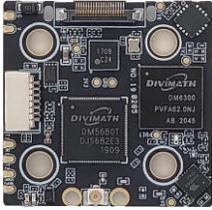# HDZero Video Transmitters

HDZero Race2

The HDZero VTX is a digital HD 720p 60fps 5.8GHz video transmitter. It is compatible with all HDZero based receivers (Shark Byte goggle module, Byte Frost monitor and ScoutHD).
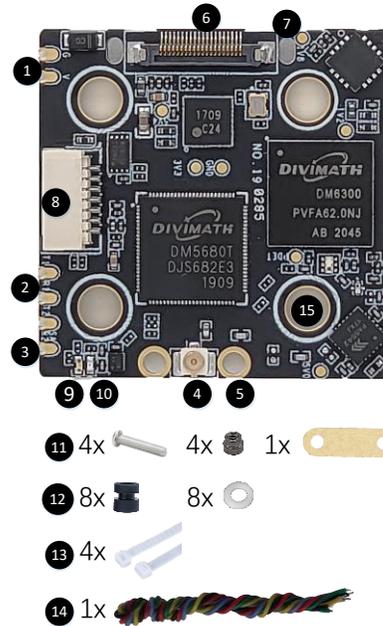
Features:

- 7-26V(2S-6s) power input
- Full support of Betaflight canvas mode (4.2.8 onwards)
- Fixed, ultra-low latency (near zero)

HDZero Race2 Video Transmitter

The HDZero Race VTX is a digital HD 720p 60fps video transmitter capable of delivering up to 200mw on 5.8GHz. It works with the Shark Byte RX5.1 goggle module to transmit video, and with a remote controller to wirelessly control the parameters for the transmitter and camera.

The power input range is 7V – 26V (2S – 6S). Though the Race VTX has integrated surge protection circuit, a large capacitor (350+uF) parallel with battery leads is **mandatory** to smooth the power supply of the whole quad.

1	Power In (G=Ground, V=7-26V)
2	T1/R1 UART Connection to FC
3	T2, Reserved, R2/SA, SA Pin
4	u.FL Antenna Connector
5	u.FL Antenna Retention Holes
6	MIPI connector
7	MIPI connector retention Holes
8	Firmware Update Connector
9	Power on LED (red)
10	Status LED (blue)
11	u.FL Antenna Retention Screws/Nut/Plate
12	Rubber Grommet (M4 to M3), 1mm O-Ring
13	Zip ties
14	Connecting wire
15	20x20 M4 mounting holes

