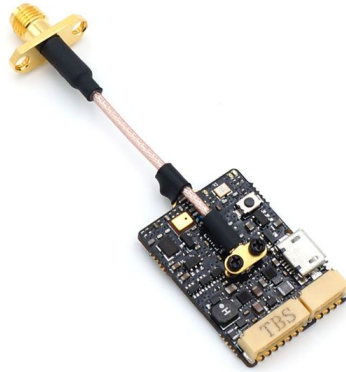


TBS UNIFY EVO 5G8 (HV) Video Transmitter



OSD capable, license-free, high power long range and freestyle VTx

Revision 2019-08-20

The TBS UNIFY EVO is a new line of video transmitters which contains a professional On Screen Display (OSD), optimized for compatibility across multiple platforms and reduced to a small form factor, completely redesigned and tailored for use in small multirotors and FPV wings. It is tightly integrated with TBS Crossfire and TBS Crossfire-compatible products such as flight controls.

Key features

- World's smallest video transmitter containing a full-featured on-screen display
- 25mW (up to 800mW with HAM license*)
- Built-in microphone (with disable feature!)
- One button frequency and power setup
- Device configuration through OSD
- SMA pigtail connector with frame mounting holes integrated
- High voltage 7-26V (2-6S LIPO) input
- Clean voltage output for FPV Camera (5V / 200mA)
- Superior input noise filtering
- **2x CRSF Serial Port** for OSD data, device setup, expansion port for sensors etc.
- Smartaudio V2.1 for one wire serial control
- High quality branded U.FL connector with additional screw locking
- USB connector for firmware update and setup through TBS Agent
- Firmware update support through CRSF when paired with TBS Crossfire System



Specifications

	TBS UNIFY EVO	
Input voltage:	7V to 26V (2S - 6S LIPO) VBat, peak max 31V. <i>Connect directly to battery or regulator with enough output power ($\geq 7V$, 1A)!</i>	
Power Output	Regulated 5V for Camera @ 200mA	
Extra features:	CleanSwipe PitMode 2x CRSF Smartaudio V2.1	
Remote software protocol	PWM, Barcodes, 2x CRSF or SmartAudio V2.1	
Output Power	CRSF: 14dBm (25mW) 20dBm (100mW*) 26dBm (400mW*) 29dBm (800mW*)	Smartaudio V2.1: 14dBm (25mW) 23dBm (200mW*) 27dBm (500mW*) 29dBm (800mW*)
Pit mode	Activate: press button during powered up. LED: red blinking	
	Deactivate: press button during powered up. LED: blue (red & blue when unlocked)	
Pit mode -> flight mode	Command through Smartaudio V2.1 & CRSF	
Channels:	Band A (8ch), B (8ch), E (5ch) Fatshark 8ch Race Band 8ch Low Race Band 8ch **	
Audio	Yes, through microphone on-board	
Power consumption	25mW: 300mA 200mW: 370mA 500mW: 500mA 800mW: 650mA	25mW: 300mA 100mW: 350mA 400mW: 450mA 800mW: 650mA
Range:	Up to 4 km with omnidirectional RHCP antennas	
Antenna connector:	U.FL high strength SMA	
Port connector	Main connector: JST-GH, 7 pin 2 nd Connector: JST-GH, 4 pin	
Dimensions:	22 (H) x 30 (W) x 4 (D) mm	
Weight:	7g excluding antenna	
Kit contents:	1x TBS UNIFY EVO, 1x 7pin cable (power, cam, crsf), 1x 4pin cable(crsf)	

* requires HAM license, special unlocking procedure!

** only where authorization has been granted



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OSD Functions

The TBS Unify EVO OSD automatically shows information that it finds in the CRSF telemetry stream. It is kept basic and clean on purpose, it sets itself up as much as it can and just works.

Here are the telemetry features currently supported:

- GPS, heading & home arrow (TBS GPS via BST, or other GPS connected to a Betaflight or iNav FC)
- Current sensor information (if provided to the Betaflight or iNav FC)
- Voltage sensor built-in to VTx
- RSSI, SNR and LQ information (when connected to a TBS Crossfire RX or FC)
- Video Transmitter Channel & Power
- HAM Callsign

Button menu control

There are categories in the menu, and settings. Pressing the button for 3 seconds will toggle between categories, pressing it for a short (1 second) press toggles between settings. To enter the menu, hold the button for 3 seconds. LED colors will signal the state of the menu, for an overview see the following table.

