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FrSky Telemetry MANUAL

The system described in this manual allows an operator to display Pixhawk flight and safety information on the Taranis controller.

1. Prerequisites

	Equipment needed		Comments
	Pixhawk autopilot		Must flash Pixhawk with C&T's FrSky telemetry firmware (see instructions below).
	FrSky Taranis or Taranis Plus		Must (1) update Taranis firmware to OpenTX 2.1.x (2) copy lua script files onto Taranis SD card (3) configure Taranis to discover sensors and execute scripts (see instructions below).
	FrSky X6R or X8R receiver		The X8R receiver usually comes with the Taranis.
	Pixhawk TTL serial to FrSky SmartPort converter		Needed to connect the Pixhawk to the FrSky X6R or X8R receiver. Converter available at craftandtheoryllc.com Length: 8"/20cm; weight: 0.1oz/2.5g
	USB A to micro-B USB cable		Needed to connect the Pixhawk to the computer
	USB A to mini-B USB cable		Needed to connect the Taranis to the computer
OPTIONAL	FrSky SP-FLVS Smart Port LiPo voltage sensor	(OPTIONAL)	System compatible with the FrSky SP-FLVS sensor. To install, connect the SP-FLVS sensor between the converter and the X6R or X8R receiver.

2. Installation instructions

A zip file containing the following files was provided for download along with your purchase:

File/folder name	Description
Manual.pdf	This installation and user manual
ArduCopter-v2.px4	A compiled ArduCopter firmware, with XPort, which must be flashed onto your Pixhawk.
"SDcard" folder	The contents of this folder must be copied to the root directory of the Taranis SD card.
Taranis_settings.eepe	EEPROM file containing customized settings for the Taranis to enable FrSky telemetry.

The manual and the contents of the "SDcard" folder may not be published or distributed to anyone, in whole or in part, without Craft and Theory's express permission. No derivative work may be prepared based upon this work.

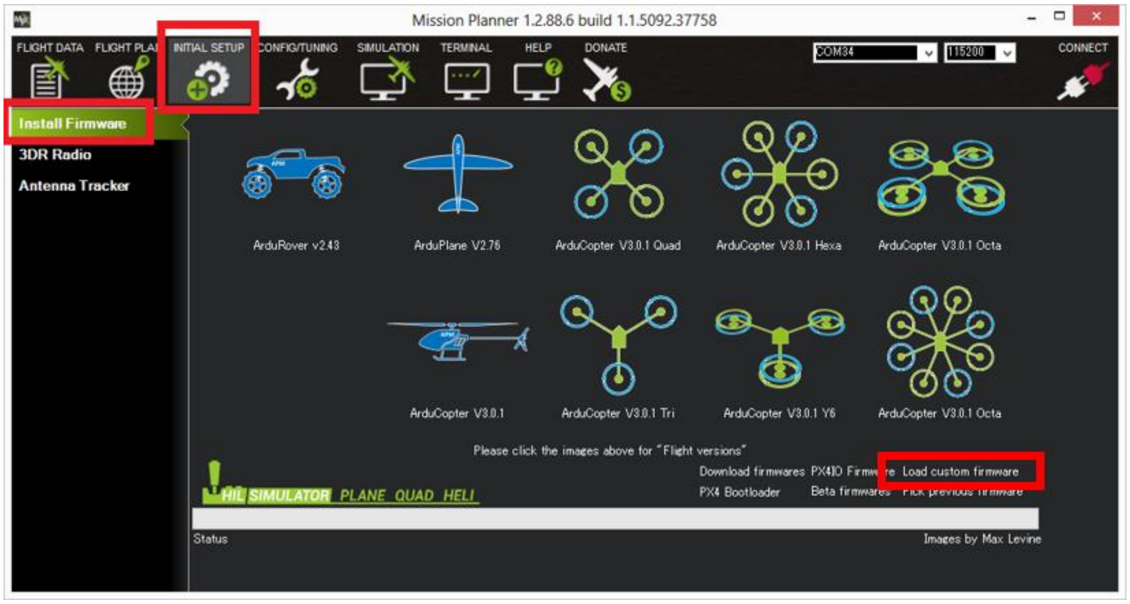
Pixhawk autopilot setup

➢ **Load C&T's FrSky telemetry firmware, featuring XPort, onto the Pixhawk:**

1. Retrieve ArduCopter-v2.px4 from the zip file provided with your purchase or download the latest version from http://github.com/craftandtheory/FrSkyTelemetry

