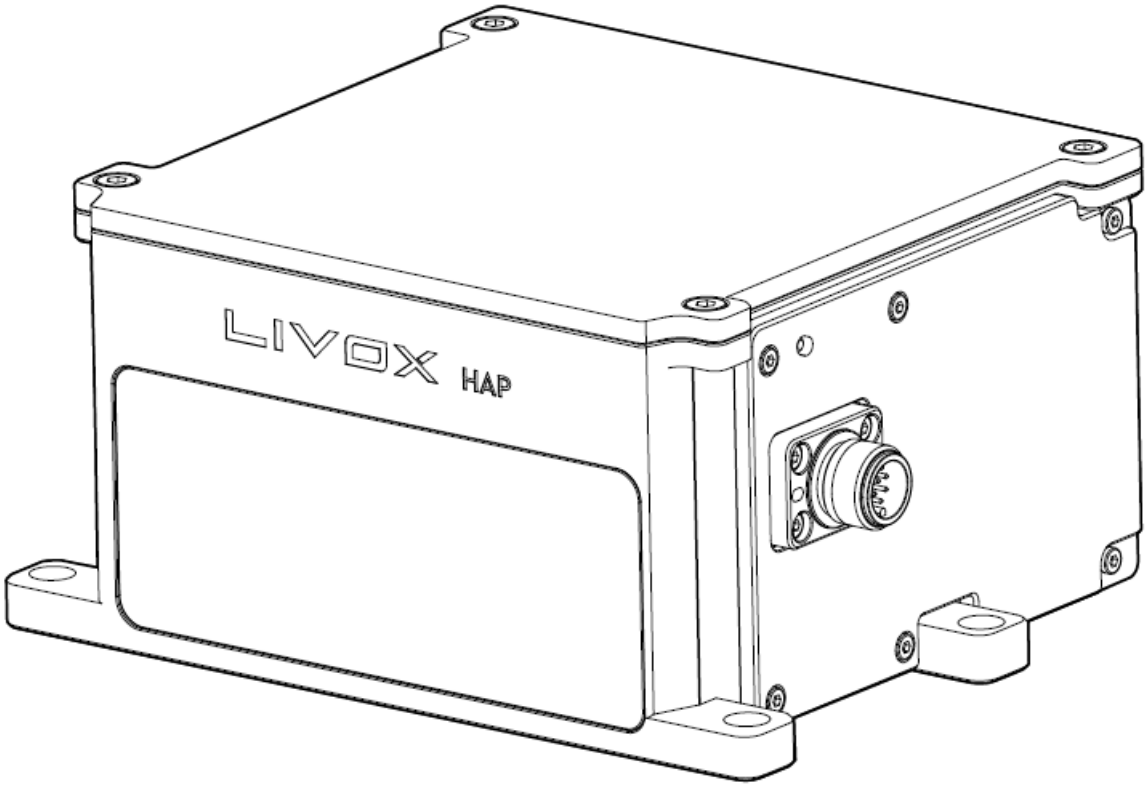
LIVOX HAP High Performance LiDAR Sensor User Guide

Contents

1 LIVOX HAP High Performance LiDAR Sensor
2 DISCLAIMER
3 WARNINGS
4 Introduction
5 Installation and Connection
6 Downloading and Using Livox Viewer 2
7 Low-Temperature Start-Up
8 Specifications
9 Documents / Resources
10 Related Posts

