
TBS FUSION receiver module

Revision 2021-10-14

Real-time image processing analog receiver module



A FUSION of the best: The image processing developed by BrainFPV, the OSD and UI by Achilles, and the hardware engineered and manufactured by TBS. When the brightest minds of the FPV industry work together, being the best at merging two analog video streams was simply not good enough!

Through active video FUSION, the displayed video instantly has less breakup and more range, without color-deterioration or video desync often experienced at the edge of reception. A state-of-the-art OSD engine drives cutting-edge interactivity while reducing the need for onboard OSD. The TBS FUSION both raises the bar at reception quality and paves the way for system-wide integration with TBS Crossfire and other devices.

Key features

- Compatible Fatshark Dominator V1, V2, V3, HD1, HD2, HD3, HDO 1/2, Orqa, and many more
- External Power Kit: Included. Required for older goggles that can't deliver enough power, or for connectivity
- RF Sensitivity: -96dBm
- Power: 5V @ 340mA, 500mAh with connectivity enabled
- Collaboration with: BrainFPV (video fusion), AchillesFPV (UI), TBS (hardware)
- Crossfire and TBS CLOUD connectivity
- Real-time telemetry based OSD



TEAM BLACKSHEEP
SERIOUS TOYS



TBS FUSION
enhanced video module

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Specifications

	TBS FUSION module
Input Power:	5-9v (2s LiPo)
Extras:	WiFi for TBS CLOUD connectivity OSD Real-time picture processing
Features	Matrix Modus, Auto search, Race mode CRSF menu, Find mode, Laptimer, OSD
Channels:	Band A/ B/ E Fatshark Race Band Low Race Band
Audio:	Passthrough to your goggles
Power consumption:	WiFi off: 5V: 380 mA, 8.4V: 270 mA WiFi on: 5V: 440 mA, 8.4V: 320 mA
Antenna connectors:	Micro USB, 2x SMA antenna connector
Connector:	Pins: 2,5mm pin header, 9 Pins
Weight:	30,5g
WiFi:	IEEE 802.11 b/g/n (2.4 GHz)
OLED:	64x128 Oled (blue)
Kit contents:	1x TBS FUSION, 1x power mod board, 2x ribbon cable, 1x 90° SMA adapter



Getting ready

Getting set up and ready to fly is a quick and simple task. In most cases plug&play when using TBS equipment.

FAQ

If you got any questions after reading this manual you should visit the [TBS FAQ](#) section

Note

This manual is written based on FUSION *FW 2.16* and WiFi *FW 2.03*. If some functions are not available for you, please update your FUSION and WiFi modules.

Some features include a connection to the TBS R/C systems. Make sure their firmware is up to date:
Crossfire 4.11 or *Tracer 5.07*

Updating

To update and configure your FUSION module, you need the TBS Agent X, which you can download from the [TBS shop](#).

To update the module, connect it by the USB port and run the update by Agent X.

For detailed instructions on how to use Agent X, have a look at the [Agent X manual](#).

Overview



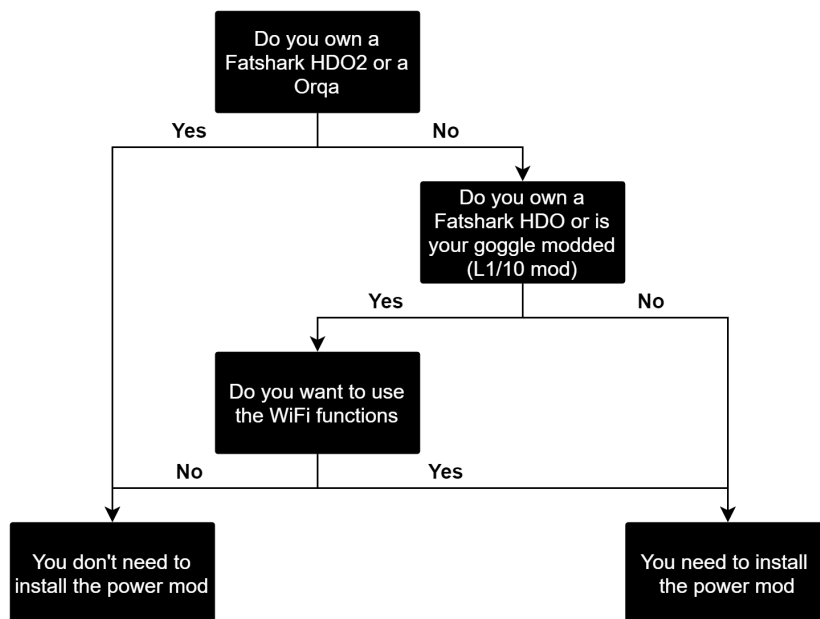
Mode switch on Fatshark goggles

On the bottom of your Fatshark goggles, you got a small switch to select the module bay or an external source. When you switch to the external source, your FUSION module will turn off unlike other modules on the market.

Power Mod

With your FUSION module, you got a small PCB and two ribbon cables. This is the power mod that you might need to install into your goggles.