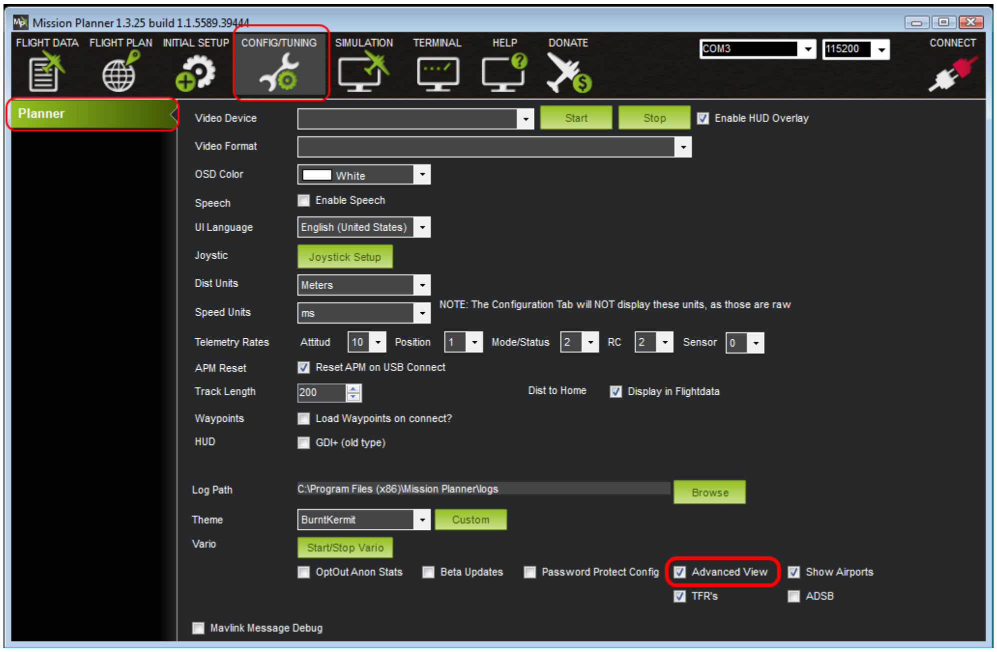
2. Download and install Mission Planner. Connect the Pixhawk via USB.

3. In Mission Planner, click on the "INITIAL SETUP" top menu icon. In the "Install Firmware" tab, click on "Load custom firmware," locate and select the firmware to flash (ArduCopter-v2.px4), and follow the rest of the flashing instructions.



Mission Planner interface showing how to load a custom firmware.

If the “Load custom firmware” option is not found, enable the option by clicking on the “CONFIG/TUNING” top menu icon and checking “Advanced View” in the “Planner” tab.



Video Device [ ] Start Stop ☑ Enable HUD Overlay

Video Format [ ]

OSD Color White

Speech ☐ Enable Speech

UI Language English (United States)

Joystic Joystick Setup

Dist Units Meters

Speed Units ms NOTE: The Configuration Tab will NOT display these units, as those are raw

Telemetry Rates Attitud 10 Position 1 Mode/Status 2 RC 2 Sensor 0

APM Reset ☑ Reset APM on USB Connect

Track Length 200 Dist to Home ☑ Display in Flightdata

Waypoints ☐ Load Waypoints on connect?

HUD ☐ GDI+ (old type)

Log Path C:\Program Files (x86)\Mission Planner\logs Browse

Theme BurntKermit Custom

Vario Start/Stop Vario

☐ OptOut Anon Stats ☐ Beta Updates ☐ Password Protect Config ☑ Advanced View ☑ Show Airports

☑ TFR's ☐ ADSB

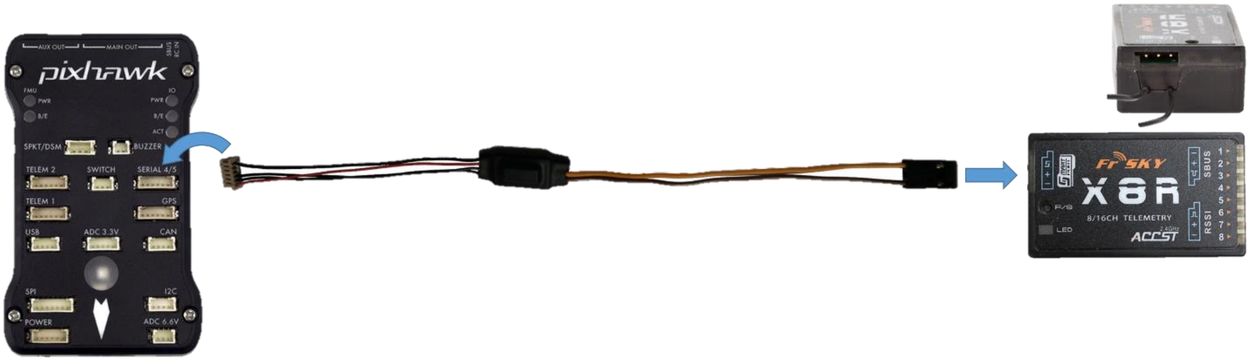
☐ Mavlink Message Debug

Mission Planner interface showing how to enable the advanced view.