Notes:
- SA Pin is needed to connect with FC only when you decide to let FC fully controls VTX's freq and outputting power. Read *Using SmartAudio* section to setup VTX table, and etc**. Note that VTX Menu is not available for this case.**
- If SA pin is not connected, VTX will use its own logic to control freq and outputting power. It has VTX Menu to setup these parameters.
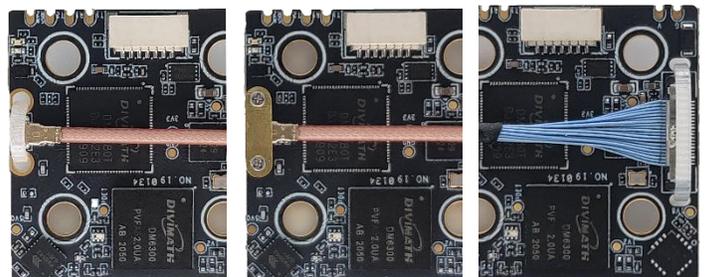
Mounting a u.FL antenna or pigtail
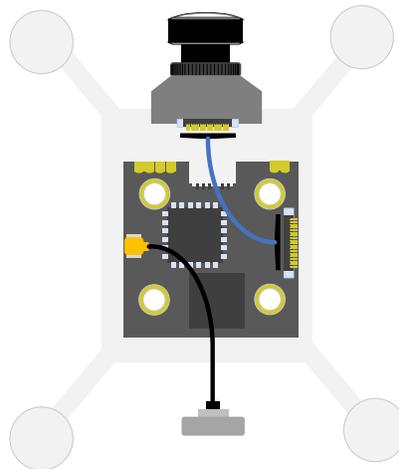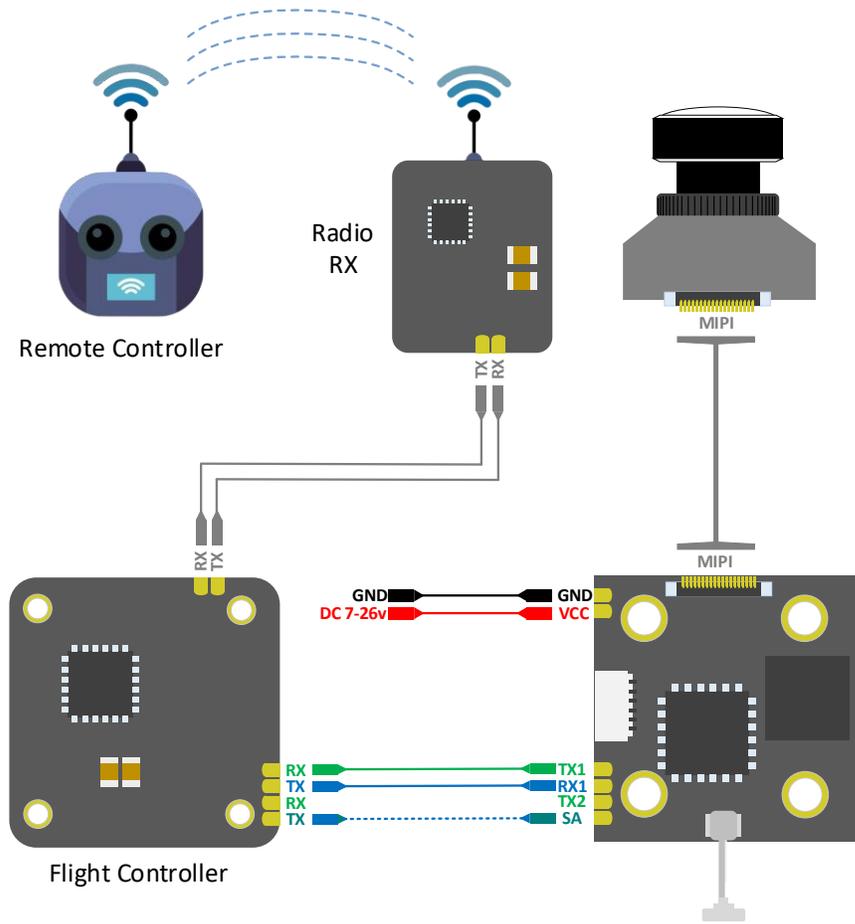There are 2 methods to mount the antenna on VTX:
- Use included retention screws, nuts and plate;
- Use included zip-ties.

Connecting MIPI cable
Use the included zip-tie to secure MIPI cable and protect MIPI connector.

Connection

Remote Controller

Radio RX

Flight Controller

MIPI

MIPI

GND — GND
DC 7-26v — VCC

RX — TX1
TX — RX1
RX — TX2
TX — SA

DIVIMATH

HDZERO™

OSD Setup

All HDZero VTXs supports MSP Canvas mode on Betaflight 4.2.8 or later. It needs a full UART with 115200 baud-rate for MSP communication. As an example: UART5 on picture below. **Note that a soft serial UART is not supported.**

(Before setting MSP UART check OSD tab and ensure PAL/NTSC selection is set to "Auto" for best results of OSD placement.)

