TBS CROSSFIRE R/C System

Adaptive Long Range Remote Control System

The TBS CROSSFIRE system is a R/C link system made for FPV enthusiasts. It features unheard of range without sacrificing basic functionality such as being immune to interference from onboard equipment, low latency control or two-way communications including telemetry functionality.

Key features

- Long range, adaptive and robust remote control system for your aircraft
- Immune to on-board noise
- Two-way communication link with real-time link vitals and telemetry
- Self-healing frequency hopping link
- Receiver beacon mode to recover your downed aircraft
- Super easy binding and configuration via built-in display
- Low latency control for perfect immersive feeling
- Free output mappable 8 output diversity with integrated backup battery or super tiny receiver (4g weight only) both with up to 12 channel PPM
- Ability to fly with multiple friends at the same time (10 or more)
- Dynamic self-selecting or selectable RF power from 10mW to 2W (local restrictions apply)
- Dedicated head-tracking input option for full FPV immersion
- Transmitter LED shows link health, OLED display for built in configuration
- Expansion port for future feature support

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Specifications

Type:	Long Range Two-Way Remote Control System
Band:	Europe: 868 MHz SRD Band America: 915 MHz ISM Band
Output RF power:	TX: Selectable 10mW - 500mW, additional 1W and 2W available with external power connected via XT30 socket RX: 30mW
Receiver sensitivity:	Up to -130dBm
Antenna:	TX: 1x omnidirectional dipole antenna - single stage RX: 2x omnidirectional dipole antennas - diversity, dual independent RF stages
R/C Channels:	8-channel traditional PWM (free mappable) or up to 12-channel PPM stream outputs Standard 2.54mm servo connectors
Radio compatibility:	Any radio with PPM stream output (absolute max. ratings: -0.3V - 15V) JR Adapter for easy install on JR, FrSky and similar radios
Interface:	TX: 1.3-inch OLED display and joystick for configuration, binding and link stats Bluetooth link for real-time telemetry to tablet or phone Micro-USB for firmware upgrade and configuration via TBS Agent software
Recovery mode:	Beacon-mode, receiver backup LiPo battery - operating time of approx. 2 days
Failsafe:	Pre-set servo positions or stops outputting servo pulse - selectable in configuration menu
Antenna connector:	Standard SMA (not RP-SMA)
Operating range:	Variable depending on output power and radio environment
Input power:	TX: +3.5 to 12.6V via RC or HT 3-pin input connector External 2S to 3S LiPo via XT30 connector RX: +5V to 6V via servo header All reverse-polarity protected
Power consumption:	TX: 1.1W, at 25mW TX: 3.2W, at 2000mW
Working temperature:	0 - 40°C
Size:	TX: 150 x 80 x 20 mm 8ch Diversity RX: 30 x 50 x 12 mm
Weight:	TX: 340 grams RX: 25 grams
Kit contents:	1x TBS CROSSFIRE TX transceiver unit, 1x TBS CROSSFIRE RX transceiver unit, 1x JR-adapter module, 1x 6-pin cable, 1x 3-pin cable

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Attention

These Long Range Systems are capable to use radio frequency transmissions and output power that may be not allowed in your country.
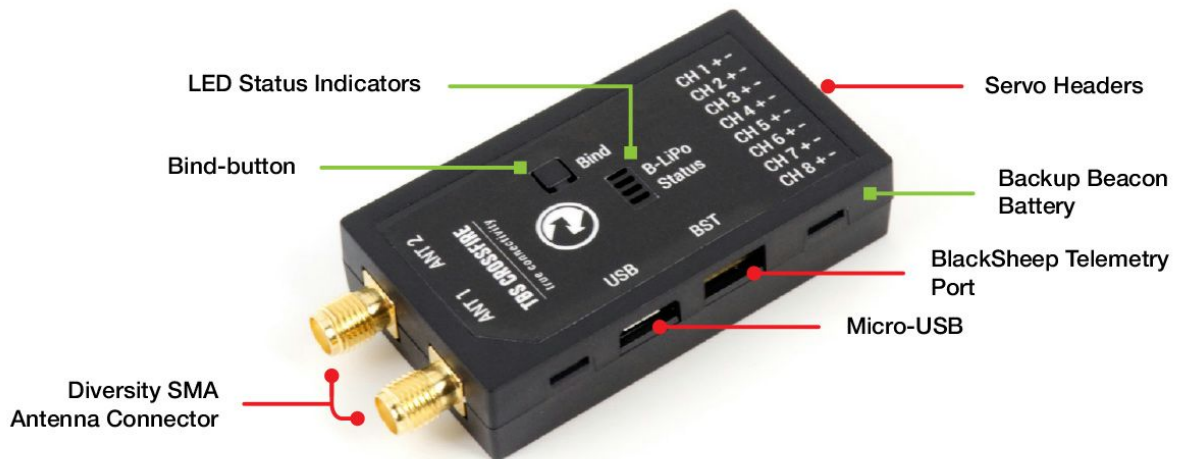
Please always check your local RF legislation to set the frequency and output power according with the regulation.

A general rule for RC aircrafts is that they must be controlled always under sight of view, check your RC regulation to keep up to date with regulations.

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Overview

The following diagram indicates the essential inputs and features of the transmitter and receiver.

SMA Antenna Connector

LED Link Status Indicator

Heatspreaders

OLED Menu Display

Five-way Joystick

Mounting holes

DC Input (XT30)

Heat-Tracking Input

R/C Input

Expansion Port (future features)

LED Status Indicators

Servo Headers

Bind-button

Backup Beacon Battery

BlackSheep Telemetry Port

Micro-USB

Diversity SMA Antenna Connector

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Setup

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

Connecting transmitter to radio

Using JR-adapter

The kit comes with a JR-adapter which simply works as a connection bridge between the JR-pins on the radio and the TBS CROSSFIRE transmitter. The adapter simply fits into the slot on the back of the radio. The radio battery power to the TBS CROSSFIRE and no additional power is necessary for RF output up to 500mW.

Insert the JR-adapter into the slot on the back of the radio, remove the adhesive sheet from the TBS CROSSFIRE back and align the four studs with the matching holes on the transmitter. Connect the 3-pin to the left port (RC) and 6-pin cable (expansion) to the right port on the transmitter.

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Power on the radio, configure a new model profile and enable the external RF module - see the radio manufacturers manual for further details on how to complete this step.

Using Hitec/Graupner/JR-cable

If you own a Hitec, Graupner or JR radio without a JR-module slot, you can still use the trainer output connector to get the necessary power and PPM control signals to the TBS CROSSFIRE transmitter.

Connect the included cable to the radio trainer port and the other end to the left port (RC) on the transmitter.

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Using Futaba-cable

For Futaba radios you can use the trainer port to feed the PPM signal to the TBS CROSSFIRE transmitter.

Connect the included cable to the radio trainer port and the other end to the left port (RC) on the transmitter.

Using custom PPM cable

If you want to connect any other radio, or have a custom setup, you can use the 3-pin pigtail-cable and solder the wires according to the table below to suite your needs.

| Radio pin (left in photo above)	TBS CROSSFIRE 3-pin cable
White - PPM	1 - PPM
Red - Power	2 - Power
Black - Ground	3 -Ground

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Connecting 8ch diversity receiver to model

The compact receiver unit fits everything from small multirotors to very large airplanes. The receiver is capable up to 8.4V and needs at least 4.5V input voltage.This can be applied to any of the eight servo headers, e.g. a servo cable from a ESC with BEC, or a stand-alone BEC, with a suitable amperage rating - min. 1A recommended. Make sure that adequate power is available by letting the model run for a few minutes with servos connected, and check your BEC temperature.

If you want to connect additional TBS products to you setup, e.g. CORE PRO, CURRENT SENSOR, BLACKBOX and GPS, we are providing a 4-way BST splitter adapter to connect everything together.

The receiver servo header pin-polarity is standard and shown in the photo below. All the power pins are reverse-polarity protected.