Do I need it



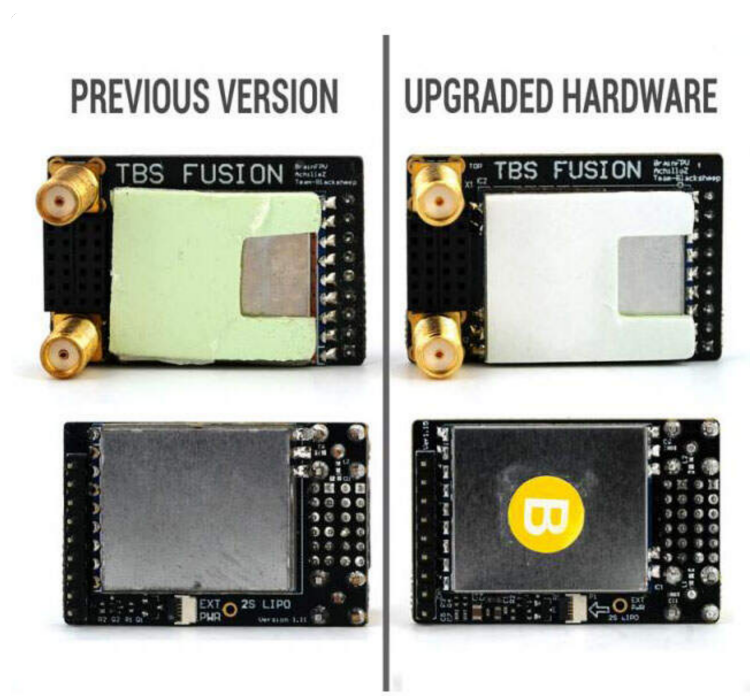
How to install the mod

There are different methods to provide battery voltage to your FUSION module. This can be done by the included power mod PCB and the ribbon cable as well as by just a single wire on the soldering spots on the PCB. [Here](#) you can see the installation process as a video.

On some goggles, this can create heat on the main PCB of your goggles. In this case, just connect a wire straight to the barrel connector of your goggles and the solder spot on the FUSION.

Upgrade receiver modules

If you bought your FUSION module before April 2020 you got the first receiver modules which got replaced by a newer revision with higher sensitivity. If you are not sure which one you got, you can check out the back of the module:



To upgrade you just replace the receiver module. *After the upgrade, you need to run the [calibration](#).*

Antenna selection

Due to the advanced image processing, the FUSION does not need two identical antennas to work properly. The most common setup is an Omni-directional antenna like the [Triumph Pro](#) on the top connector and a patch like the [TBS Patch](#) on the bottom connector.

Make sure to use SMA antennas!

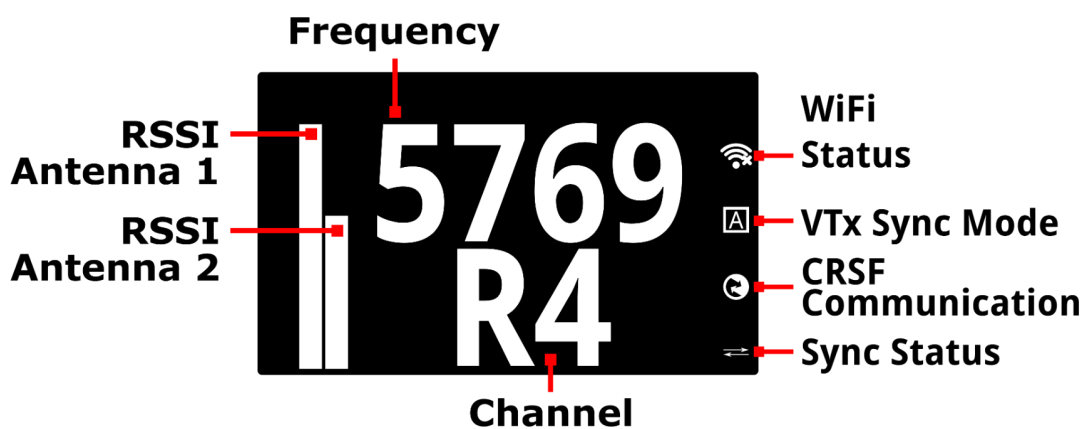
General functions

Main Screen

The startup mode of the FUSION when you power it up. You can switch channels and bands easily with the joystick. **Up/Down** to change the band, **Left/Right** to change the channel.

When the OSD Status shows locked, you can not change the channel or band. To unlock it, just push the joystick in any direction and wait for 2 seconds. Then the symbol will switch to open. A few seconds after you changed the channel/ band the FUSION will be locked again.

OLED

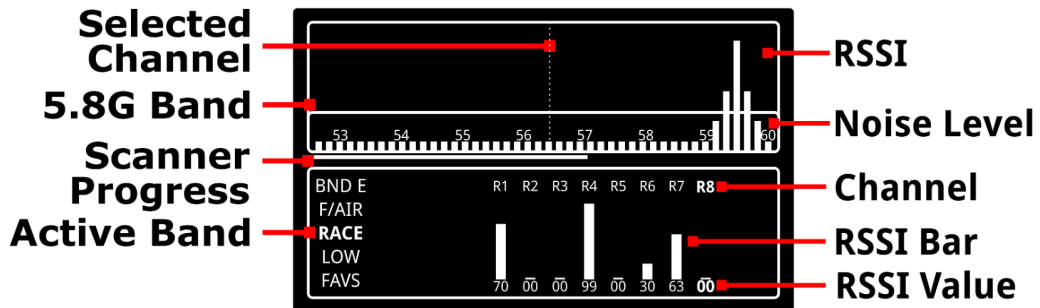


- **Frequency:** Frequency of the selected channel
- **RSSI:** Signal strength for each antenna
- **Sync Status:** Sny when a SA or CRSF VTX is connected to the CROSSFIRE/ TRACER RX and the channel of the VTX and FUSION match (SYNC/ NO SYNC)
- **WiFi Status:** CLOUD connection status - connected(no cross)/ not connected (with cross)
- **VTX Sync Mode:** Shows the sync type selected (**Auto/ Lead/ Follow**)
- **Sync Status:** Status of the communication between FUSION and CROSSFIRE/ TRACER