1. Channel select mode

Enter the menu by pressing the button for 3s. Red LED will flash 1 time. Select channels by simple short presses.

2. Band select mode

Press button for an additional 3s. Red LED will flash 2 times. Select band by simple short presses.

3. Unlock & power select mode

(FOR HAM USERS ONLY!) Press button for 20 to 25 seconds. The Red LED will flash 3 times to confirm. You have unlocked the video transmitter for use with all frequencies (see frequency table below).

NOTE: Unlock only works if you are inside the band selection menu

The power select mode is now accessible. Once unlocked, you can select the power level according to the table below. To lock the transmitter, go back into band select menu and press the button for 20 to 25 seconds again.

Save and exit

At any time during the menu settings, press the button for 5 seconds or longer. Blue LED will turn on, settings are saved and it will exit the menu.

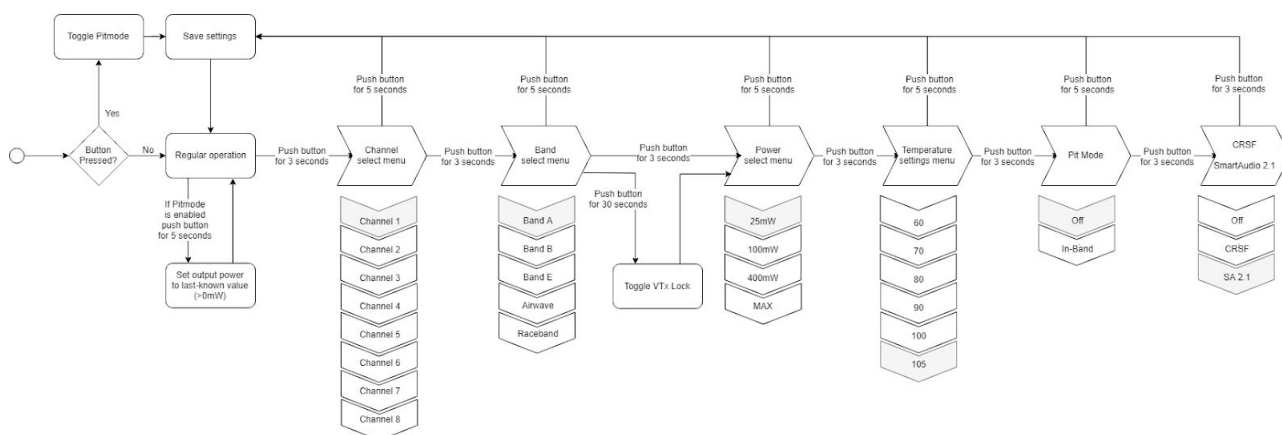


PWM Control

For setups without flight control and receivers that do not have CRSF capability, such as R/C cars or boats, we have enabled a control for the button via PWM control. You can connect a PWM channel to the CRSF RX1 port and simply move a switch from low to high to press and high to low to depress the button. The single PWM channel is the most simple way of using a video transmitter.

The menu control is identical to using the button. Follow the instructions below to set up the video transmitter and OSD.

Button menu structure



Menu Table

RED LED		BLUE LED							
		1x	2x	3x	4x	5x	6x	7x	8x
1x	Channel	1	2	3	4	5	6	7	8
2x	Band	A	B	E	Airwave	Race			
3x	Power Level	25mW	100mW	400mW					
4x	Limit Temp.	60	70	80	90	100	105		
5x	PIT Mode	OFF	IN-BAND						
6x	CRSF/ SA	OFF	CRSF	SA					

Frequency Table

Channel	1	2	3	4	5	6	7	8	
Band A	5865	5845	5825	5805	5785	5765	5745	5725	MHz
Band B	5733	5752	5771	5790	5809	5828	5847	5866	MHz
Band E	5705	5685	5665	5645	5885	5905	5925	5945	MHz



Airwave	5740	5760	5780	5800	5820	5840	5860	5880	MHz
Race Band	5658	5695	5732	5769	5806	5843	5880	5917	MHz
PowerLevel	25	100	400	800					mW

The selections in orange requires HAM license to operate legally. Black selections are only available on special request (custom firmware for large events with prior legal body approval). The video transmitter ensures that you cannot select illegal channels or power levels by accident:

- When controlled by the push button, you will need to confirm having a HAM license by following the steps described above to unlock your video transmitter
- Through the CORE PRO, you are required to enter your HAM license number under the "Callsign" menu before you can access the high power transmission settings and the locked out channels

LED Flash Codes for Channel, Band and Power

The TBS UNIFY PRO 5G8 signals selected channel, band and power levels using a startup sequence of LED codes. The same sequence is also repeated in the menu to make it unified. First, the RED LED flashes to indicate the item being shown. One flash for channel, two flashes for band, three flashes for power level. Subsequently, the BLUE LED will indicate the value.