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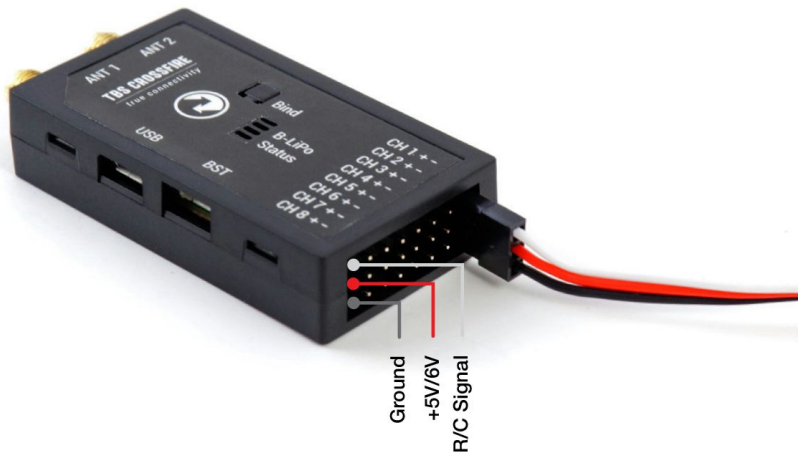
Connecting micro receiver

The TBS CROSSFIRE micro receiver comes with two sockets. One is for BST capability (BlackSheep Telemetry), the other is for one (1) R/C output which can be configured to either PWM, PPM or SBUS. The receiver can run off anything between 4.5V and 8.4V and can either drive one servo, or connect to any PPM or SBUS capable flight control. Binding the receiver to the transmitter is described on the next page and is the same as the diversity receiver.

Cleanflight pilots with a STM32F1 processor board (e.g. Naze32 and similar) can select the "n.i. SBUS" (Not-Inverted SBUS) to directly connect to your FC without any inverters or special soldering hacks.

Connecting Antennas

The CROSSFIRE system used regular SMA connectors - where the antenna has the center pin. Connect the supplied antennas to the SMA connectors on the transmitter and receiver. The straight connector is for the transmitter and the other two for the diversity receiver.

For optimal radio coverage and range, mount the receiver antennas perpendicular (90°) to each other.

Caution: It is never safe to run a RF transmitting device without an antenna, regardless if it is the transmitter or receiver as both function as transceivers in this system. The absolute maximum rating for the receiving part is +10dBm, so if you use high power settings (>500mW) and hold the antennas (TX and RX) very close together the RX can be damaged.

Binding

Binding the transmitter and receiver is super simple.

1. Just power up the TBS CROSSFIRE transmitter
2. Enter the configuration menu by pressing and holding the joystick for 3 seconds, select "General" and "Binding" - a message "Binding" will start blinking, waiting for the receiver
3. Now, power up the receiver (without pressing the Bind button!), if your receiver has not been previously bound, it will automatically bind. Otherwise, press and release the "BIND" button on the receiver to initiate binding. On the receiver is a timeout of one minute for after power up to enter bind mode. If the status LED will start blinking slowly you the receiver has switched successfully to bind mode.

Within a few seconds the process will finish with a "Binding complete" message. If it doesn't bind, please verify that your firmware is to the newest version on both the receiver and the transmitter. During the first few weeks, please check back regularly for firmware updates.

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Set failsafe

Setting the R/C failsafe parameters is a very important part of the configuration, don't skip it! You never know when you will have problems with uplink and lose control of your aircraft.

1. Power up both the transmitter and receiver
2. Adjust the radio stick positions or trims to the desired failsafe position, i.e. low throttle, flat glide angle or failsafe mode on your flight control. Make sure no propellers are mounted - just in case.
3. There are two ways to set failsafe, either simply press the joystick Up for 3 seconds, or enter the configuration menu by pressing and holding the joystick for 3 seconds, select "General" and "Set failsafe" - this will transfer the current R/C control parameters to the receiver which will store them internally
4. Try the failsafe by turning off the transmitter and watch the servo outputs engage in the pre-set failsafe positions

Head-tracking

The TBS CROSSFIRE supports standard head-tracking input via the right 3-pin HT port on the transmitter. Solder the included pigtail cable to suite your particular head-tracking setup.

The status display will indicate if the signal has been recognized properly. The head-tracking input signals will output on the receiver (to be announced).

Connecting TBS equipment

There is an issue when you want to run BST devices like the GPS or BLACKBOX direct without a CORE PRO. Most of the BST devices needs 5V which the CORE PRO provides. The CROSSFIRE RX does not power the BST when 5V is applied to the servo connectors. The following explains the required power needs:

- TBS BLACKBOX - Can be powered by the BST 5V or by the Flight Controller over the ext. FC port
- TBS GPS - Can only be powered by the BST 5V
- TBS CURRENT SENSOR - Provides VBatt but needs BST 5V to run itself
- TBS CROSSFIRE RX - Can be powered over one of the eight servo connectors or by BST 5V
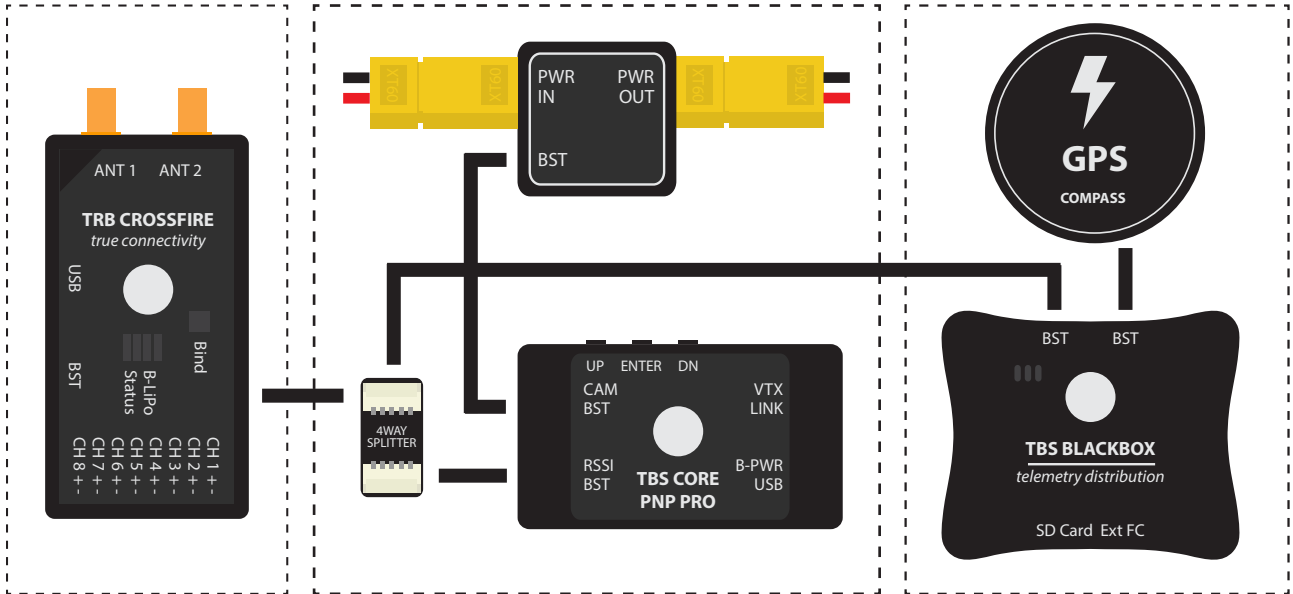- TBS CORE PRO - This is only device is providing 5V on the BST line

| Power type:	BST 5V	VBATT	ESC/BEC 5V	FC 5V
TBS CROSSFIRE	✔ IN		✔ IN	
TBS BLACKBOX	✔ IN			✔ IN
TBS GPS	✔ IN			
TBS CORE PRO	✔ OUT	✔ IN		
TBS CURRENT SENSOR	✔ IN	✔ OUT		
TBS BULLETPROOF ESC (SET)			✔ OUT	