WiFi and VTX Follow symbols are not shown when these options are deactivated

When you change the band or the channel with **UP/ DOWN** or **LEFT/ RIGHT** a “mini band scanner” instantly show you the best channel, with **ENTER** the FUSION will switch the channel:

OSD



- **Selected Channel:** Position of the selected channel on the 5.8GHz band
- **5.8G Band:** Complete 5.8GHz band
- **Scanner Progress:** Band scanning status
- **Active Band:** Selected band
- **RSSI:** Signal strength of any received signal
- **Noise Level:** Weak signals, mostly noise from the VTX's
- **Channel:** Selected Channel
- **RSSI Bar:** Signal strength for each channel, as bar
- **RSSI Value:** Signal strength for each channel, as value (0-99)



Startup channel

On startup, the FUSION will tune in to a certain channel.

Permanent Startup:

If you want your FUSION to always start with the same channel, Set this channel as a [Favorite](#), navigate to the X band, **push** and hold the joystick for a moment until the menu shows up, and select *Permanent Startup*.



In case you no longer want it to start with a fixed channel, just delete it from the X band.

Last used Channel:

When no permanent startup channel is selected, the FUSION will start with the last used channel



Favorites

Up to 8 channels can be set as a Favorite. For this, select a channel from any band in the *Matrix* menu, **push** and hold the joystick for a moment till the menu shows up and select *Save 5860*.



The channels will be sorted in the order they have been set as favorites. Those channels can be found as *X* band.

If you want to change the order, this can be done by the *TBS Agent X/ L/ M* or the FUSION CRSF menu.

Deleting: If you want to erase a channel from the favorites, select this channel in the *X* band, **push** and hold the joystick for a moment till the menu shows up, and select *Delete* or *Delete all* to remove all of them at once.



A user frequency can also be set as a favorite like any other channel.

Fatshark button control

The channel select button on your Fatshark goggles (or other goggles working the same way) will be used to switch through the favorite band.

If you are in any other band and hit the channel button on your goggles, the FUSION will jump to the favorite band and the favorite selected by the channel button.

User frequency



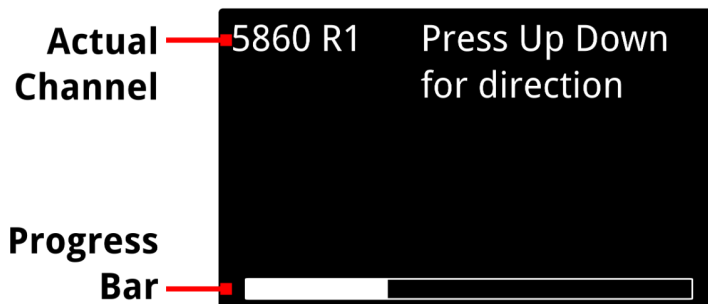
In the Main overview, you can switch from the standard band selection to a manually selected frequency. To do so, select any channel in the *Main* menu and hold down the joystick for about 2 sec till the sub-menu shows up. In their select *Custom Freq.* Now you can set the frequency with *Up* and *Down*. If The selected frequency does not match with any of the standard bands, it will show *US XXX*. When you leave the channel, your User Frequency is gone. If you want to use it more than once, add it as a *Favorite*.

A user frequency can also be set as a [favorite](#) like any other channel.

Autolock

Let the FUSION search for a strong signal. **Up/Down** to search for the next signal. When a strong signal is found, the FUSION will tune in to this channel and return to the live feed.

OLED + OSD



- **Actual Channel:** the channel the FUSION is scanning right now
- **Progress Bar:** Scan status over the entire 5.8 band

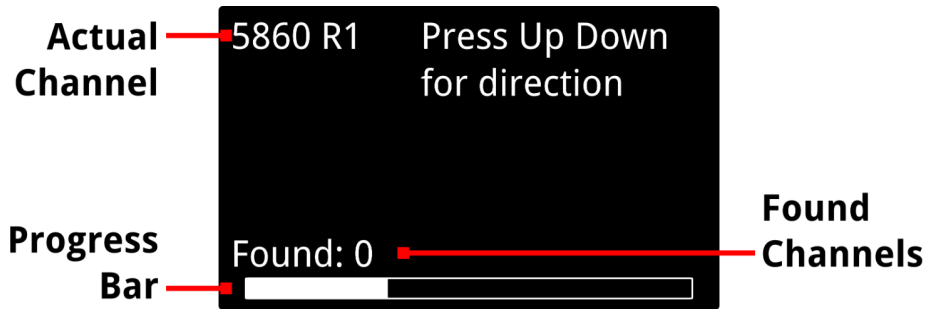


Multilock

The FUSION searches for up to 8 channels. Those channels are listed in the OSD on the left side and you can navigate through them with **UP/ DOWN**. This feature comes in handy when you are on a race with up to 8 active pilots and want to watch their video feed.