LIVOX

LIVOX HAP High Performance LiDAR Sensor



DISCLAIMER

This product is NOT a toy and is not suitable for children under the age of 16. Adults should keep the product out of the reach of children and exercise caution when operating this product in the presence of children. This product incorporates various advanced technologies. However, inappropriate use of the product could result in personal injury or property damage. Read the materials associated with the product before using for the first time. These documents are included in the product package and/or are available online on the LIVOXM Technology Company Limited ("Livox") website (**www.livoxtech.com**). The information in this document affects your satety and your legal rights and responsibilities. Read this entire document carefully to ensure proper configuration before use. Failure to read and follow the instructions and warnings in this doCument may result in serious injury to yourself or others, damage to or loss of your Livox product, or damage to other objects in the vicinity. By using this product, you hereby signify that you have read this disclaimer carefully and that you understand and agree to abide by the terms and conditions herein. EXCEPT AS EXPRESSLY PROVIDED IN LIVOX AFTER-SALES SERVICE POLICIES AVAILABLE AT **www.livoxtech.com**, THE PRODUCT AND ALL MATERIALS, AND CONTENT AVAILABLE THROUGH THE PRODUCT ARE PROVIDED "AS IS" AND ON AN "AS AVAILABLE" I OR IMPLIED. LIVOX DISCLAIMS ALL WARRANTIES OF ANY KIND, EXCEPT AS EXPRESSLY PROVIDED IN LIVOX AFTERSALES WITHOUT WARRANTY OR CONDIT N OF ANY KIND, EITHER EXPRESS SERVICE POLICIES, WHETHER EXPRESS OR IMPLIED, RELATING TO THE PRODUCT, PRODUCT ACCESSORIES, AND ALL MATERIALS, INCLUDING: (A) ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, TITLE, QUIET ENJOYMENT, OR NONINFRINGEMENT; AND (B) ANY WARRANTY ARISING OUT OF COURSE OF DEALING, USAGE, OR TRADE. LIVOX DOES NOT WARRANT, EXCEPT AS EXPRESSLY PROVIDED IN LVOX WARRANTY, THAT THE PRODUCT, PRODUCT ACCESSORIES, OR ANY PORTION OF THE PRODUCT, OR ANY MATERIALS, WILL BE UNINTERRUPTED, SECURE, OR FREE OF ERRORS, VIRUSES, OR OTHER HARMFUL COMPONENTS, AND DOES NOT WARRANT THAT ANY OF THOSE ISSUES WILL BE CORRECTED. NO ADVICE OR INFORMATION, WHETHER ORAL OR WRITTEN, OBTAINED BY YOU FROM THE PRODUCT, PRODUCT ACCESSORIES, OR ANY MATERIALS WILL CREATE ANY WARRANTY REGARDING LIVOx OR THE PRODUCT THAT IS NOT EXPRESSLY STATED IN THESE TERMS. YOU ASSUME ALL RISKS FOR ANY DAMAGE THAT MAY RESULT FROM YOUR USE OF OR ACCESS TO THE PRODUCT, PRODUCT ACCESSORIES, AND ANY MATERIALS. YOU UNDERSTAND AND AGREE THAT YOU USE THE PRODUCT AT YOUR OWN DISCRETION AND RISK, AND THAT YOU ARE SOLELY RESPONSIBLE FOR ANY PERSONAL INJURY, DEATH, DAMAGE TO YOUR PROPERTY (INCLUDING YOUR COMPUTER SYSTEM OR MOBILE DEVICE OR LIVOX HARDWARE USED IN CONNECTION WITH THE PRODUCT) OR THIRD PARTY PROPERTY, OR THE LOSS OF DATA THAT RESULTS FROM YOUR USE OF OR INABILITY TO USE THE PRODUCT. SOME JURISDICTIONS MAY PROHIBIT A DISCLAIMER OF

WARRANTIES AND YOU MAY HAVE OTHER RIGHTS THAT VARY FROM JURISDICTION TO JURISDICTION.

Livox accepts no liability for damage, injury or any legal responsibility incurred directly or indirectly from the use of this product. The user shall observe safe and lawful practices including, but not limited to, those set forth in this quick start guide. You shall be solely responsible for all your behaviors when using this product.

WARNINGS

1. Be careful when using Livox HAP" in conditions with low visibility such as foggy or stormy weather. In such conditions, the detection range may be reduced. For detection range in conditions with high visibility, refer to the Specifications section.
2. When mounting LivOx HAP, allow a space of at least 10 mm around Livox HAP to prevent poor air flow affecting heat dissipation, and make sure the waterproof breathable valve is not blocked. It is normal for the temperature of Livox HAP to increase during use.
3. DO NOT touch the optical window of Livox HAP. Dust and stains on the optical window can negatively affect the performance. Use compressed air, isopropyl alcohol, or a lens cloth to clean the optical window correctly. Refer to the Livox HAP User Manual for more information on how to clean optical windows.
4. When customizing Livox HAP power cables, make sure the current-carrying capacity of the cable can support the power requirement of Livox HAP. Otherwise, the product may become a fire hazard or be damaged permanently.
5. In order to avoid electric shocks or radiation exposure, DO NOT disassemble the Livox HAP. If an accessory or product part needs to be replaced, contact Livox for support.
6. Livox HAP is classified as a Class 1 Laser Product (EC/EN 60825-1: 2014) and is safe under all normal conditions of use.
7. Liquid damage is not covered under warranty.
8. DO NOT drop Livox HAP.
9. The Livox HAP Quick Start Guide containrs important information. Make sure to read before first use and keep for reference.