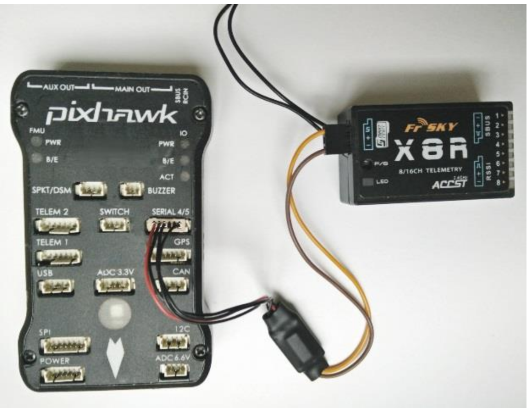
General instructions on how to flash a firmware onto the Pixhawk are available here: http://copter.ardupilot.com/wiki/common-loading-firmware-onto-pixhawk/

Compared to the original ArduCopter solution, the XPort implementation offers enhanced performance and notable improvements in capabilities (HUD, MAVLink messages, failsafes, etc.). **The ArduCopter-v2.px4 firmware file MUST be the one provided by Craft and Theory. Any other firmware differs in content and will cause the interface not to function.**

4. Connect the converter to the SERIAL 4/5 port on the Pixhawk and to the Smart.Port port on the X6R or X8R.



Once plugged in, the setup should look like this (RC channels connection between Pixhawk and receiver – e.g., SBUS – not shown):

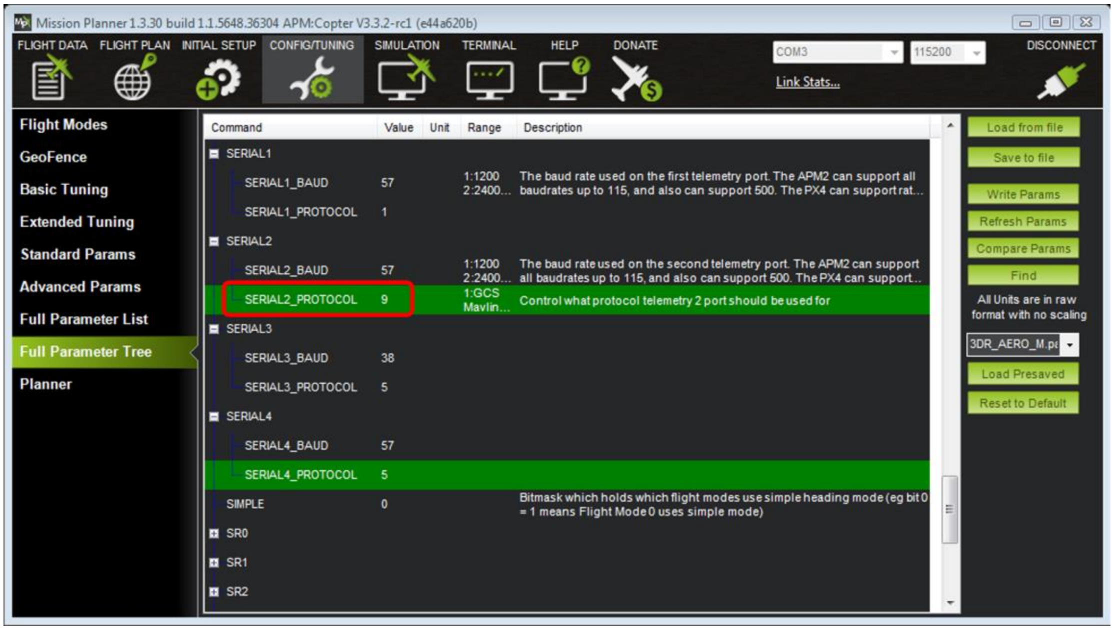


Hardware setup of the FrSky telemetry link.

You can alternatively connect the converter to the TELEM1, TELEM2, or GPS port on the Pixhawk. You must then set in Mission Planner the corresponding parameter to the value “9”:

Port used	Parameter
TELEM1	SERIAL1_PROTOCOL
TELEM2	SERIAL2_PROTOCOL
GPS	SERIAL3_PROTOCOL
SERIAL 4/5	SERIAL4_PROTOCOL

Don’t forget to set the other SERIAL#_PROTOCOL parameters back to their default values if not used for the converter as only one port can be used for FrSky at a time!