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TBS BST DEVICES - Power Connectivity

Sept. 2015 - by ivc.no/tbs

CORE PRO supplies 5V power to all BST devices

Flight Controller provides 5V via ESC/BEC to all devices

Note: CROSSFIRE requires 400mA
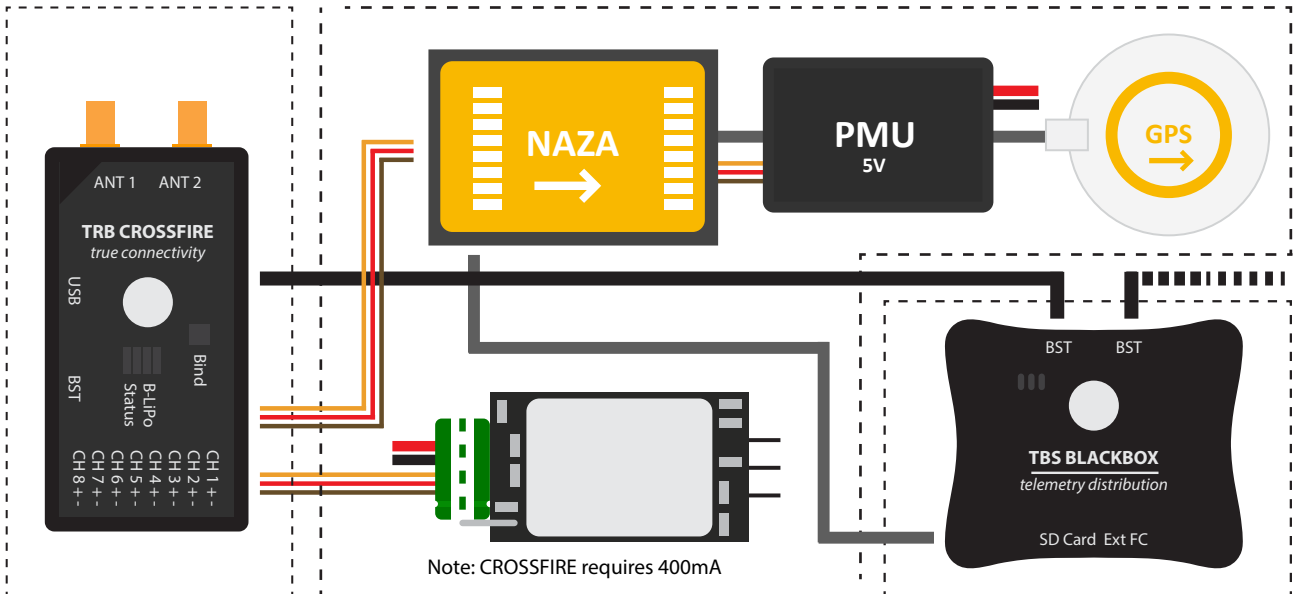
Operation

Status display

After power-on, the main screen shows the current state of the transmitter, i.e. link status, transmission power, R/C- and head-tracking input signal state.
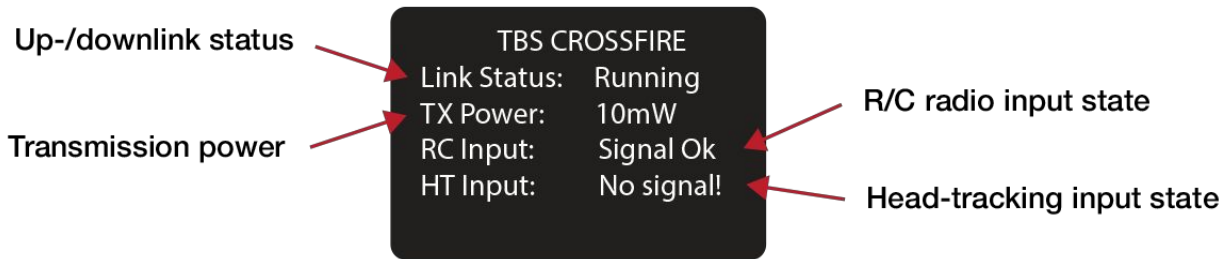
- **Link Status** - State of the wireless link [Connecting, Running]
- **TX Power** - Output transmission power [10mW, 25mW, 100mW, 500mW, 1W, 2W]
- **RC Input** - Radio R/C PPM signal input status [No signal, Signal OK]
- **HT Input** - Head-tracking PPM signal input status[No signal, Signal OK]

Up- and downlink status

Toggle the joystick to the right to show the status of the up- and downlink.
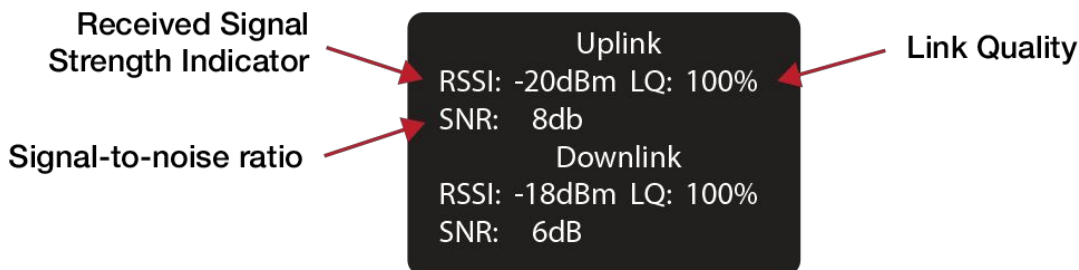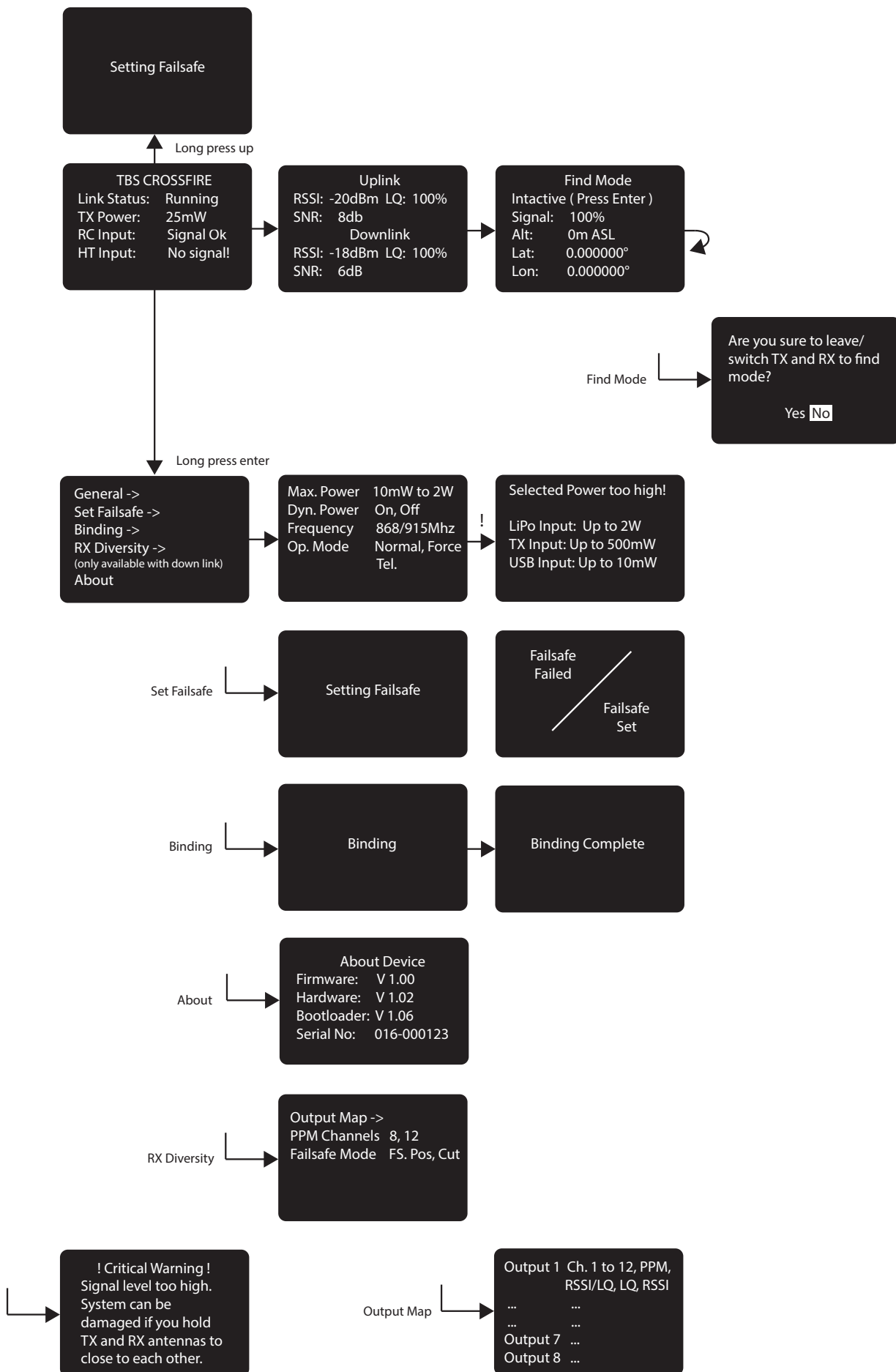