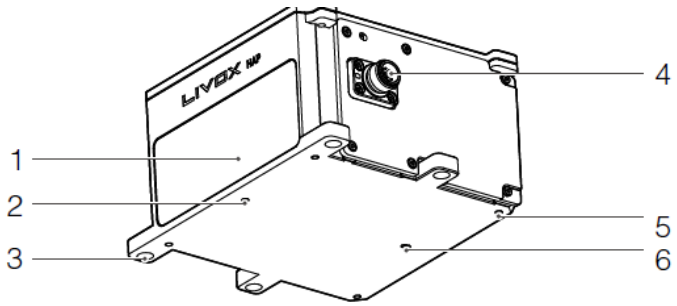
Introduction

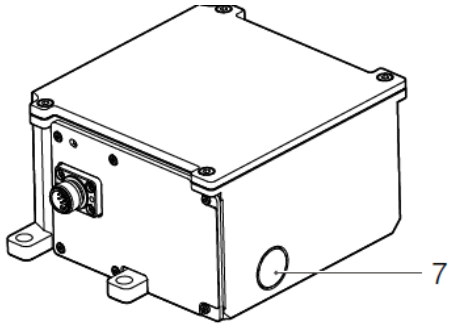
As the next-generation product of Livox Horizon, Livox HAP is a high-performance LiDAR sensor with a compact design and superior precision. It can be used for multiple applications including autonomous driving, robotic navigation, dynamic path planning. and high-precision mapping. Compared to Livox Horizon, LivOx HAP features a FOV of 120° (horizontal) and 25° (vertical), a longer detection range of 150 m (at 10% reflectivity, 100 klux), and a higher point rate of 452K points/s. Users can check real-time point clouds using Livox Viewer 2, and a software development kit (Livox SDK) is provided to help you develop customizable applications using 3D data acquired from point clouds. Livox HAP has two models which are HAP (T1) and HAP (TX). The document is intended for the HAP (TX).

HAP (TX)