Red LED:	Indicate item - Channel, band or power setting
Blue LED:	Indicate value

For example, Channel 6, Band B, Power of 500mW, will have the following startup LED code:

- 1x Red and 6x Blue = Channel, 6
- 2x Red and 2x Blue = Band, 2 (=B)
- 3x Red and 3x Blue = Power, 3 (= 500mW)

Once the Video transmitter has successfully booted up, it will show a constant BLUE for locked state, and a constant RED + BLUE for unlocked state.

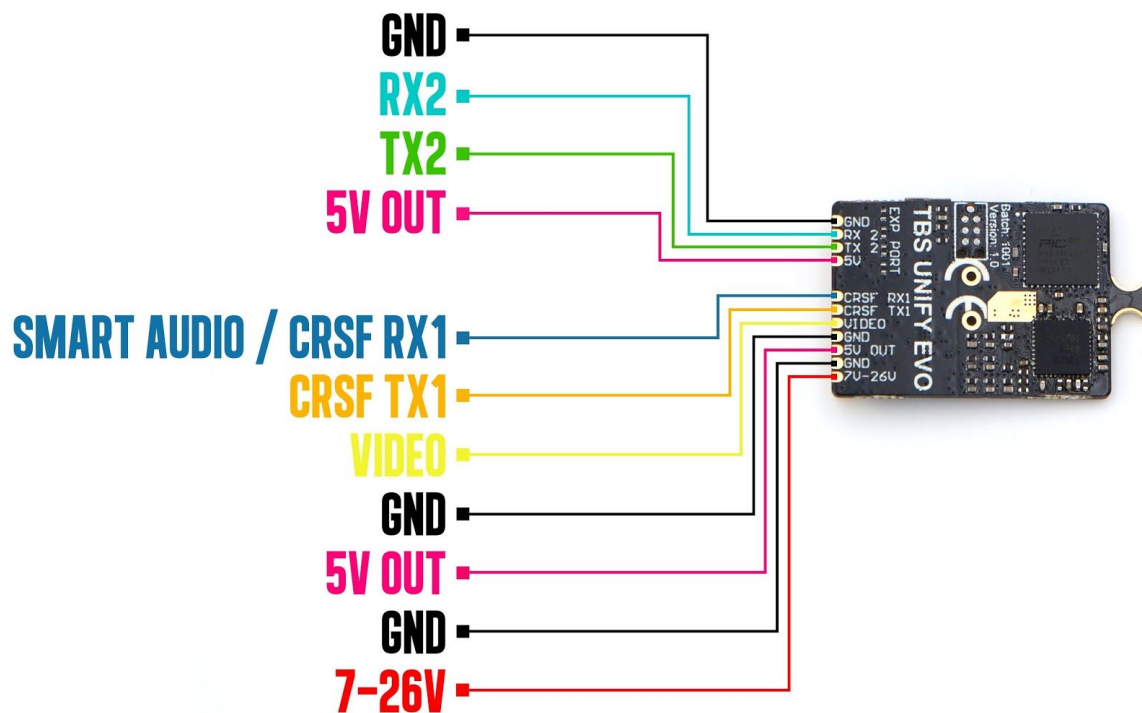


Installation / Mounting

When installing the Unify EVO, please ensure adequate airflow during flight. Up to power levels of 200mW, no airflow is less critical. With higher power setting airflow is required to maintain the set power level.

In case there is no or not enough airflow to maintain the temperature limit, the Unify EVO will slowly reduce output power to ensure proper function without any overheating. The reduction in output power is slow and gradual so there is no immediate range issue. As it regulates back the output power, red LED starts to blink.