- **RSSI** - Received signal strength indicator, measurement of the power present in a received radio signal [typ. -1dBm (good) to -130dBm (bad), logarithmic scale]
- **LQ** - Link Quality, based on the percentage of signal data received at the end-point [0 to 100%]
- **SNR** - Signal-to-noise ratio, compares the level of a desired signal to the level of background noise

The RSSI determines your available link budget on a logarithmic scale, with each additional -6dBm representing twice the range of your current distance. E.g. you are at 5km range with a RSSI of -84dBm. At a range of 10km you are expected to see a -90dBm RSSI. The receiver is capable of receiving signals up to -130dBm. The SNR plots your current RSSI against the noise floor, giving you a rough indication of the remaining range in real-time. The CROSSFIRE can receive signals down to about -12dB SNR, way below the noise floor. Any SNR above 8dB cannot be accurately measured and will result in an SNR of 8dBm.

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TBS CROSSFIRE Transmitter - Menu Overview

Sept. 2015 - by ivc.no/tbs

Setting Failsafe

Long press up

```
TBS CROSSFIRE
Link Status:   Running
TX Power:      25mW
RC Input:      Signal Ok
HT Input:      No signal!
```

```
           Uplink
RSSI: -20dBm  LQ: 100%
SNR:   8db
           Downlink
RSSI: -18dBm  LQ: 100%
SNR:   6dB
```

```
         Find Mode
Intactive ( Press Enter )
Signal:    100%
Alt:       0m ASL
Lat:       0.000000°
Lon:       0.000000°
```

Find Mode

```
Are you sure to leave/
switch TX and RX to find
mode?

          Yes  No
```

Long press enter

```
General ->
Set Failsafe ->
Binding ->
RX Diversity ->
(only available with down link)
About
```

```
Max. Power    10mW to 2W
Dyn. Power    On, Off
Frequency     868/915Mhz
Op. Mode      Normal, Force
              Tel.
```

`!`

```
Selected Power too high!

LiPo Input:  Up to 2W
TX Input: Up to 500mW
USB Input: Up to 10mW
```

Set Failsafe

Setting Failsafe

```
Failsafe
Failed
              Failsafe
              Set
```

Binding

Binding

Binding Complete

About

```
      About Device
Firmware:    V 1.00
Hardware:    V 1.02
Bootloader: V 1.06
Serial No:    016-000123
```

RX Diversity

```
Output Map ->
PPM Channels   8, 12
Failsafe Mode  FS. Pos, Cut
```

```
 ! Critical Warning !
 Signal level too high.
 System can be
 damaged if you hold
 TX and RX antennas to
 close to each other.
```

Output Map

```
Output 1  Ch. 1 to 12, PPM,
          RSSI/LQ, LQ, RSSI
...        ...
...        ...
Output 7  ...
Output 8  ...
```

With LQ at 50% you can still comfortably fly a gimbal-quad in ATTI or GPS mode since there is still a certain amount of valid data reaching the flight controller. Once your link quality goes way down the system switches down to low framerate mode that gives you a lot more range, however only 4 updates per second.

Find mode

The Find-mode provides you with a way to locate a downed aircraft. A GPS signal is currently required to use this mode (other detection modes are being developed). Install our TBS GPS module or TBS BLACKBOX logging unit (via APM/NAZA GPS) to the BST-port on side of the receiver.

In normal use the GPS coordinates are continuously updated and the latest data is displayed on the "Find Mode" screen. If the model looses power you can review the last known coordinates to locate your model.
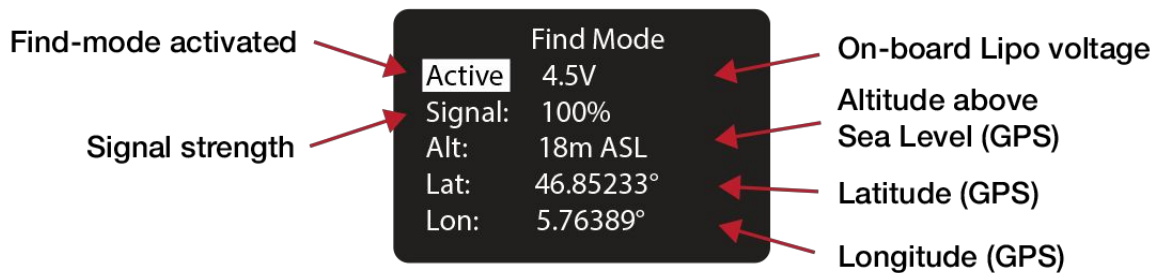
- **Inactive (Press Enter) / Active** - Enable/disable the Find-mode, shows on-board LiPo voltage Do NOT enable during flight!
- **Signal** - Receiver signal strength, makes it possible to triangulate the location [0 to 100%]
- **Alt** - Altitude above Sea Level, GPS required [0 to 5000m]
- **Lat** - Latitude, GPS required
- **Lat** - Longitude, GPS required