1. Optical Window
2. Locating Hole 1
3. M6 Mounting Hole ($6.5) x 4
4. M12 Aviation Connector
5. M3 Mounting Holex 4

6. Locating Hole 2
7. Waterproof Breathable Valve

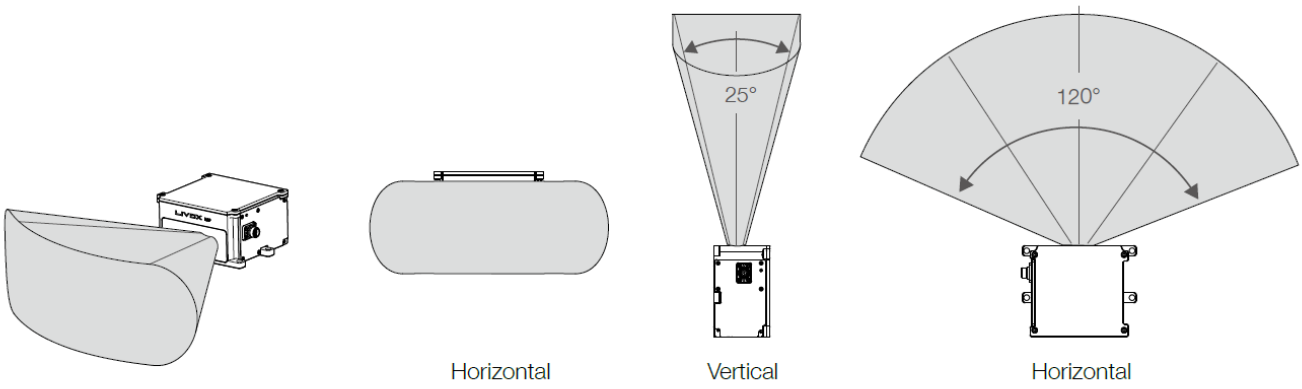




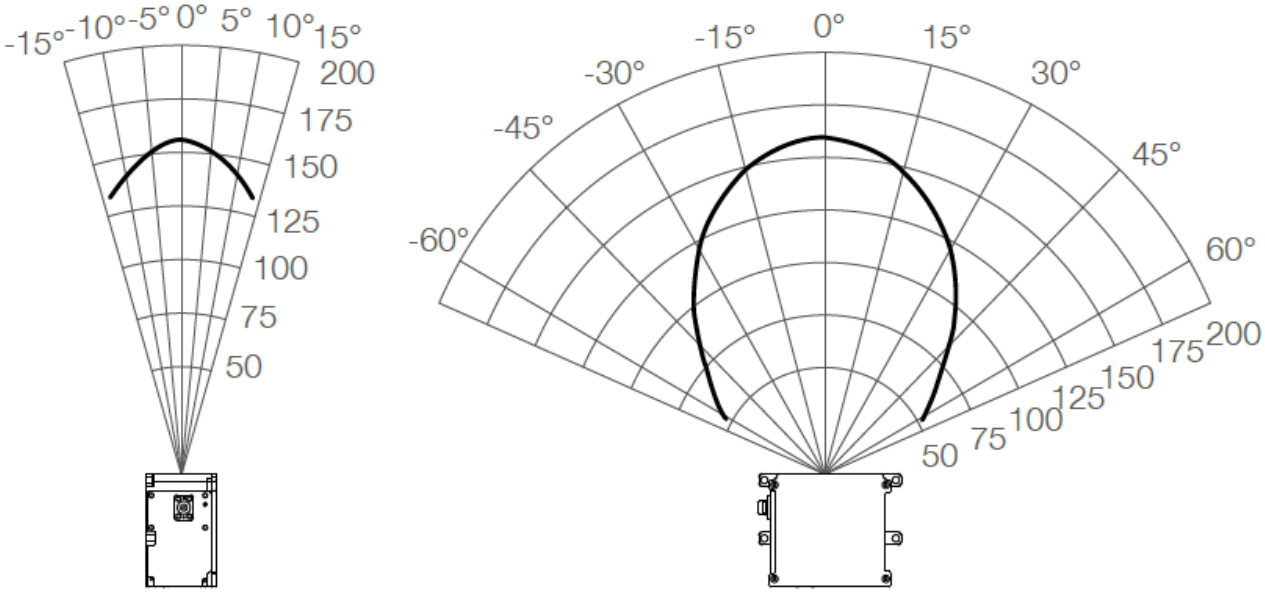
Installation and Connection

Effective FOV Range

HAP (TX) has a FOV of 120° (horizontal) x 25° (vertical) as shown below. When mounting HAP (TX), make sure that the FOV is not blocked by any objects. Visit **www.livoxtech.com**/hap to download the 3D models of HAP (TX) and its FOV.



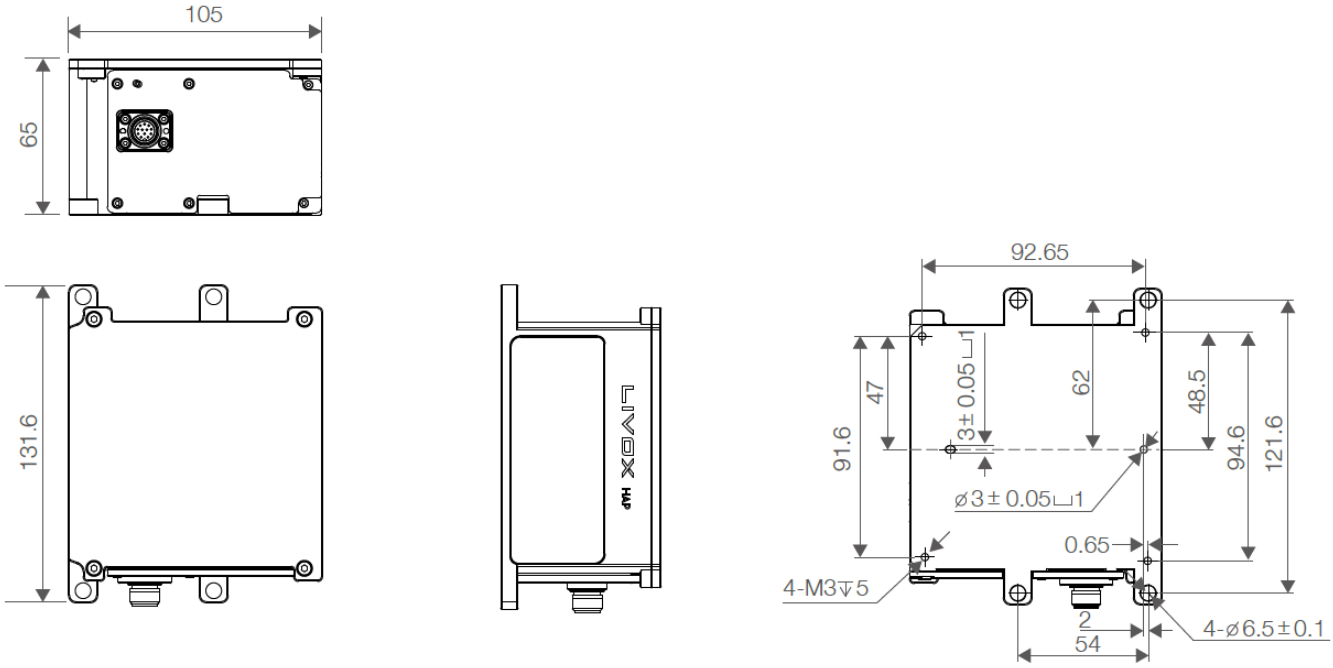
Note that the effective detecting distance of HAP (IX) varies based on where the object is within the FOV. Ihe closer to the edge of the FOv, the shorter the effective detecting distance is. The closer to the center of the FOv, the further the efective detecting distance. Refer to the diagrams below:



