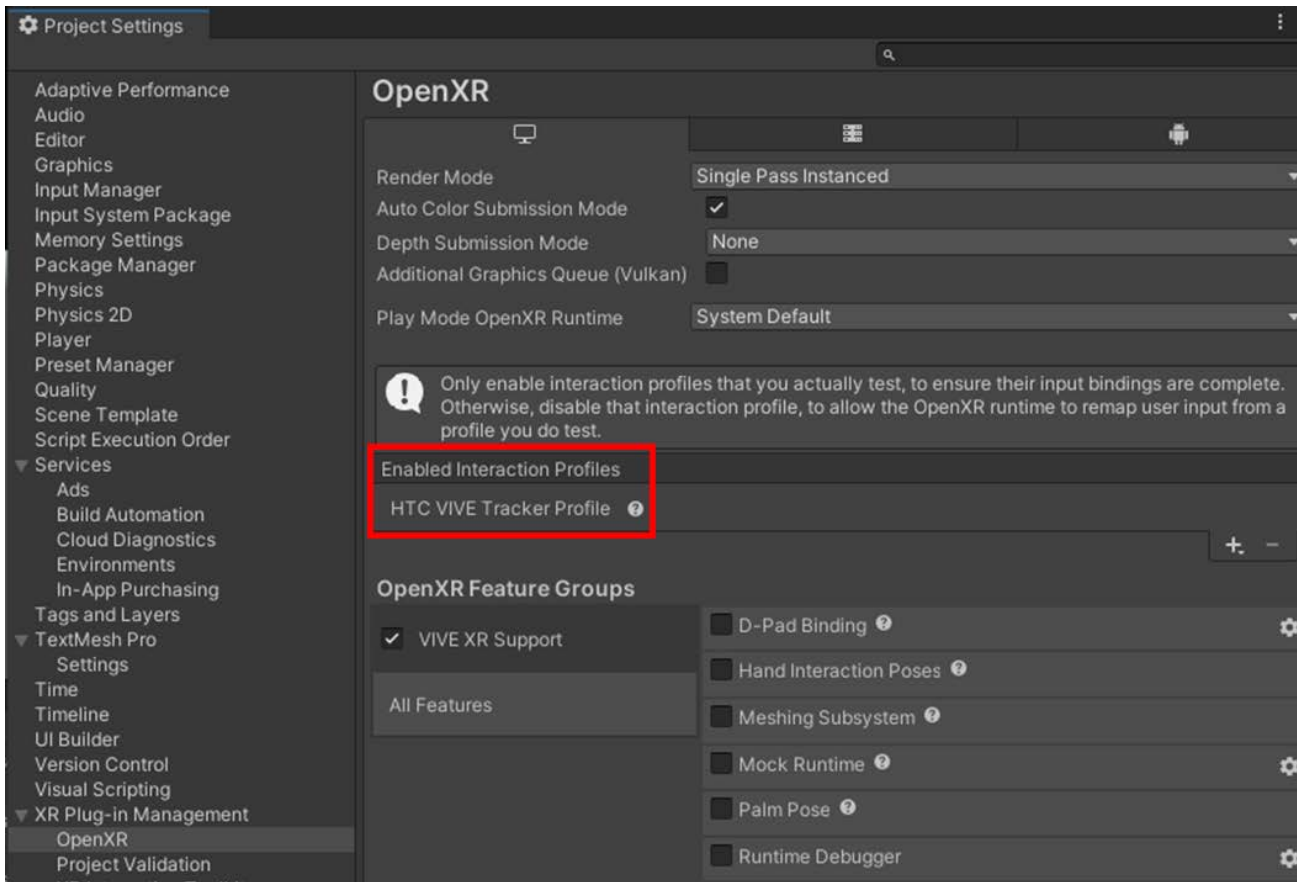
- Go to **VIVE > OpenXR Installer**, and then select **Install or Update latest version**.



- In the **Package Manager** window, import **VIVE OpenXR Samples**.