Unify Pro EVO Pinout



OSD Menu & LUA Control

Connect the CRSF RX / TX ports from the Video Transmitter to a spare UART port on your FC with CRSF enabled, or to the TBS Crossfire RX. If the channels are properly configured, you can enter the OSD menu with throttle down and yaw left.

If for any reason this doesn't work, configure the video transmitter by connecting the VTx to the TBS Agent X or using the Crossfire LUA script on your Taranis. Ensure that the channel mapping is accurate and that Stick Control is enabled.

All of the settings should be self-explanatory. Flight controls with current and voltage sensors will automatically have that data shown, same for GPS information. Otherwise voltage sensor will fall back to VBatt input of the VTx. If your Crossfire is connected to the FC or the VTx via CRSF, then you will also be able to see full CRSF RSSI information.

If your flight controller only supports MAVLink, you can try to connect the Flight Controller to the Crossfire RX's Mavlink port, and connect the Crossfire RX to the Video transmitter in order to share the FC information to the OSD.

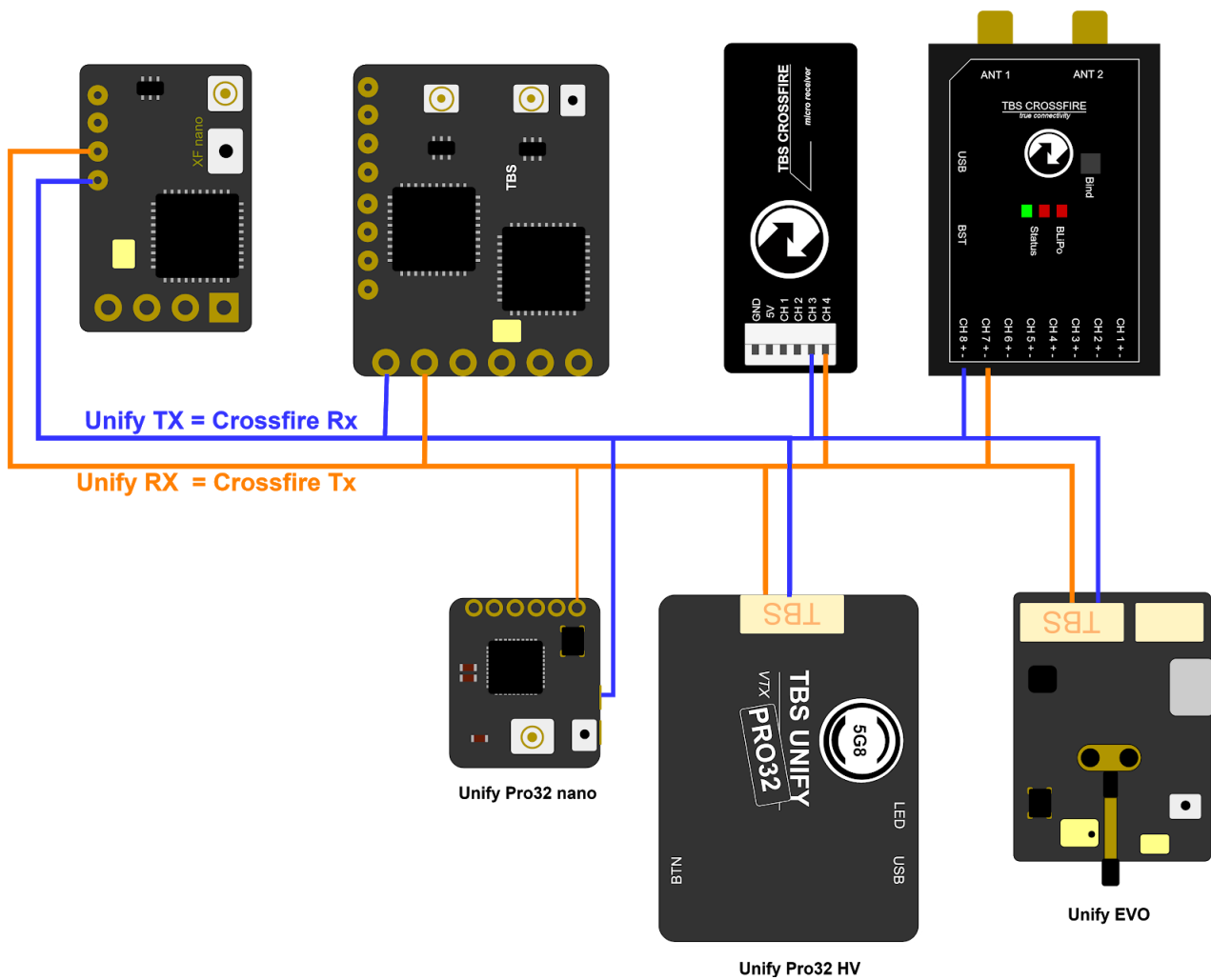
Connecting the EVO to a Crossfire receiver