To enable SmartAudio on Race VTX, connect the SA pin of Race VTX to an available UART.TX pin of FC and assign that port as peripheral "VTX(TBS SmartAudio)". As an example: UART3 on picture below. **Note that not all UART ports of FC support SmartAudio, check your FC user manual before making connection.**

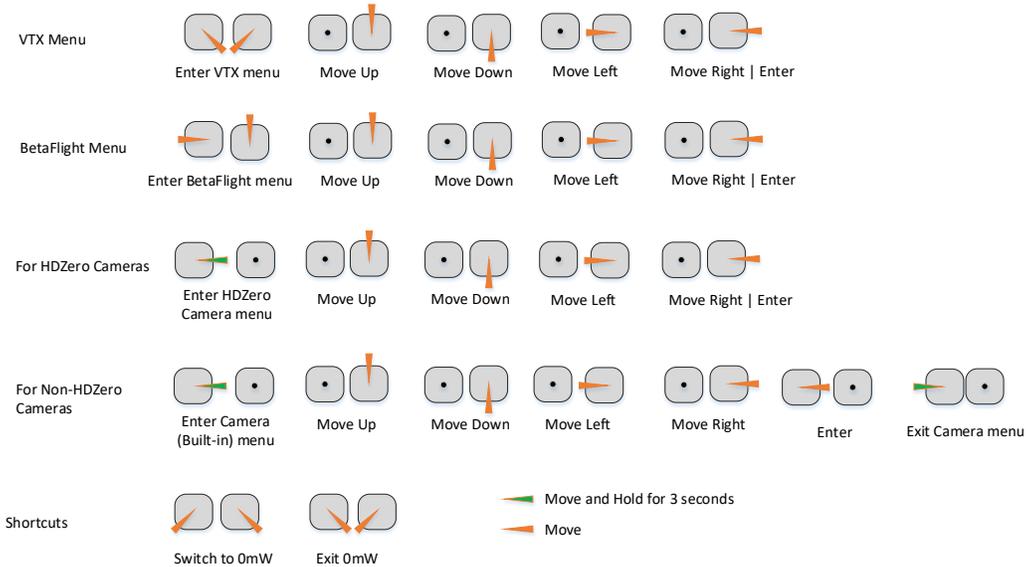It is mandatory to enter the following CLI commands to enable canvas mode on FC. Here is an example:

```
set osd_displayport_device = MSP
set displayport_msp_serial = 4
save
```

Please note that "set displayport_msp_serial = 4" specifies the serial port of 4 (UART '5' in above picture minus 1).

Stick Movement

VTX Menu	Enter VTX menu	Move Up	Move Down	Move Left	Move Right | Enter
BetaFlight Menu	Enter BetaFlight menu	Move Up	Move Down	Move Left	Move Right | Enter
For HDZero Cameras	Enter HDZero Camera menu	Move Up	Move Down	Move Left	Move Right | Enter
For Non-HDZero Cameras	Enter Camera (Built-in) menu	Move Up	Move Down	Move Left	Move Right / Enter / Exit Camera menu
Shortcuts	Switch to 0mW	Exit 0mW			Move and Hold for 3 seconds / Move

Using VTX Menu (SA PIN is not connected or disabled via the ports tab)

VTX menu will be available when
- No VTX.SA pin, or
- VTX.SA pin is *not* physically connected with FC, or
- VTX.SA pin is connected but the related UART port of FC is disabled.

All HDZero VTXs have the following settings for its RF power level management. These setting can be changed over VTX menu.

POWER: The desired RF power level is selectable between 25mW, 200mW (and 500mW for Freestyle Lite). The actual RF power level depends on the following settings and FC status.

PIT_MODE: The three modes of this setting are:
- **P1MW**: The output RF power will be 0.1mW (in order to not interfere with other pilots) in this mode. If the quad is armed, RF output power will be automatically set to the *POWER* within seconds.
- **0MW**: There will be zero RF output in this mode. If quad is armed, RF output power will be automatically set to *POWER* within seconds.
- **OFF**: The output RF power will be set to *POWER* setting.
  (Note that after first arm, the vtx will not enter pitmode again until vbat power is reset)

LP_MODE:
- **ON**: If *PIT_MODE* is OFF and the quad is disarmed, the RF power level will be forced to 25mW regardless of *POWER* setting. The output RF power will be set to *POWER* setting when quad is armed.
- **OFF**: The output RF power will be set to *POWER* setting.