Vertical Horizontal

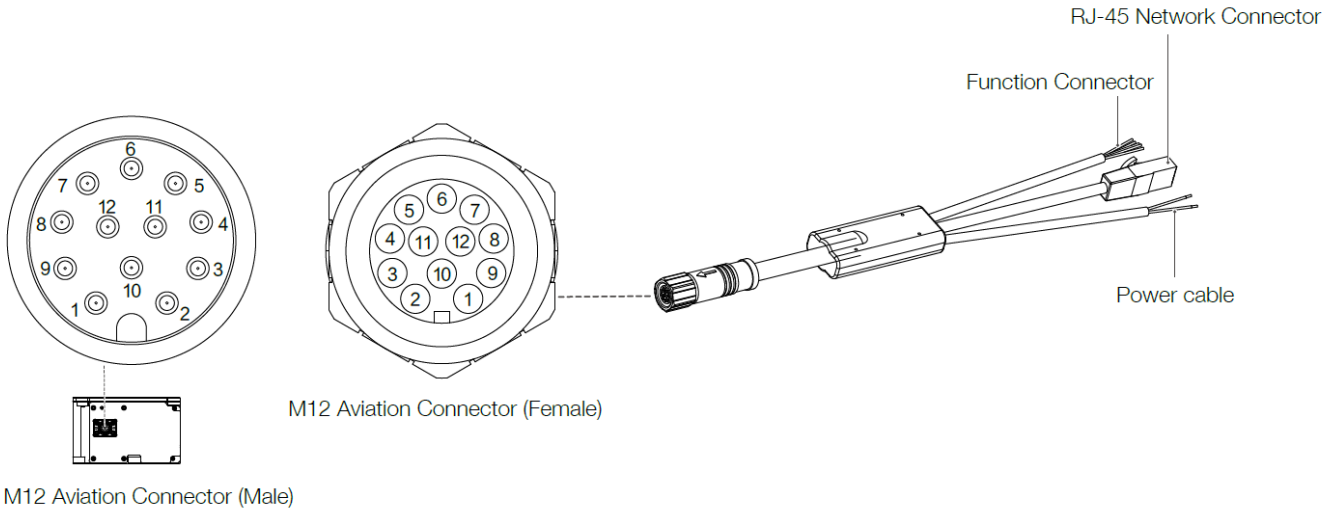
Mounting the HAP (TX)

Refer to the dimensions and the mounting holes in the diagrams below to mount or embed HAP (TX) appropriately. Note that the corresponding screws should be purchased in advance.



Connectors

HAP (TX) uses the high-reliability M12 aviation connector (male). Users can connect to HAP (TX) through the Livox Aviation Connector 1-to-3 Splitter Cable (sold separately) for power supply and transmission of data and control signals.