The receiver has an on-board LiPo battery to operate in beacon-mode. This allows the transmitter to send the last known GPS coordinates to the display on the transmitter, after certain trigger events have happened. See the operation flow diagram on the following page.
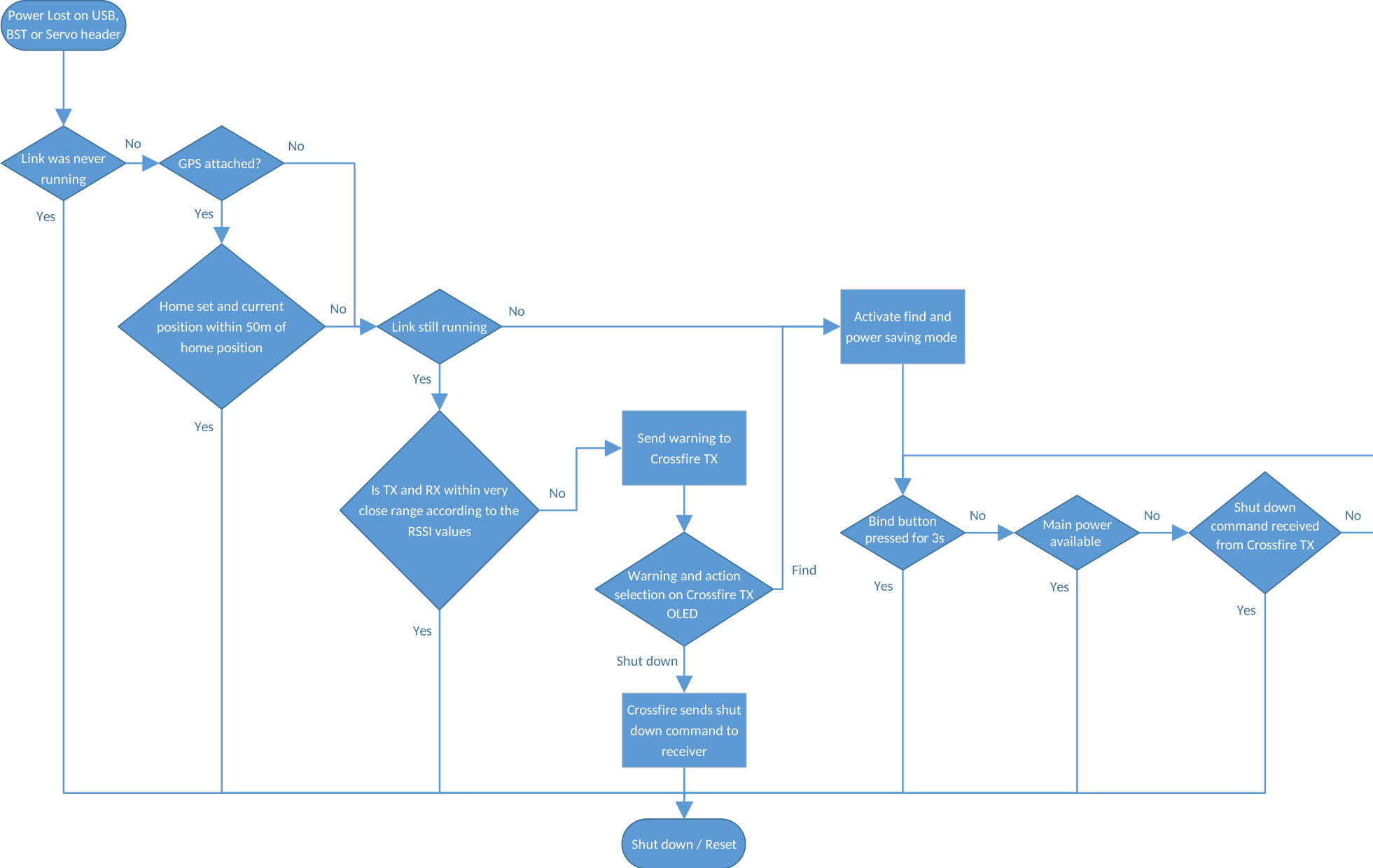

Direction finder

Using the transmitter antenna together with a parabolic reflector, you can estimate the heading of the receiver by looking at the signal strength indicator. Print out the DIY reflector template included on the last pages of this manual with no scaling on thick paper, place a of aluminium foil on top of the main reflector sheet and cut out the shapes with an exacto knife. Place the reflector in the middle of the antenna.

TBS CROSSFIRE - Find Mode Operation

Sept. 2015 - by Remo

Power Lost on USB, BST or Servo header

Link was never running

GPS attached?

Home set and current position within 50m of home position

Link still running

Activate find and power saving mode

Is TX and RX within very close range according to the RSSI values

Send warning to Crossfire TX

Warning and action selection on Crossfire TX OLED

Crossfire sends shut down command to receiver

Bind button pressed for 3s

Main power available

Shut down command received from Crossfire TX

Shut down / Reset

No / Yes labels: No, Yes, No, No, Yes, No, Yes, No, Find, Shut down, No, Yes, No, Yes, No, Yes

Transmitter LED status indicator

The RGB LED on the transmitter gives you at any moment an indication of your link status. Going from green to yellow. Once you are in yellow your RSSI values are either very low or you are already in the low-framerate link mode.

LED sequence	Description
Pulsing	Ready, trying to connect to receiver or no down link established
Green	Solid uplink, high framerate link mode
Yellow	Unreliable uplink or low-framerate link mode
Fast green blinking	Transmitter bootloader active or firmware upgrade
Fast red flashing	Warning, a message is shown on the OLED display
Purple	Find-mode engaged

Receiver LED status indicator

There are three LEDs on the receiver giving you an indication of link- and backup-battery status.

Receiver LED indicators	Description
Solid green	Link is up and running OK
Solid red	No packages received from the transmitter and receiver is in failsafe mode
Slow green blinking	Receiver is in binding mode
Fast green blinking	Receiver bootloader active or firmware upgrade
Green is flashing	Receiver is in Find-mode (up to 1 min. delay between flashing)

If the receiver is in Find-mode it can be cancelled by pressing the "Bind"-button. So if you back home and the receiver still thinks it got lost, you can turn it off like by pressing the button once.

The on-board LiPo battery in the receiver is automatically charged every time the receiver is used. The third LED indicators on the receiver's front face displays the current state of the battery.

Battery LED indicator	Status
Red	Backup battery is charging

The backup battery is used if the model gets lost. The receiver can stay alive even if the entire plane or copter does not have power anymore.

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Real-time telemetry using Bluetooth

The transmitter has Bluetooth communication functionality built-in for easy telemetry distribution to a tablet or phone. Install the [Droidplanner app](#) from 3DRobotics (currently Android only) and power up the CROSSFIRE receiver with either the GPS directly connected or indirectly via the BLACKBOX.

GPS Directly

The TBS GPS connects directly to the BST port. Use the suitable BST cable length. Power is supplied by via the servo headers, either by a ESC or a dedicated BEC.


Via BLACKBOX

Connect the TBS GPS to the TBS BLACKBOX and then the to the BST port on the TBS CROSSFIRE. Power can be either supplied to the servo headers from an ESC/BEC, or to the FC port on the BLACKBOX from NAZA/PIXHACK flight controller.

Pairing

Once the CROSSFIRE is up and running, go to the Bluetooth pairing screen and look for a new device called "Crossfire ####" in the list. Tap the CROSSFIRE entry and accept the pairing request. It is now ready to be used with Droidplanner.
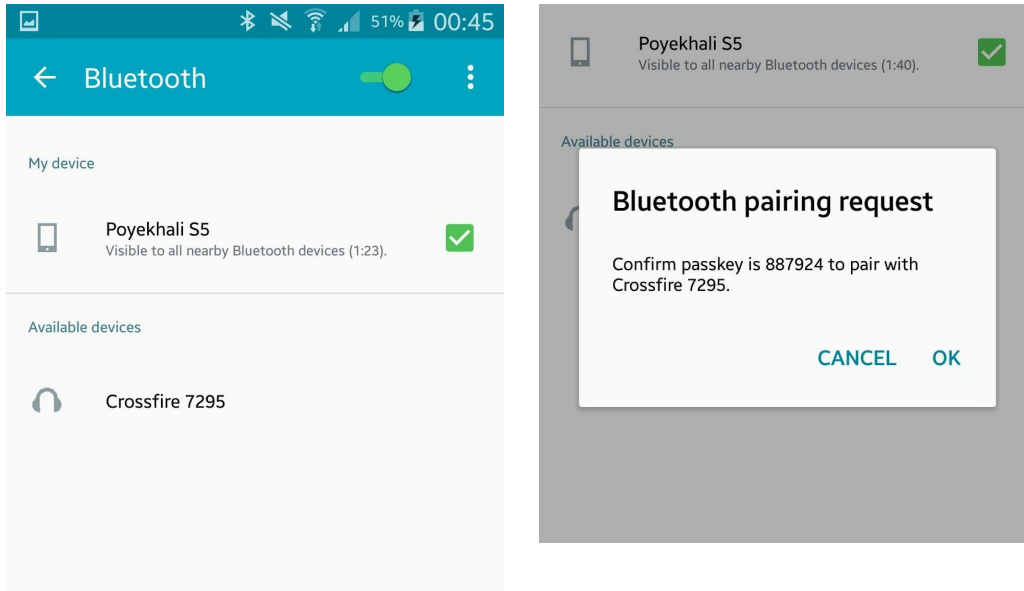
Real-time telemetry updates will now stream from the CROSSFIRE transmitter to your handheld. A map overlay makes it perfect to track race performance or to locate a down aircraft.