OFFSET_25MW: It is for fine tune RF output power to be 25mW. The range is [-10:10], and step size is about 0.3dB per increasement.

> Notes:
> - HDZero VTX will still become hot even on P1mW mode. It is better to keep VTX on PIT 0mW mode when it will be idle for a while. Though the receiver will not have live video on this mode, it will come back as soon as the quad is armed.
> - Use sticks shortcut to enter 0mW, and to exit 0mW mode.

Using SmartAudio (Race VTX only)

HDZero Race VTX can be controlled by FC using the TBS SmartAudio V2.1. In such a case, VTX will output RF power and channel commanded by FC directly. To avoid conflict, VTX menu is not avaiable if SmartAudio is enabled.

> Notes:
> 1. HDZero Race VTX outputs 0.1mW when SmartAudio PIT mode is ON.
> 2. HDZero Race VTX does *not* support SmartAudio out range PIT mode.
> 3. When HDZero Race VTX boots up, it will automaticlly detect the existence of a valid SmartAudio link with FC within 10 seconds. If the link exists, FC will fully control race VTX's RF output power and working frequency.

VTX table needs to be set as below. Please note that HDZero Race VTX supports all 8 channels (R1 ~ R8) on R band, and 2 channels (F2 and F4) on F band.

Selected Mode

⬤	Enter frequency directly
RACEBAND ▾	Band
Channel 1 ▾	Channel
25 ▾	Power
⬤	Pit Mode
0 ⬍	Pit Mode frequency
Off ▾	Low Power Disarm

VTX Table

2 ⬍ Number of bands   8 ⬍ Number of channels by band   ❓

Name	Letter	Factory	1	2	3	4	5	6	7	8	
RACEBAND	R	🔵	5658	5695	5732	5769	5806	5843	5880	5917	Band 1
FATSHARK	F	🔵	0	5760	0	5800	0	0	0	0	Band 2

3 ⬍ Number of power levels   ❓

1	2	3	
1	2	3	Value
25	200	0	Label

The above setting can also be done with the following CLI commands:

```
vtxtable bands 2
vtxtable channels 8
vtxtable band 1 RACEBAND R FACTORY 5658 5695 5732 5769 5806 5843 5880 5917
vtxtable band 2 FATSHARK F FACTORY 0 5760 0 5800 0 0 0 0
vtxtable powerlevels 3
vtxtable powervalues 1 2 3
vtxtable powerlabels 25 200 0
save
```

With SmartAudio, user can change channel number and power level even when quad is on air.

Example 1: Map a 3-phase button (aux channel 3) to 3 different RF power levels (25mW, 200mW, and 0mW).

VTX	<index>	<aux_channel>	<vtx_band>	<vtx_channel>	<vtx_power>	<start_range>	<end_range>
vtx	0	2	0	0	1	900	1300
vtx	1	2	0	0	2	1300	1700
vtx	2	2	0	0	3	1700	2100
		(aux ch -1)		0 means no change			

```
vtx 0 2 0 0 1 900 1300
vtx 1 2 0 0 2 1300 1700
vtx 2 2 0 0 3 1700 2100
save
```

Example 2: Map a 3-phase button (aux channel 4) to Channel R1, R2 and F2.

VTX	<index>	<aux_channel>	<vtx_band>	<vtx_channel>	<vtx_power>	<start_range>	<end_range>
vtx	3	3	1	1	0	900	1300
vtx	4	3	1	2	0	1300	1700
vtx	5	3	2	2	0	1700	2100
					0=no change		

```
vtx 3 3 1 1 0 900 1300
vtx 4 3 1 2 0 1300 1700
vtx 5 3 2 2 0 1700 2100
save
```

3 different RF power levels are specified on the above table. #1 and #2 specify 25 mW and 200mW RF power respectively, and #3 is to turn off RF output completely.