OLED

During the scan:



- **Active Channel:** The channel the FUSION is scanning right now
- **Progress Bar:** Scan status
- **Found Channels:** Number of channels that are found

After the scan:



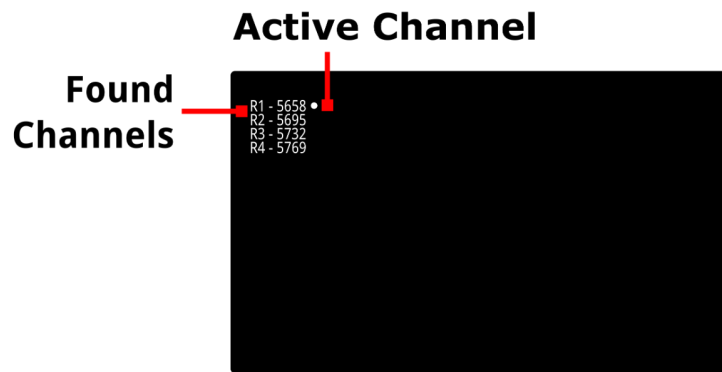
- **Active Channel:** The channel you are viewing right now
- **Found Channels:** List of the found channels during the scanning
- **Empty Slots:** when less than 8 channels are found, the remaining slots will stay empty



OSD

During the scanning, the OSD shows the same as the OLED.

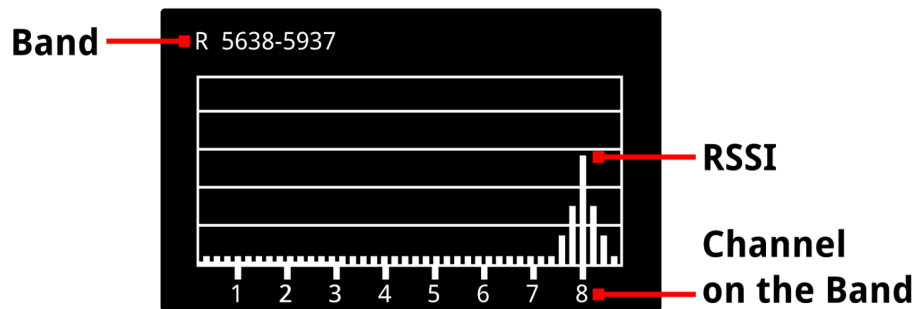
After the scan:



Spectrum analyzer

With the spectrum analyzer, you can check the entire 5.8GHz band for signals. This will only affect the markers on the frequency line so you can see where the signal is located on your band.

OLED

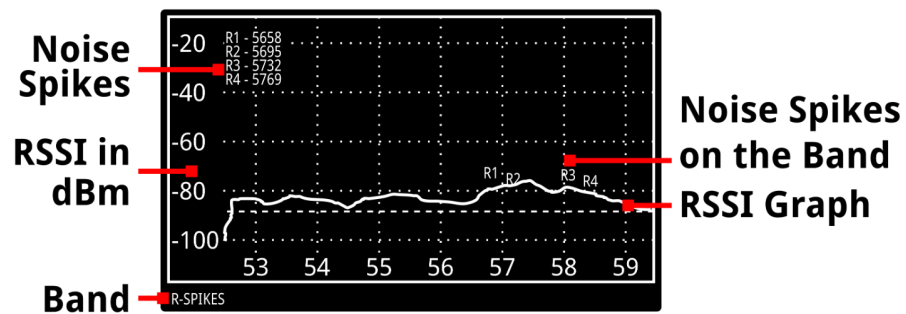


- **Band:** The band that's scanned
- **RSSI:** Signal strength on the entire band
- **Channel on the Band:** shows the position of the channels on the 5.8GHz spectrum

You can switch the band by clicking **UP/ DOWN**

OSD

In the OSD you get a detailed scan of the entire band including the average noise floor.



- **Noise Spikes:** Channels with up to 30% RSSI. Shown in the top left as list as well as on the graph
- **RSSI in dBm:** RSSI Scale. The lower the number, the weaker the signal
- **Band:** The band which is scanned for noise spikes
- **RSSI Graph:** RSSI scan result over the spectrum

UP/ DOWN got no effect on the OSD. **Right-click** will change the band which is scanned for noise.

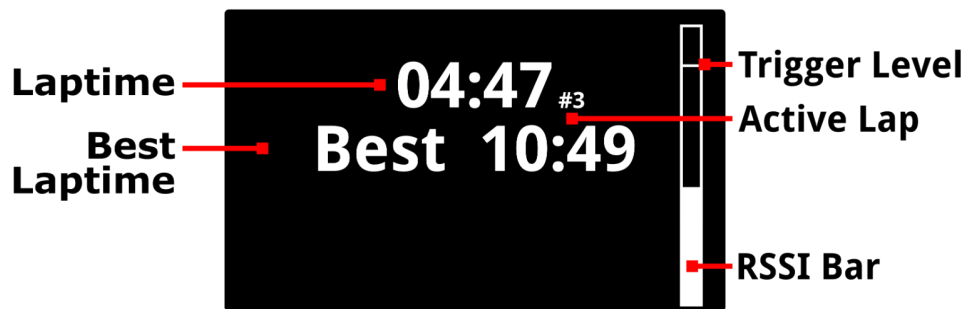
Laptimer

If you want to count your lap times on a racetrack, you can do it by using your FUSION module. To increase a setting, **push** or **hold** the joystick.