If you own a TBS Crossfire, you can connect the TBS Evo straight to the Crossfire receiver. Therefore you got two options: connect it by SmartAudio 2.1, which let you change the VTx settings, or by CRSF.

If you connect it by CRSF, you will get the Crossfire link informations (LQ with 300%, RSSI for both antennas, SNR, Tx Power) in the OSD. You also get the ability to navigate your osd by the sticks of your radio, as well as you can enable PitMode by a switch - without the need for a fc.

To get CRSF on more than one output of the receiver, you need to flash it with fw 2.93 or later. If you use a FC as well, set output 4 to CRSF TX and connect the wires according to the following graphic and [the EVO pinout](#)





Connect your TBS EVO VTx to the Agent X. Set "Data Port" to CRSF and check that the "Channel Map" is set up according to your radio. If you use a wing mixer, set it up as described in [here](#). If you want to use PitMode on a switch, you need to set the channel number of the switch you want to use for it in the "Channel Map" menu as well.



Barcode Control

The video transmitter can be controlled via barcodes through your camera. This allows you to enable pitmode, and power up your video transmitter by holding the barcode in front of your camera. Or simply to carry your favorite channel in your pocket or on your backpack and revert to that channel easily and quickly.

You can download a PDF barcode catalog from this link:

- <http://www.team-blacksheep.com/tbs-vtx-barcodes.pdf>

Android app:

- <https://noahwaldner.ch/en/tbs-barcode-generator>
- <https://apocolipse.github.io/UnifyEvoBarcodeGenerator/>

Raw .json file:

- <http://firmware.team-blacksheep.com/barcodes>

We are always expanding the functionality. If you have any crazy ideas for implementing barcodes for your races or other purposes, please let us know! We're happy to expand the functionality at all times!

Technology showcase

PitMode

PitMode is a mode where the video transmitter only runs on an incredibly low output power. This prevents interference with others at events, while still allowing a minimum of visibility for emergency last-minute setting changes.

With the TBS UNIFY PRO32 line, Pit Mode has been slightly modified in behavior. The main button on the video transmitter is used to toggle pitmode flag at power-up, and SmartAudio / CRSF can modify this flag as well. Smart Audio / CRSF can enter also enter pit mode during runtime using the power setting 0mW, which will not modify the flag (the VTx will never power up at the 0mW power setting). To leave pitmode during operation, simply set your desired power setting using Smart Audio, CRSF or the button menu.

SmartAudio 2.1

SmartAudio is a protocol developed by TBS for OSD to VTx communication. SmartAudio is a single-wire UART protocol, running over the Audio-wire. All newer generation OSDs at TBS, and all UNIFY PRO series VTx, and all modern flight controllers support SmartAudio!



With the UNIFY PRO32 line we have launched SmartAudio V2.1. Over the regular SmartAudio, it changed control for PitMode in operation to a switch(on / off) rather than a flag that is refreshed on reboot.

If you are a OSD or VTx developer interested in adding support for SmartAudio, please check our [SmartAudio specification](#). SmartAudio is a free-to-use protocol. If you'd like to use "TBS SmartAudio" in your marketing, you may contact us for licensing options:

- <http://team-blacksheep.freshdesk.com/>

CRSF

CRSF is a protocol designed by Team BlackSheep and championed through the TBS Crossfire remote control system. It has been integrated into most popular remote controls, is a incredibly high bandwidth (low latency) full duplex, serial data transmission protocol. It comes with native functionality such as OTA (over the air) firmware upgrades, localized configuration menus and a smart routing protocol.

With the advent of the TBS UNIFY PRO32, for the first time in FPV history does a VTx now support this functionality. We can configure channel, output power and pitmode settings. Additionally, software updates via the TBS Crossfire platform are now possible.