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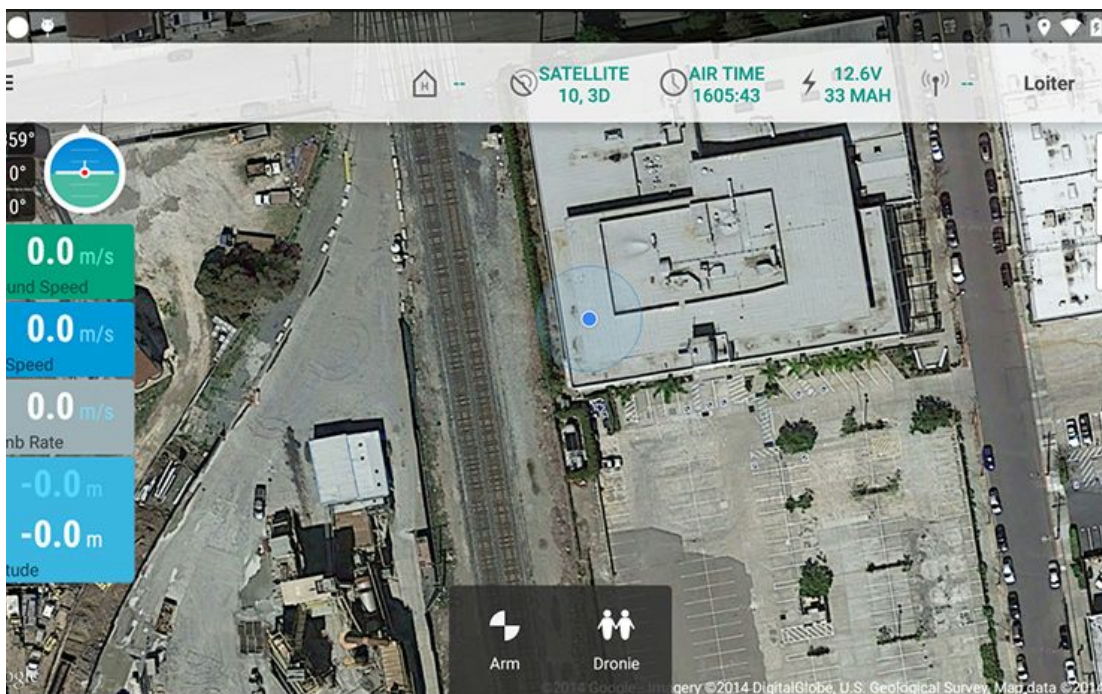
Configuration

Changing any setting related to the TBS CROSSFIRE R/C link is done using a handy OLED display and five-way joystick on the back of the transmitter.

All configuration for the receiver, including servo signal type and binding, is initiated from the display only.

To enter and navigating the menu system:
- Configuration menu - long press the joystick, 3 seconds
- Enter change - short press the joystick or left navigation
- Select item - short press or right navigation
- Menu navigation - Up, down, left, right joystick press

Receiver

PWM or PPM servo output

The default setting is to output traditional PWM signals on all eight channels on the receiver. To output PPM, e.g. for multirotors, you can enable this in the configuration menu. Each channel can be configured independently to output traditional PWM, RSSI, LQ or RSSI/LQ combined. Channel 1 and 2 can be configured to output PPM stream. If both channels are set to PPM, you will get the identical stream on both outputs, e.g. useful for large aircraft with servo decoder hubs. To change output mapping:

1. Power on both the transmitter and receiver
2. Enter the configuration menu, select "RX Diversity" and "Output Map" - Note: this option is only available if the transmitter is getting a valid RC input from the radio
3. Pick a channel from 1 to 8, and toggle between "Ch.1 to 12" (PWM), "PPM", "RSSI, "LQ" and "RSSI/LQ"

The following table shows the channel mapping in the different servo output modes:

Receiver pin	Output type	Default value
1	PWM Ch1 to 12, **PPM**, RSSI, LQ, RSSI/LQ	PWM Ch. 1
2	PWM Ch1 to 12, **PPM**, RSSI, LQ, RSSI/LQ	PWM Ch. 2
3	PWM Ch1 to 12, RSSI, LQ, RSSI/LQ	PWM Ch. 3
4	PWM Ch1 to 12, RSSI, LQ, RSSI/LQ	PWM Ch. 4
5	PWM Ch1 to 12, RSSI, LQ, RSSI/LQ	PWM Ch. 5
6	PWM Ch1 to 12, RSSI, LQ, RSSI/LQ	PWM Ch. 6
7	PWM Ch1 to 12, RSSI, LQ, RSSI/LQ	PWM Ch. 7
8	PWM Ch1 to 12, **SBUS**, RSSI, LQ, RSSI/LQ	PWM Ch. 8

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Receiver SBUS output

The 8-ch diversity receiver as well as the micro receiver support SBUS and n.i.SBUS (non-inverted) respectively. The diversity receiver exposes this functionality on output port 8, selectable via the output port mapping menu. The micro receiver only has one output port, and it is either PWM, PPM, SBUS or n.i.SBUS capable. The setting for this is also available via the output port mapping menu.

Receiver RSSI output

To get digital (PWM) RSSI output for use on OSD and similar equipment, pick a free channel and set the output to RSSI. You can also output your RSSI by injecting it into the PPM stream. Use the "PPM Mapping" menu for this.

Transmission power

The transmitter's RF output power is highly configurable and can be selected dynamically via the display menu. It defaults to 100mW and will provide 15 km of safe range in rural conditions.

It is recommended to use dynamic power option. This will allow you to fly at very low power and the system will increase the power automatically (faster than you can hit the power switch yourself) if you are about to lose the link.

Some output power restrictions apply depending on the available power source:

Power source	Available output power
USB power input (+5V)	10mW (*10dBm*)
RC/HT radio power input (+3.5 to +12.6V)	10mW (*10dBm*), 25mW (*14dBm*), 100mW (*20dBm*), 500mW (*27dBm*)
External LiPo power input (+3.5V to +12.6V) (XT30, shown in photo below)	10mW (*10dBm*), 25mW (*14dBm*), 100mW (*20dBm*), 500mW (*27dBm*), 1W (*30dBm*), 2W (*33dBm*)

To change RF power:
1. Enter the configuration menu, select "General" and "Max Power"
2. Pick the RF output power you require and move joystick left to confirm
3. The change is instant if the required input power is available and can be done at any moment

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Every 6 dBm increase in output power results in a doubling of the theoretical possible distance that is achievable.

If you set a power level that is outside the connected power source, it will still be remembered for later but the output power will be limited to according to the cable above.

You may hear a subtle buzzing or humming sound on some radios or nearby speakers on higher power levels. This is completely normal and non-harmful. In the case of the Taranis it is an issue of the remote itself and can be fixed by following this guide by boltrc.com.

Dynamic Transmission Power

The system can automatically choose the power level most suitable for the situation at hand. For instance, if you fly close to the transmitter you normally only require minimal TX power and the system will therefore switch to lowest possible TX power level required to maintain a good up-link.

The maximum TX power level the system is allowed to use, can be defined by changing "Max Power" in the configuration menu.

To enable dynamic power:

1. Enter the configuration menu, select "General" and "Dyn. Power"
2. Toggle "Off" to "On" by pressing Down, press Left to apply the change
3. The current dynamic TX power level is displayed in the main display

Transmission frequency

The TBS CROSSFIRE supports two different frequency bands, depending on your local regulation. The frequency is locked to your locale when you upgrade the firmware, but can be changed in TBS AGENT.

Below is a general overview of the primary frequency segmentation.

| General area	Frequency
ITU Region 1 - Europe/Africa/Middle East	868 MHz SRD band
ITU Region 2 - America/Greenland	915 MHz ISM band
ITU Region 3 - Asia/Oceania	915 MHz ISM band

To change frequency band:

1. Power up both the transmitter and receiver
2. Enter the configuration menu, select "General" and "Frequency"
3. Pick the either 868MHz or 915Mhz depending on your locale and press Enter

The frequency change is instant, and affects transmitter and receiver. It can even be changed in-flight if necessary.