- **Laps:** Amount of laps you want to race (1 - 30)
- **Time:** Maximum time till a lap will be counted as finished (10 - 50s)
- **RSSI:** RSSI level of the lower Antenna when the "start gate" is reached (50-95% in 5% steps)
- **Tune:** Fine-tune the threshold of the RSSI trigger (5-50)
- **Start:** Starts a 10s count down after which the timer begins to run
- **Score:** Shows the result of your last race. Push the joystick to the right to toggle to the next 10 rounds

OLED

During the race:



After the race:

The screenshot shows a black OLED display with white text. The title "Results" is at the top. Below it, a table lists lap numbers and times. On the left, the text "Lap Number" has a red arrow pointing to the first column. On the right, the text "Laptime" has a red arrow pointing to the second column.

Results	
1. 10:45	6. 10:45
2. 09:23	7. 10:45
3. 07:45	8. 10:45
4. 11:67	9. 10:45
5. 10:55	10. 10:45



OSD

During the race:

The OSD during the race displays the following information:

- Race Time**: 15:53
- Countdown**: 3
- Laptimer/Active Lap**: 04:47/3

After the race:

The OSD after the race displays the following information:

Laps Result	
1	10:45
2	9:23
3	x- 7:45 -x
4	11:67
5	00:00
6	00:00
7	00:00
8	00:00
9	00:00
10	00:00

Additional OSD elements:

- Fastest Laptimer**: 7:45
- Lap Number**: 7
- Laptime**: 00:00
- Further Results**: Page 1/1



Quad find

If you crashed your drone and have no idea where it's now, you can use the Quad Find feature.

It works best with a high gain antenna or no antennas at all. Move your FUSION around like radar and check for the RSSI bar and the sound from the beeper to find the direction of your grounded drone.

To start the Find mode, select the channel you want to search. Now you can open the menu and select *Quad Find* or push and hold the joystick and select *Quad Find* in the submenu



The Quad Find mode uses the lower antenna port.



Settings

Sound

Enables or disables the beeper when you navigate in the menu or the Quad Find mode.

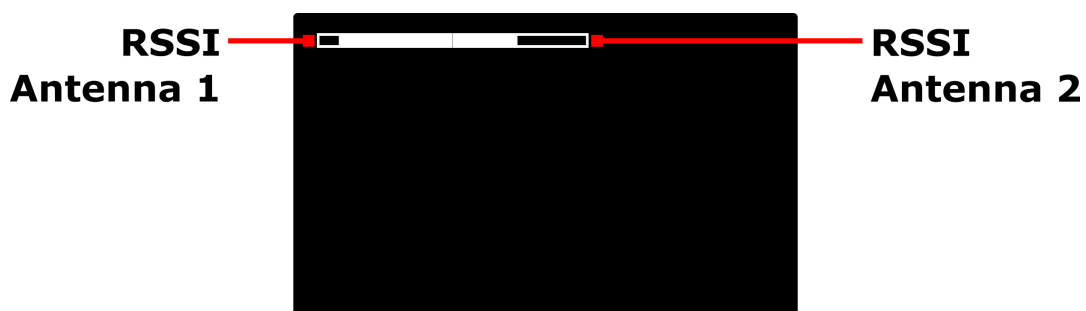
OSD Settings

Mirror Menu to OSD

Show the menu in the OSD or not. This does not affect the other OSD elements.

RSSI Bars

Enable/ disable the RSSI bar in your OSD and change the position by the presets.

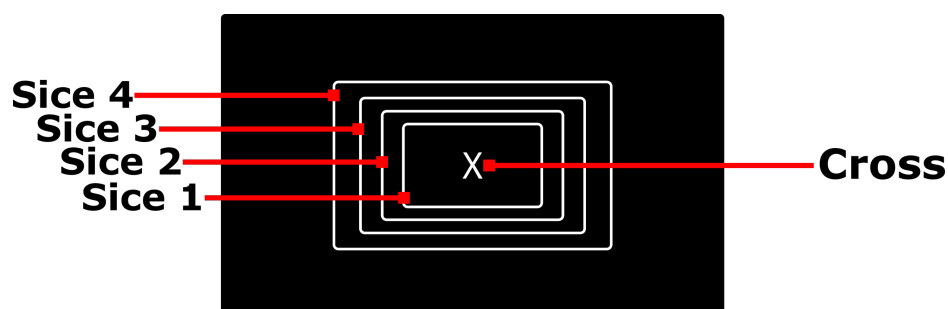


CRSF Telemetry

If you enable OSD Telemetry you get telemetry-based OSD elements. Perfect if you use an FC without OSD or models without any FC at all. Details on the setup and the elements can be found in [this section](#).

Focus Target

Shows a rectangle or a cross in different sizes in the middle of your OSD. This comes in handy when you try to follow a car or on a wing race.



Invert L/R Button

Changes which direction is left and right. Makes the navigation by OSD or OLED intuitive.



CRSF

The CRSF Menu gives you the same functionality as the Agent M/ L/ X

FUSION

Let you change the main settings of the FUSION module

WiFi

Shows the available WiFi settings like password protection, lets you connect your FUSION to a hotspot, etc.

The WiFi module will not show up when it's disabled in *Settings/ WiFi*.

More information on the available settings can be found in the [TBS CLOUD](#) section.

Other devices

When you have set up the connection between your FUSION and the TBS CROSSFIRE/ TRACER TX by a direct connection or via CLOUD, every device is connected to the CROSSFIRE/ TRACER RX will show up here. This includes the CROSSFIRE/ TRACER TX, WiFi, CROSSFIRE/ TRACER RX, any Unify32/ EVO VTX connected by CRSF, FCs like Kiss that are connected by CRSF, and upcoming devices.

FUSION

Here you can select if you want to use the advanced image processing of the TBS FUSION module or just use it as a diversity module.