See below for more information on the HAP (TX) M12 aviation connector (male) and the Livox Aviation Connector 1-to-3 Splitter Cable.

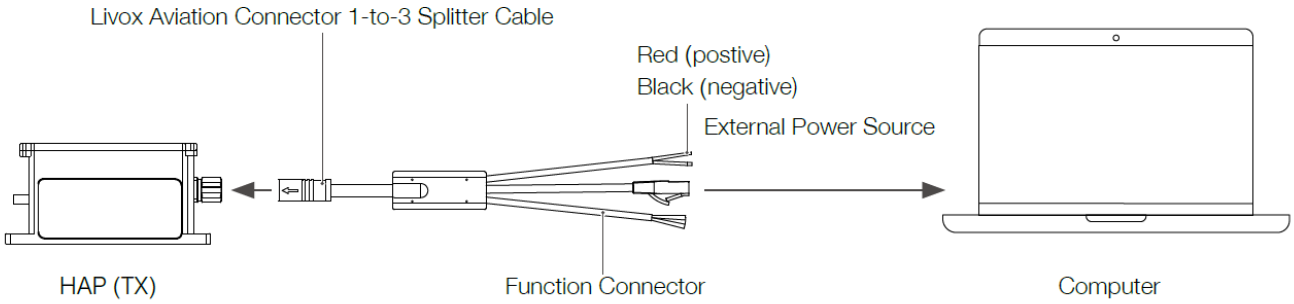
M12 Aviation Connector Pin	Signal	Type	Description	Color	Function
1	Power+	Power	DC VCC	Red (positive)	Power cable (Connects to DC power)
9	Power+	Power	DC VCC		
2	Ground	Power	Ground	Black (negative)	
3	Ground	Power	Ground		
4	Ethernet-TX+	Output	Ethernet-TX+	Orange/white	Ethernet cable (Connects to computer or router)
5	Ethernet-TX-	Output	Ethernet-TX-	Orange	
6	Ethernet-RX+	Input	Ethernet-RX+	Green/white	
7	Ethernet-RX-	Input	Ethernet-RX-	Green	
8	N/A	N/A	N/A	Purple/white	Function cable (Not in use. DO NOT connect with other power or signal cables to avoid short circuits.)
10	N/A	N/A	N/A	Gray/white	
11	N/A	N/A	N/A	Gray	
12	N/A	N/A	N/A	Purple	
2&3	Ground	Ground	Ground	Black	

Connecting the HAP (TX)

All HAP (TX) are set to static IP address mode by default with an IP address of 192.168.1.100. The default subnet masks of HAP (TX) are all 255.255.255.0 and their default gateways are 192.168.1.1. Directly connect HAP (TX)

to the computer.

- Before connecting, set the IP address of the computer to static IP address mode. Set the IP address of the computer to the same network subnet as the IP address of HAP (TX) (example: 192.168.1.50), and set the subnet mask of the computer to 255.255.255.0.
- Connect HAP (TX) as shown below.



- a. Connect the M12 aviation connector (female) on Livox Aviation Connector 1-to-3 Splitter Cable with the M12 aviation connector (male) on HAP (TX). The lock nut of the M12 aviation connector (female) should be tightened with a wrench to ensure there is a secure connection with the end face of the lock nut of the M12 aviation connector (male). Make sure there is no gap between them.
- b. Connect the RJ-45 network connector on the Livox Aviation Connector 1-to-3 Splitter Cable to the computer.
- c. Connect the external power connector on the Livox Aviation Connector 1-to-3 Splitter Cable to the external power source. Pay attention to the input voltage range and polarity.
    - The Livox Aviation Connector 1-to-3 Splitter Cable must be purchased separately.
    - Refer to the Livox HAP User Manual on how to set the IP address of the computer.
    - When multiple HAP (TX) LiDAR sensors are connected to one computer in static IP address mode, make sure all sensors connected have different static IP addresses. Refer to Livox HAP User Manual for more information on how to set the IP address for each LiDAR sensor.
    - When HAP (TX) is directly connected to an external power source, as the working voltage of HAP (TX) is 9 to 18V DC, make sure the voltage range of the power source is within the allowable range. Make sure the positive and negative ends of the power cable are connected correctly.
    - The function connector does not need to be used as it has no electrical connection inside HAP (TX).