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Operating modes
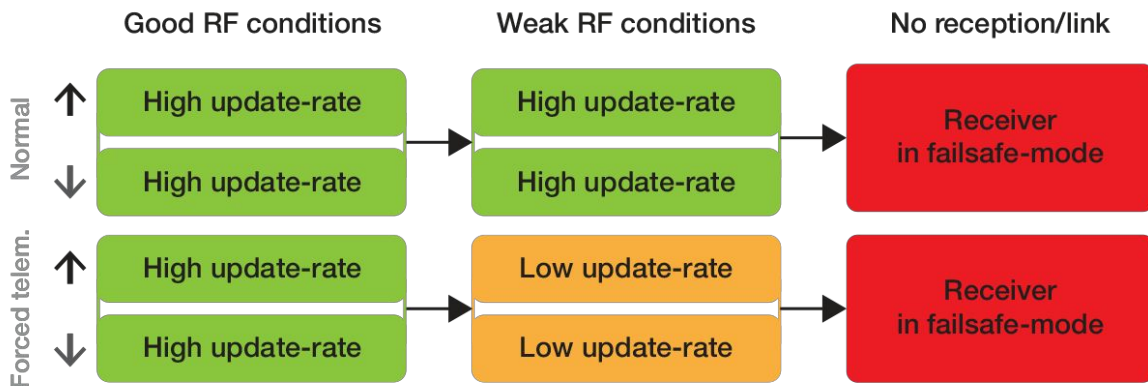
The link has two operation modes; the first is "Normal"-mode where up-link and down-link always updates at 50Hz (50 times per second) and the second is "Forced Telemetry"-mode the transmitter judges the down-link and changes between 50Hz and 4Hz update rate.

In "Normal"-mode does not switch to the low update rate, this helpful where your transmitter is in a area with high-noise and unpredictable conditions, e.g. if you are standing on a skyscraper next to an antenna, the return-link may be lost while the uplink is still going strong. In these situations it is preferential to keep uplink regardless of the downlink condition. Please note that the this mode does not guarantee failure-free operation in urban environments. If you are planning to fly in RF-noisy places always ensure that you have the proper failsafe procedures in place and that you measure your RF environment and choose the most suitable frequency and/or output power for your mission goals.

However, in "Forced Telemetry"-mode the link relies on the telemetry communication to provide link status info, RSSI, etc. If the downlink (receiver-to-transmitter link) fails, the link switches to a lower update rate to improve signal range by a factor of four (additional 12dBi of sensitivity). If the down link is close to the range limit it will switch to 4Hz to keep receiving with the same transmitting power from the receiver. The reason for this the huge difference of the transmitting power between the CROSSFIRE transmitter and the CROSSFIRE receiver.

To change link mode:
1. Enter the configuration menu, select "General"
2. Toggle between "Normal" and "Forced Telemetry""
3. Press Left to enable the new link mode

Re-bind receiver

If you need to rebind the receiver, enable "Bind" in the TBS CROSSFIRE transmitter configuration menu and, with the receiver already powered on, press the "BIND" button once. The display should display "Binding complete".

Note that there is no complicated - "3-hands-required" - plug-in and push button procedure. Just power your model, wait for the receiver to turn on and then push the "Bind"-button.
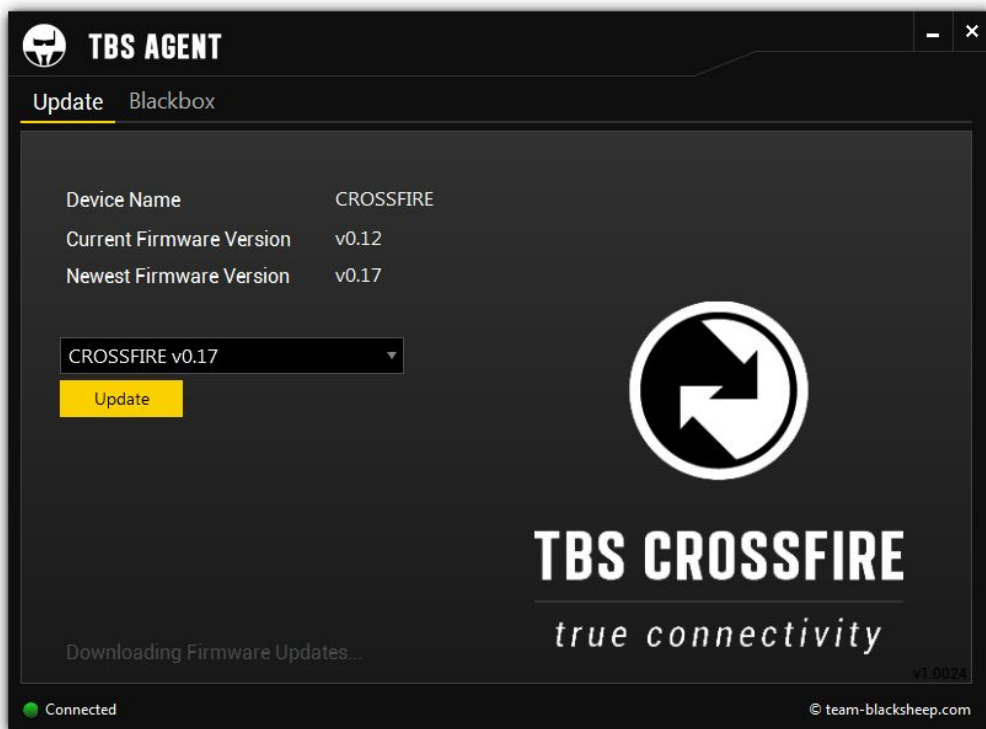
Firmware upgrade

Updates to the transmitter and receiver is applied using our TBS AGENT software. This takes care of all the downloading of the latest firmware, verification- and upgrade process.

Installing TBS Agent

Download the installer from http://www.team-blacksheep.com/corepro/agent (Windows7/8, 64-bit required) - no drivers needed to use the application, but an Internet connection is required to download the latest firmware versions.

Turn off the radio or disconnect any model batteries. Plug in a micro-USB cable on the transmitter or receiver, power is provided via USB. The software will automatically detect the device and offer you the option to upgrade the firmware if a newer version is available.

When the status indicator is green and says "Connected", you can upgrade or downgrade the firmware.

To upgrade the firmware, select the latest version from the drop-down menu and click Update. You can also upgrade the Crossfire receiver via the CORE PRO if it is connected on BST. Rapid blinking indicates that the process is working and being updated. The process will take about 1 minute. Check all settings after the process is finished.

Over-the-air Software Updates

As of V1.06, the TBS CROSSFIRE supports over-the-air software updates to the receiver. This means that the last time you ever need to remove your receiver from the aircraft to reach the USB socket is your update to

V1.06 or higher. To use over-the-air software updates, connect your CROSSFIRE transmitter to the TBS Agent and run the update. Once finished, bind to your receiver and follow the instructions on the OLED screen as normal. Apply this update once for each aircraft/receiver you have set up.

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Antennas

The TBS CROSSFIRE kit comes with standard dipole antennas, these are perfect for normal flying. Tuning antennas (handmade from Ukraine, shown in the photo above) are available as upgrade of you want the absolute best signal quality.

Metallic objects, such as cables or handles, should be kept away from the antenna while it is in use, from both the transmitter and the receiver.

The amount of clearance required is higher for lower frequencies than it is for higher frequencies. To achieve the best range possible, the 900 MHz antenna needs to be almost 60% higher compared to a normal 2.4GHz setup. In normal use try to hold the radio fairly high off the ground and with the antenna vertical, without straining yourself of course. This is also a good technique you can use to quickly improve the RF transmission if the link is about to fail or you briefly lost the signal. Standing on a hillside or on top of a slope also helps to improve the conditions and range.