We suggest using the FUSION mode all the time unless you experience issues with your video. Then you can try switching to diversity mode.

WiFi

Turn the WiFi module *on* or *off*. If you don't want to use the WiFi features, you can turn it off.

VTX Sync

When you change the channel on your drone or your FUSION module, this feature allows you to sync both devices thru your Crossfire. There are three settings available:

- **Lead:** the VTX follows the channel it gets from the FUSION. In the matrix menu, press and hold the joystick for a few seconds till the submenu opens and select *Send to VTX*
- **Follow:** When you change the channel on your VTX the FUSION will follow this change. This only works when the Crossfire gets the information about the new channel like when you change it through an LUA script or by the Crossfire slots/ VideoTX menu
- **Lead Auto:** Same as VTX Lead but the new channel will be sent as soon as you changed it on the FUSION



Details on how to set it up can be found [here](#).

Dynamic VTX

With this feature, your FUSION changes the power level of your VTX according to the RSSI. It works like the CROSSFIRE/ TRACER dynamic power feature. Details about the wiring and setup can be found at [Dynamic VTX power setup](#).

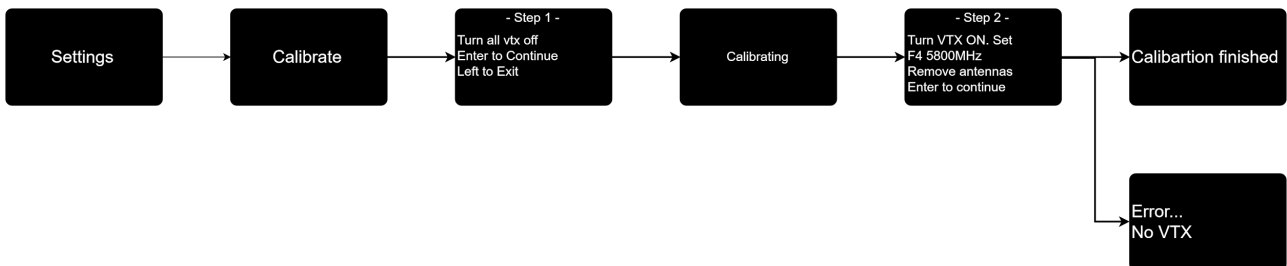
Mute VRX

Disables the audio forwarding to your goggles.

Calibrate

When you get a new receiver module or notice a bigger difference between the antennas while they have the same antennas on them you should calibrate the FUSION module.

Make sure you got *no antennas attached* on the FUSION and the VTX is set to *25mW, 5800MHz*



About

Shows the software version as well as the hardware revision and serial number from the module:

- **Firmware:** Version number of the WiFi firmware
- **Hardware:** Hardware revision of the WiFi module
- **Bootloader:** Version number of the Bootloader
- **Serial Number:** Serial number of the WiFi module



Additional information

TBS CLOUD

All TBS Tracer transmitters and the FUSION video receivers include a built-in WiFi module that allows you to connect all your gear through the TBS CLOUD. This allows using of features like VTX follow*, dynamic VTX power*, and other upcoming features.

Note: at the moment all the CLOUD features require a hotspot with internet access.

**[TBS FUSION](#) video receiver required*

Menu

- **WiFi Client**
 - **AP Mode:** enables/ disables the WiFi module
 - **Default SSID:** enables/ disables the SSID broadcast of FUSION hotspot
 - **SSID:** SSID/ name of the selected external hotspot
 - **Password:** password for the selected hotspot
 - **Connect:** manually connect to the network. Only necessary when a new network is chosen in the *SSID* option
 - **Scan:** scans for WiFi networks. Found networks can be chosen under *SSID*, manually reconnect by *Connect* is required
 - **Forget WiFi:** erases all saved networks and their passwords
 - **Upgrade:** starts the self-update for the WiFi firmware. **Disabled at the moment**
- **WebUI**
 - **AP Lock:** enables/ disables password authentication for FUSION internal WiFi hotspot
 - **Password:** set up a password for FUSION internal WiFi hotspot
 - **Login:** enables/ disables password authentication for FUSION internal Web Ui
 - **Password:** set up a password for FUSION internal Web Ui
- **About**
 - **WiFi:** name of the WiFi hotspot/ Network your FUSION is connected to
 - **IP:** IP address the FUSION module was assigned by WiFi network
 - **Server:** connection status
 - **Firmware:** version number of the WiFi firmware
 - **Hardware:** hardware revision of the WiFi module
 - **Bootloader:** version number of the WiFi Bootloader firmware
 - **Serial Number:** serial number of the WiFi module



Update the WiFi module

- Download and unpack the firmware files for the WiFi module from [TBS](#)
- Power up your FUSION and make sure the WiFi is enabled (Settings -> WiFi)
- On your PC or phone search for a new WiFi network like "TBS_FUSION_AP_XXXXXX"
- Connect your pc with this network. On Windows machines, this can take up to one minute
- Open your browser and enter IP in the address bar: 192.168.4.1
- Click on *Select file* and search for the unpacked firmware files you downloaded before



- Hit *Update* and wait for the website to reload
 - **Do not shut down your Module during the WiFi module updating process**

[Here](#) you can find the whole process as video

Connection to a WiFi hotspot

Once your WiFi module is initiated, you can now connect to an external hotspot. The easiest way is to connect it by the **Web-UI**:

- Connect the FUSION to your goggles or by USB power it up
- On your PC or phone search for a new WiFi network like "TBS_FUSION_AP_XXXXXX"
- Connect your pc/ phone with this network. On Windows machines, this can take up to one minute
- Open your browser and enter IP in the address bar: 192.168.4.1
- Open the *WiFi* tab
- Click on Scan to search for available WiFi hotspot/ networks
- Click on the name of the found network you want to connect to - the name will be entered for you
- Enter your password and hit Connect/ Disconnect
- When you refresh the WebUI page after a few seconds, you will see the IP address assigned by the WiFi network for tracer TX

Note: if WiFi hotspot/ network has no internet connection, CLOUD-based features will not work.