Downloading and Using Livox Viewer 2

Visit http://www.livoxtech.com and download the latest Livox Viewer 2 to check the point cloud data. Livox Viewer 2 supports WINDOWS® 10 (64 bit) and UBUNTUTM 18.04 (64 bit).

1. Download the file named “Livox Viewer 2”.
2. Unzip the Livox Viewer 2 file and click to open the .exe file named “Livox Viewer 2”. For Ubuntu users, unzip the Livox Viewer 2 file and click to open the “./livox_viewer_2.sh” file under the root directory.
3. If a system window with network authorization pops up when opening Livox Viewer 2, allow Livox Viewer 2 to access network.
4. The device manager window is on the left side of Livox Viewer 2 and the main interface is on the right side. Click to display or hide the device manager window. In this device manager window, users can check all Livox LiDAR sensors in the local area network (LAN).
5. Click “LiDAR” on the top of the device manager window.

6. Select the Livox HAP you want to check and click to connect. Alternatively, select the Livox HAP you want to check, right click,
7. After connecting, click or press the space key on the keyboard to view the point cloud data.
    - For Windows users, Livox Viewer 2 may fail to detect LiDAR sensors if Windows Firewall is turned on. In this situation, go to the Control Panel to turn off Windows Firewall and restart Livox Viewer 2.
    - Download and read the Livox Viewer 2 User Manual for more information on how to use Livox Viewer 2.

Low-Temperature Start-Up

The working temperature of HAP (TX) is from -40° to 85° C (-40° to 185° F). If the ambient temperature is below 0° C (32° F), HAP (TX) may enter self-heating mode when connected to a power supply. The lower the temperature, the greater the self-heating power. The self-heating power can reach a maximum of 40W. Therefore, make sure the external power source is appropriate, especially in a low- temperature environment.

Specifications

Model	HAP (TX)
Laser Wavelength	905 nm
Laser Safety①	Class 1 (IEC 60825-1:2014) (safe for eyes)
Detection Range (@100 klx)②	150 m @ 10% reflectivity
FOV	120° (horizonal)×25° (vertical)
Distance Random Error (1σ)③	< 2 cm @ 20 m (80% reflectivity)
Distance System Error	< ±3 cm @ 20 m
Angular Random Error (1σ)	< 0.1°
Beam Divergence	0.03° (horizonal)×0.28° (vertical)
Point Rate	452,000 points/s
Data Port	100BASE-TX Ethernet
Data Synchronization	gPTP
False Alarm Ratio (@100 klx)④	0.01%
Operation Temperatature Range	-40° to 85°C (-40° to 185°F)

Storage Temperature Range	-40° to 95°C (-40° to 203°F)
IP Rating	IP67
Power⑤	Rated power 12 W Starting power 26 W Low temperature heating power 40 W
Power Supply Voltage Range⑥	9-18 V DC For versions that support 9-32 V DC power supply voltage, please contact Livox or submit a request via www.livoxtech.com/contact.
Noise	< 45 dB(A) (40 cm omnidirectional)
Dimensions	105 × 131.6 × 65 mm
Weight	Approx. 1120 g
IMU	Not supported. For versions that support IMUs, please contact Livox or submit a request via www.livoxtech.com/contact.

1. The divergence of the embedded laser is approximately 25.2° (horizontal) × 8° (vertical), which was measured at full width at half maximum. The maximum power of the embedded laser may exceed 65 W. In order to avoid being injured by the laser, DO NOT disassemble HAP (TX).
2. HAP (TX) cannot precisely detect objects which are less than 0.5 m away.
3. Tested in an environment at a temperature of 25° C (77° F). The actual environment may differ from the testing environment. The figure listed is for reference only. The point cloud may distort to a varying extent when the target object is within the range of 0.5 to 2 m.
4. The false alarm ratio of the noise created by the stray light in a test environment of 100 klx at a temperature of 25° C (77° F).
5. In low-temperature environments, HAP (TX) will first enter self-heating mode, and its power may reach a maximum amount of 40 W. Make sure the power supply is suitable based on the peak power value of HAP (TX). Refer to the Livox HAP User Manual for more information.
6. Make sure the output voltage of the power supply is within this range at all times.

Documents / Resources

	LIVOX HAP High Performance LiDAR Sensor [pdf] User Guide HAP, High Performance LiDAR Sensor, HAP High Performance LiDAR Sensor, LiDAR Sensor, Sensor