CleanSwitch

A new feature introduced with the TBS UNIFY PRO 5G8 is CleanSwitch. When video transmitters power up or change frequency, they usually send a burst across the entire band which disturbs fellow flying pilots. All UNIFY PRO32 5G8 video transmitters will remain in their lowest power output (less than 0.1mW) while changing channels and powering up. This ensures interruption-free racing, even with multiple video transmitters changing channels, or powering up. Despite all this, TBS UNIFY PRO & EVO are still the fastest video transmitter on power up - thus ensuring it is the perfect choice for any application where quick channel changes are a necessity!



Declaration of Conformity



EU - DECLARATION OF CONFORMITY

We affirm that the electrical equipment manufactured by us complies with the requirements of the EC Council Directive on electromagnetic compatibility 2004/108/EC

Manufacturer:

TBS Avionics Co Ltd
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Unit 1204, Century Centre
Kwun Tong, Hong Kong

Tel: +852 5685 2608
Fax: +852 5685 2608
E-Mail: rpirker@team-blacksheep.com

Description of the appliance:

5G8 System

Trade name and model of appliance:

TBS Unify EVO (A-TBSS-TUNEV)
SNR 0741587433095

Applicable Standard (s):

- EN 55032:2012/AC:2013
- EN 55024:2010
- EN61000-3-2:2014:2010 EN61000-3-3:2013

Assumption of conformity is based on the application of the harmonized standards and, when applicable or required, a European Community notified body certification, as shown in the attached schedule.

January 24th, 2018



Raphael Pirker, CEO
TBS Avionics Co Ltd.



Good practices

We have compiled a list of all of practices which have been tried and tested in countless environments and situations by the TBS crew and other experienced FPV pilots.

Follow these simple rules, even if rumors on the internet suggest otherwise, and you will have success in FPV.

- Start with the bare essentials and add equipment one step at a time, after each new equipment was added to proper range- and stress tests.
- Do not fly with a video system that is capable of outperforming your R/C system in terms of range.
- Do not fly with a R/C frequency higher than the video frequency (e.g. 2.4GHz R/C, 900MHz video).
- Monitor the vitals of your plane (R/C link and battery). Flying with a digital R/C link without RSSI is dangerous.
- Do not use 2.4GHz R/C unless you fly well within its range limits, in noise-free environments and always within LOS. Since this is most likely never the case, it is recommended to not use 2.4GHz R/C systems for longer range FPV.
- Do not fly at the limits of video, if you see noise in your picture, turn around and buy a higher-gain receiver antenna before going out further.
- Shielded wires or twisted cables only, anything else picks up RF noise and can cause problems.
- When using powerful R/C transmitters, make sure your groundstation equipment is properly shielded.
- Adding Return-To-Home (RTH) to an unreliable system does not increase the chances of getting your plane back. Work on making your system reliable without RTH first, then add RTH as an additional safety measure if you must.
- Avoid powering the VTx directly from battery, step-up or step-down the voltage and provide a constant level of power to your VTx. Make sure your VTx runs until your battery dies.
- Do not power your camera directly unless it works along the complete voltage range of your battery. Step-up or step-down the voltage and provide a constant level of power to your camera. Make sure your camera runs until your battery dies.
- A single battery system is safer than using two dedicated batteries for R/C and FPV. Two batteries in parallel even further mitigate sources of failure.
- For maximum video range and “law compatibility”, use 2.4GHz video with high-gain antennas.
- When flying with R/C buddies that fly on 2.4GHz, or when flying in cities, it is perfectly possible to use 2.4GHz video provided you stick to the channels that do not lie in their band (CH5 to CH8 for Lawmate systems, available from TBS).
- Do not use diversity video receivers as a replacement for pointing your antennas, diversity should



be used to mitigate polarization issues.

- Improving the antenna gain on the receiver end is better than increasing the output power (except in RF-noisy areas). More tx power causes more issues with RF on your plane. 500mW is plenty of power!
- Try to achieve as much separation of the VTx and R/C receiver as possible to lower the RF noise floor and EMI interference.
- Do not buy the cheapest equipment unless it is proven to work reliably (e.g. parts falling off, multitudes of bug fix firmware updates, community hacks and mods are a good indicator of poor quality and something you do NOT want to buy for a safe system). Do due diligence and some research before sending your aircraft skyward.

Manual designed by ivc.no, written by TBS and ivc.no.