HDZero Race VTX will become very hot if it is on bench without airflow even it is on 25mW or PIT mode. It is recommended to put VTX on 0mW while quad is waiting on the line.

When #3 is selected from SmartAudio menu by mistake, the receiver will lose video feed since VTX is not transmitting. Use stick command 🔲🔲 to exit 0mW mode.

HDZero Race2 VTX SPECIFICATIONS

Weight:
  6 grams
Dimensions:
  34mm x 34mm single board
Mounting Pattern:
  20mm x 20mm with M4 to M3 rubber grommets
Operating Frequencies:

CH	Freq (MHz)
R1	5658
R2	5695
R3	5732
R4	5769
R5	5806
R6	5843
R7	5880
R8	5917
F2	5760
F4	5800

Transmitting Power/Power Consumption:
  25mW: 5.0W
  200mW: 5.8W
IO Interface:
  u.FL
  UART 3.3V
  Update Port: 7-pin SH 1.0
Supported Flight Control System:
  BetaFlight: 4.2.8 or above
Input Voltage:
  7-26V
Operating temperature:
  32°-104°F (0°-40°C)

FAQ

1	What is HDZero?	HDZero is a wireless video transceiver technology developed and owned by Divmath. It has the following products: (1) Shark Byte TX5S.1 VTX (2) Shark Byte TX5M.1 VTX (3) Shark Byte TX5R.1 VTX (4) Shark Byte RX5.1 VRX (goggle module) (5) ScoutHD Goggle (6) ByteFrost (7) HDZero Race2 VTX
2	Where is the firmware and user manual?	https://www.hd-zero.com/document
3	Facebook Group and Discord Server?	www.facebook.com/groups/HDZero https://discord.gg/JPesSHpmCU
4	How is firmware organized?	VTX and VRX have to on the same reversion for working together. (1) RX5.1.ddmmyyyy.zip, the firmware for RX5.1, (2) TX5S.1.ddmmyyyy.zip, the firmware for TX5S.1, (3) TX5M.1.ddmmyyyy.zip, the firmware for TX5M.1, (4) TX5R.1.ddmmyyyy.zip, the firmware for TX5R.1 ScoutHD release is named as "ScoutHD_ddmmyyyy.zip". It does NOT contain firmware for any VTX. ByteFrost release is named as "ByteFrost_ddmmyyyy.zip", it contains firmware for ground station (monitor), but does not have firmware for AHD VTX.
5	How to Update Shark Byte Firmware?	(1) Download firmware from https://www.hd-zero.com/document (2) Please follow steps on Page 14 on Shark Byte User Manuel 08042021.pdf Note: Both VTX and VRX need to be updated with the same release. VTX will NOT work properly with VRX that is on firmware from different release
6	How to Update ScoutHD Firmware?	(1) Download the firmware from https://www.hd-zero.com/document (2) Unzip content of "ScoutHD_ddmmyyyy.zip onto root directory of a SD-card, insert the SD card into ScoutHD (3) Power on the ScoutHD, and wait for "Success" to be shown on screen.
7	How to Update Byte Frost (monitor) Firmware?	(1) Download the firmware from https://www.hd-zero.com/document (2) Unzip content of "ByteFrost_ddmmyyyy.zip onto root directory of a SD-card, insert the SD card into Byte Frost (3) Power on the Byte Frost receiver, and wait for "Success" to be shown on screen.
8	How to un-brick a RX5.1/ScoutHD/ByteFrost monitor	Follow steps on Page 14 on Shark Byte User Manual 08042021.pdf
9	Does VRX have low voltage alarm?	VRX does not have low voltage alarm. We recommend using an in-line battery alarm (not included) between the battery and DC cable
10	How does VRX power cable work?	DC cable has integrated DC regulator which converts from 3S-6S to fixed 7.8V output. (Manual says 3S-4S) It is very important to unplug DC cable from battery after flight. Otherwise, DC cable will suck up battery power and cause permanent damage to battery.
11	Can VTX be powered by 6S?	Yes, all VTXs can be powered by 2S-6S except the following: - first batch of TX5M.1 that does not have a black tin box on the corner