Agent X menu works as well:

- Power up your FUSION and connect it by USB to your Agent X
- Navigate in the FUSION menu to *WiFi/ General*
- Hit *Scan* to search for available networks
- Under *SSID* you can select the found network
- Enter a password for the selected WiFi hotspot/ network in *Password* option
- Select *Connect* to start the manual connection to the selected WiFi hotspot/ network
- Done

Direct CROSSFIRE/ TRACER connection

You can connect your FUSION module directly to the WiFi access point of your TBS CROSSFIRE/ TRACER. This short connection unlocks the needed speed to get features like Dynamic VTX power or the real-time telemetry-based OSD running smoothly. Details for these features can be found in the following chapters

Connecting your FUSION to the CROSSFIRE/ TRACER is an easy job:

- Power up your CROSSFIRE/ TRACER with a radio
- Power up your FUSION module
- Make sure the WiFi of the CROSSFIRE/ TRACER and the FUSION is turned on
- Navigate in your FUSION to *Settings/ CRSF/ FUSION WiFi/ General*
- Search for networks and then select the CROSSFIRE/ TRACER WiFi module
 - No password is needed unless you enabled one in the CROSSFIRE/ TRACER WiFi module
- Hit *Connect* and wait for the message to disappear

When you power up your devices, the FUSION OSD and OLED will show no VTX-related data as they need to sync up at the beginning. This can take up to 30s.



VTX sync setup (Follow/ Lead/ Auto)

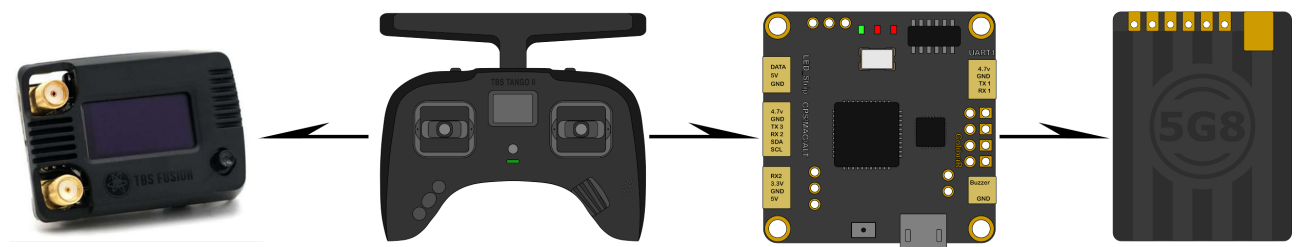
VTX sync allows you to sync the channel of the FUSION and your video transmitter over the Crossfire. To get it up and running, connect your FUSION to the Crossfire TX WiFi AP. Depending on the sync type there are different options for the wiring available.

Note: if your VTX is connected by CRSF to the CROSSFIRE/ TRACER RX it can take up to 20 seconds for the new channel to be sent to the VTX

Follow

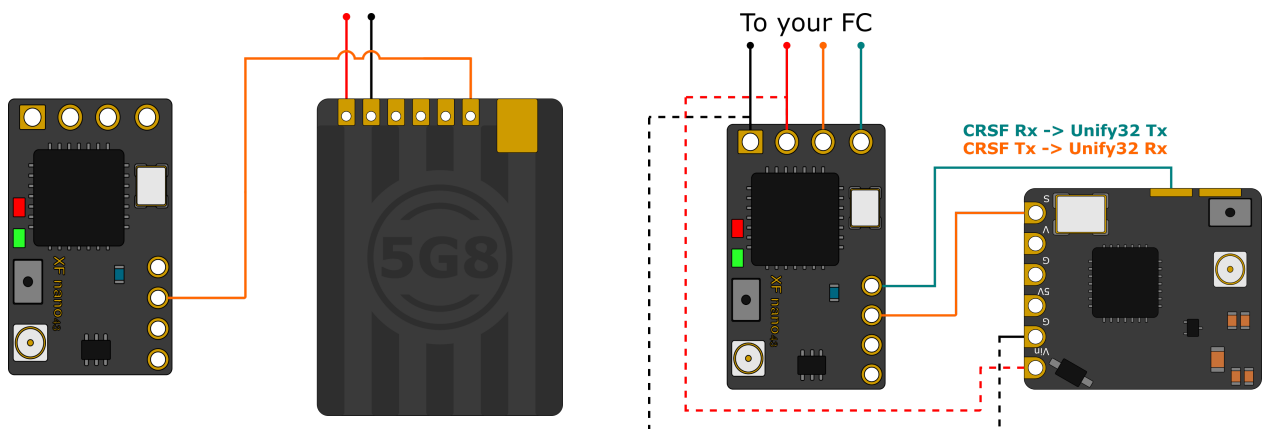
With *Follow* the FUSION will follow the VTX change. You can connect your VTX straight to the CROSSFIRE/ TRACER by CRSF or SmartAudio or with an FC in between when you use an LUA script on the remote. If you own a Unify Evo which is connected by CRSF to the CROSSFIRE/ TRACER transmitter you can change the channel by the build-in OSD menu and the FUSION will follow it as well.