5. Make sure that **HTC VIVE Tracker Profile** is in the **Enabled Interaction Profiles** list.



6. Open the **VIVETrackerSample** scene, and then click **Play**.

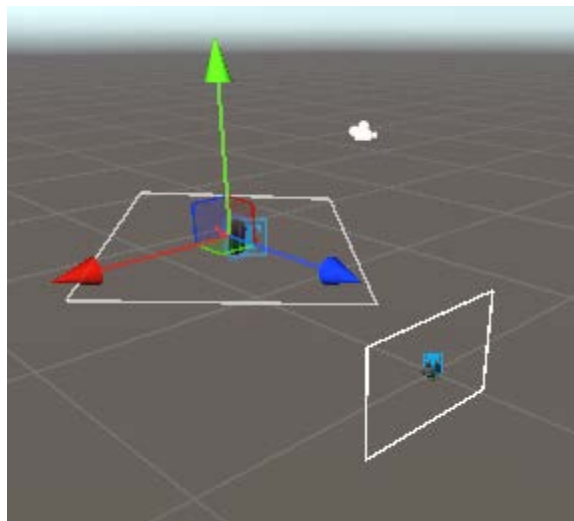


Fig. 19: VIVE Tracker > Chest



Fig. 20: VIVE Ultimate Tracker model in Game view

You can also refer to the [online tutorial](#).

Troubleshooting

Topic	Question	Answer
General	I'm having problems pairing the VIVE Ultimate Tracker. What should I do?	<p>Try the following:</p> <ul style="list-style-type: none"> • Make sure that the VIVE Ultimate Tracker is fully charged and that its firmware is up to date. For details, see Updating the VIVE Ultimate Tracker firmware. • Restart the VIVE Ultimate Tracker, and then press and hold the power button for two seconds to start the pairing process.
	Why am I experiencing stuttering in my PC VR streaming session while using VIVE Ultimate Tracker?	Stuttering is normally caused by a poor Wi-Fi signal. We recommend connecting your headset to a 5 GHz network for optimal coverage. Avoid using the 6 GHz band.
	Why is the status LED on the tracker continuously blinking green?	This LED behavior means that the map data of the tracker is not synchronized. To fix this, connect the headset to a Wi-Fi network.
Tracking	What can I do if VIVE Ultimate Tracker tracking is not stable or accurate?	<p>Try the following:</p> <ul style="list-style-type: none"> • Clean the tracker's two camera lenses with a dry microfiber cloth. • Move the tracker to the center of your play area for the best tracking results. • Maintain a distance of at least 1.5 meters between the tracker and any obstacles in your play area. • Keep these in mind for your play area: <ul style="list-style-type: none"> ○ The space needs to be bright enough for you to read a book comfortably. ○ The space should not have intense light or glare. ○ The space should not have reflective objects. ○ The walls, ceiling, and floor must not be completely blank. Spread out a patterned rug and add hang posters and photos for better tracking.

	<p>What should I do if the tracker's position in VR and the real world don't match?</p>	<p>Try the following:</p> <p>Recalibrate camera tracking</p> <ol style="list-style-type: none"> 1. Hold the VIVE Ultimate Tracker with one hand in front of your chest. Make sure that the tracker's cameras are facing forward and that your fingers are not blocking their view. 2. Without touching the camera lenses, use your other hand to block the view of the cameras for five seconds. 3. Remove the hand covering cameras to allow the tracker to recalibrate. <p>Turn off other space calibration tools</p> <p>Having the VIVE Space Calibrator run simultaneously with other space calibration tools affects the space alignment of the VIVE Ultimate Tracker. Check for other active third-party space calibration tools.</p> <ol style="list-style-type: none"> 1. In SteamVR, go to Manage SteamVR Add-Ons. 2. If any space calibration tool is running, turn it off.
	<p>Why can't I see the tracker in VR when it's attached to my lower body?</p>	<p>This issue may occur when the low angles of your play area are not scanned correctly. To fix this, do the following:</p> <ol style="list-style-type: none"> 1. Detach the VIVE Ultimate Tracker from your body. <p>Important: For the following steps, make sure that your fingers are not blocking the view of the cameras.</p> <ol style="list-style-type: none"> 2. Hold the VIVE Ultimate Tracker in front of your chest until you see the tracker in VR. Make sure that the camera is facing forward. 3. Slowly lower the tracker back to its original position on your body. <p>Tip: To improve tracking accuracy, keep a steady hold of the tracker while scanning the area at the lowest position.</p> <ol style="list-style-type: none"> 4. Reattach the tracker to your body.
	<p>Why is tracking jittery and jumpy when using the VIVE Ultimate Tracker?</p>	<p>There may be wireless interference in your play area caused by other devices. If possible, temporarily turn off other wireless devices when you're using the VIVE Ultimate Tracker.</p>