		- first batch of TX5S.1 that has serial number starting with "0B" It is mandatory to put a big capacitor (220+ uF 50V) in parallel to battery leads to smooth the power supply of the whole quad when VTX is directly powered by battery. No need for such a cap when powered by 2S-3S. But adding a cap is never a bad idea though. It is strongly suggested to use BEC output to power VTX. The BEC has clean voltage than directly powered from battery

Trouble Shooting

1	Video feed is working but no OSD	(a) VTX/VRX Firmware mismatch: Update both VTX and VRX from the same firmware release.
		(b) Wire connection: TX and RX of FC board should be connected with RX and TX pads of VTX respectively.
		(c) Betaflight setting: Instruction on Page 10/11 on Shark Byte User Manuel 08042021.pdf
		 - Betaflight 4.2.8 or above
		 - CLI commands
		   set osd_displayport_device = MSP
		   set displayport_msp_serial = n-1//n= serial port number minus 1
		   save
		   get displayport_msp_serial //to verify the value previously set
		(d) Try another UART port of FC (avoid to use soft-serial and SA ports)

2	No Blue LED on VTX	From Firmware Rev30092021, Blue LED works as the following way:
		(1) Flashing at 1Hz periodically if *no* camera is found after VTX is powered up
		(2) Flashing 8 times if MSP connection is established with FC after VTX is powered up
		(3) Remains OFF for HDZero Micro Camera(Beta), ON for all other cameras.
		
		If a Non beta HDZero Micro camera is attached, and get NO blue LED, please
		(a) Check if MIPI cable is secured on both end of camera and VTX, and check if cable itself is fine
		(b) Carefully check VTX MIPI connector if there is any bent pin
		(c) If it is Foxeer Digisight Camera, make sure it is NOT on analog mode
		   - Digisight goes to analog when pressing left for 3 sec
		   - Use stick commands blindly or disconnect mipi and use external joystick.
		   - Joystick does not work in digital mode. Must use stick commands (Thr mid, yaw right) to enter cam menu (BF OSD disappears)
		(d) If it is Micro HDZero camera, it needs firmware that is released after June 23 2021

3	Snow noise even in short distance	(a) Add a big capacitor (350+ uF 50V) in parallel to battery leads to smooth the power supply of the whole quad

		(b) Move Radio RX and its antenna away from VTX
		(c) Do not place VTX next to ESC board
		(d) Try another pigtail (if there is)
		(e) Try another antenna
		(f) Ensure U.FL connector of VTX has at least 7mm vertical clearance
		(g) Check if there is other VTX (analog, DJI, HDZero) working on current channel
		(h) Check if there is WIFI interference
4	Recording files are zero byte length	There are two recording file format: TS and MOV format On TS format, VRX ensures video will be recorded until last second before VRX is powered off. On MOV format, VRX will not have enough time to close the recorded file if VRX is powered off. Therefore, it is important to manually close the file by switching to setting mode (Long press Left key) or switching channel (press Right key) before powered down VRX

5	SD card not working	(a) An 8G-32G SD card Recommended
		 (b) Format SD card before using:
		    - Use VRX to format SD card
		    - Use Windows to format (Choose FAT32 and Allocation Unit size to 4096 bytes)

6	No Red LED	(a) Make sure input voltage is 7V-26V (b) The VTX consumes about 5W, make sure power source has enough max current
7	Why is chan/band/power displayed as ?.?.?	When you are not using Smart Audio some information is no longer passed through to the MSP port by Betaflight. In this instance you need to select an unused UART and enable in the peripherals VTX(TBS SmartAudio) Next set up the VTX table as per setting up Smart Audio section