Change the VTx Channel by the CRSF Lua



Lead and Lead Auto

Lead works when a VTX is connected straight to the CROSSFIRE/ TRACER receiver by CRSF or SmartAudio. When you change the channel on your FUSION module, auto lead will send the channel instantly to the VTX. With Lead, you need to ENTER and select *Send to VTX in the matrix menu*.



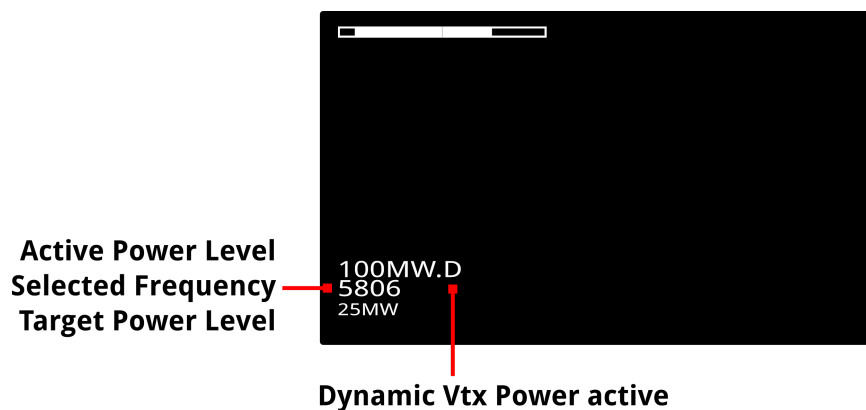
Dynamic VTX power setup

The setup for Dynamic VTX power is the same as for VTX follow. Connect your FUSION to the AP of the CROSSFIRE/ TRACER TX and enable Dynamic VTX. Your VTX needs to be connected to the CROSSFIRE/ TRACER RX by CSRF or SmartAudio.

The Unify32/ Evo must be on FW 1.16 for this to work.

Note: for this feature to work properly you should use the WiFi direct connection to the CROSSFIRE/ TRACER.

The OSD and the OLED show the actual power level and the one the FUSION is sending to the VTX. When the link between the CROSSFIRE/ TRACER and the FUSION is running, you will see the VTX Power in your OSD:

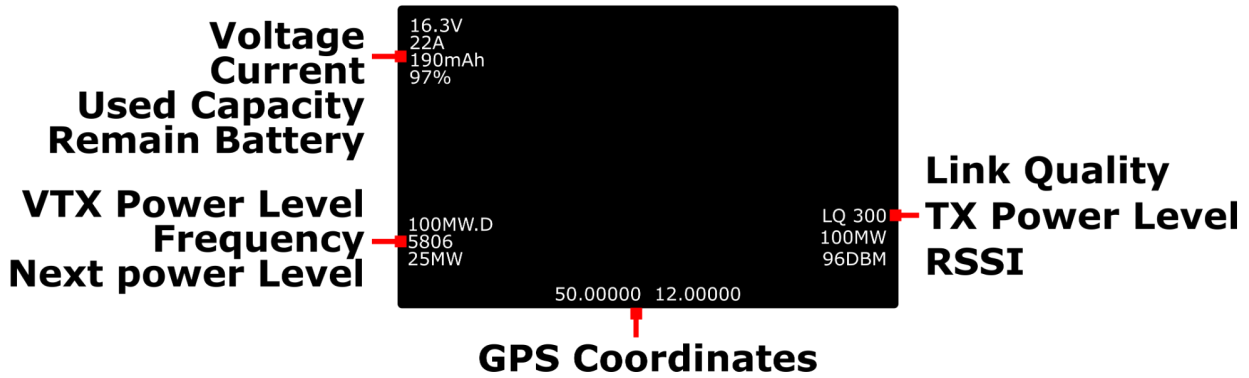


If the link between the CROSSFIRE/ TRACER and the FUSION or the telemetry should break up, the VTX will use the max. Possible power level as a safety feature.

The power level will change to the max power first and then slowly ramp down to make sure your signal will not break up.

OSD with real-time telemetry data

The FUSION can show you real-time- telemetry-based data of your drone in the OSD. You need to be connected to the CROSSFIRE/ TRACER over WiFi (direct connection or by CLOUD) and need a source for the Voltage information like an FC or a Unify Evo, Core Pro, or the in-built voltage sensor of the CROSSFIRE/ TRACER receiver. Once the connection is established and running, you will see the data in your OSD:



Note: for this feature to work properly you should use the WiFi direct connection to the CROSSFIRE/ TRACER.

As a safety feature, the FUSION requires you to be on the same frequency as the VTX. To ensure this, *VTX Auto* mode should be active while the VTX is connected to the CROSSFIRE/ TRACER RX by CRSF or SmartAudio. Otherwise, the OSD will not show the telemetry data.

If you use a VTX that is not connected to the CROSSFIRE/ TRACER RX the OSD will show up (except for GPS data).

FAQ

- I got weird numbers in my OSD



- Those numbers are used for debugging. You can disable them in the Menu und *FUSION menu/ Settings/ CRSF/ FUSION Module/ Diagnostic: off*

Manual written and designed by Kamikatz-fpv.de in cooperation with TBS



TEAM BLACKSHEEP
SERIOUS TOYS



TBS FUSION
enhanced video module