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 written and designed by ivc.no in cooperation with TBS.

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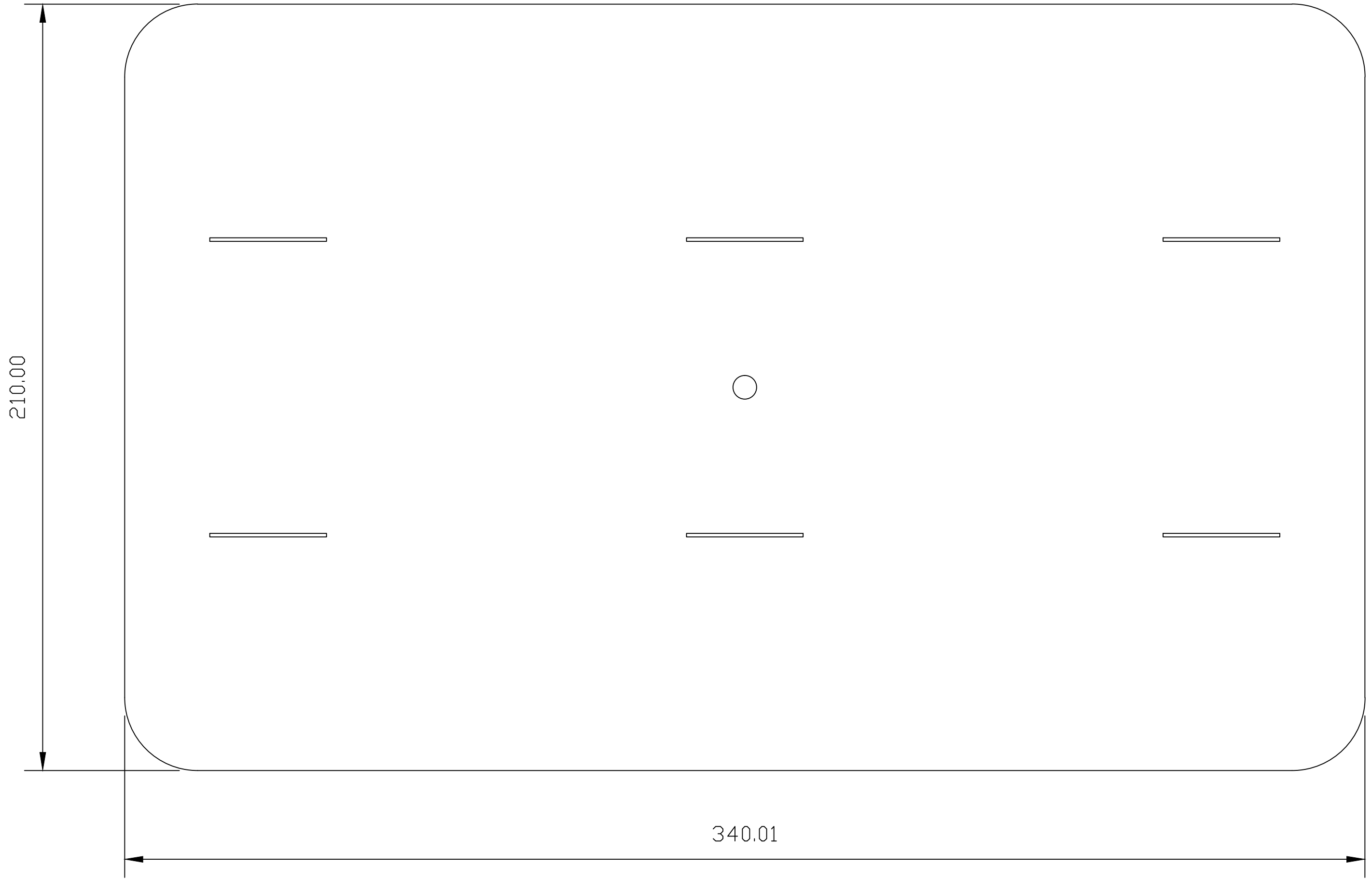
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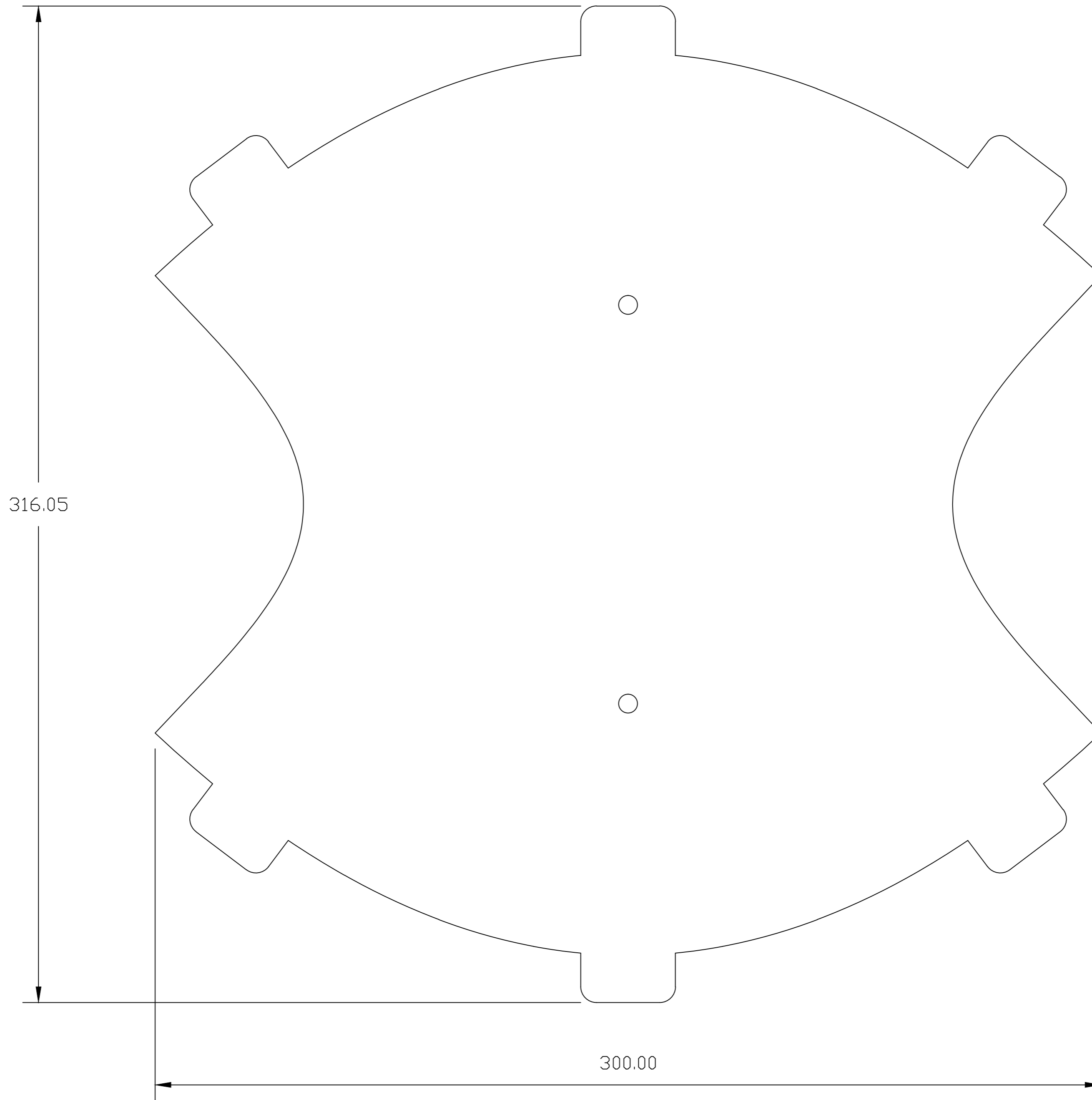
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Parabolic reflector - front card die-cut (Dimension in mm)