Command	Value	Unit	Range	Description
SERIAL1				
SERIAL1_BAUD	57		1:1200 2:2400...	The baud rate used on the first telemetry port. The APM2 can support all baudrates up to 115, and also can support 500. The PX4 can support rat...
SERIAL1_PROTOCOL	1			
SERIAL2				
SERIAL2_BAUD	57		1:1200 2:2400...	The baud rate used on the second telemetry port. The APM2 can support all baudrates up to 115, and also can support 500. The PX4 can support...
SERIAL2_PROTOCOL	9		1:GCS Mavlin...	Control what protocol telemetry 2 port should be used for
SERIAL3				
SERIAL3_BAUD	38			
SERIAL3_PROTOCOL	5			
SERIAL4				
SERIAL4_BAUD	57			
SERIAL4_PROTOCOL	5			
SIMPLE	0			Bitmask which holds which flight modes use simple heading mode (eg bit 0 = 1 means Flight Mode 0 uses simple mode)
SR0				
SR1				
SR2				

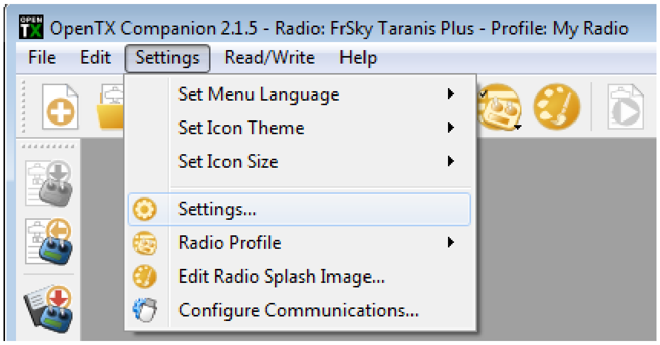
Example Pixhawk configuration where the converter is connected to TELEM2.

Taranis setup

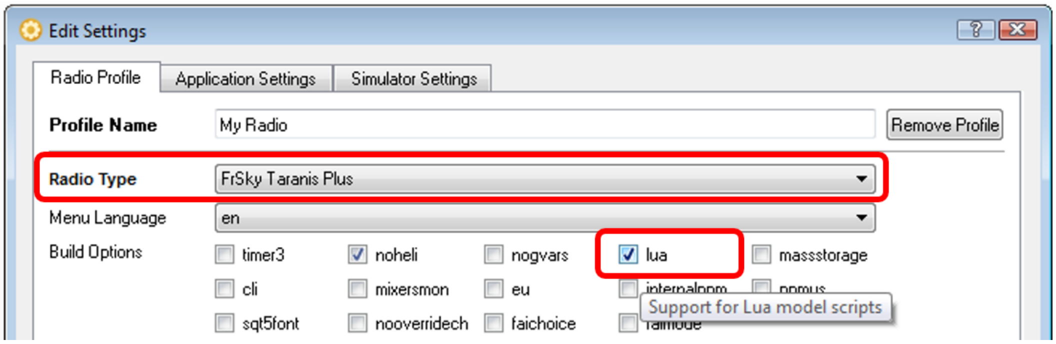
➢ Update Taranis firmware to OpenTX 2.1.x

1. Download and install the latest version of OpenTX Companion from http://www.open-tx.org/downloads.html

2. Open the OpenTX Companion program, then go to Setting >> Settings


OpenTX Companion 2.1.5 - Radio: FrSky Taranis Plus - Profile: My Radio
File
Edit
Settings
Read/Write
Help
Set Menu Language
Set Icon Theme
Set Icon Size
Settings...
Radio Profile
Edit Radio Splash Image...
Configure Communications...

3. Select your "Radio Type" (Taranis or Taranis Plus), make sure the lua build option is checked, then press OK.



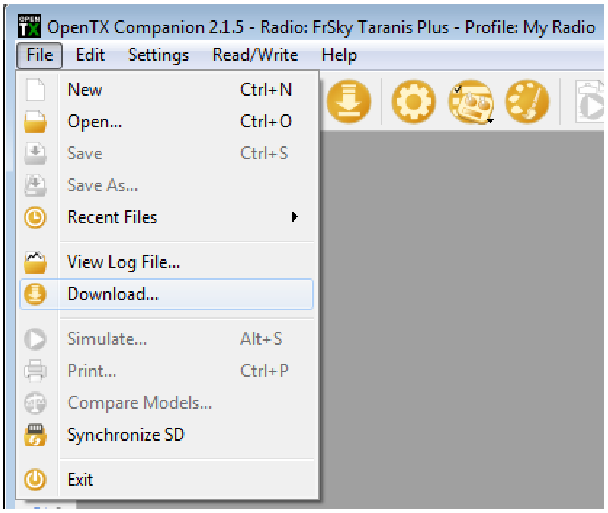
Profile Name My Radio

Radio Type FrSky Taranis Plus

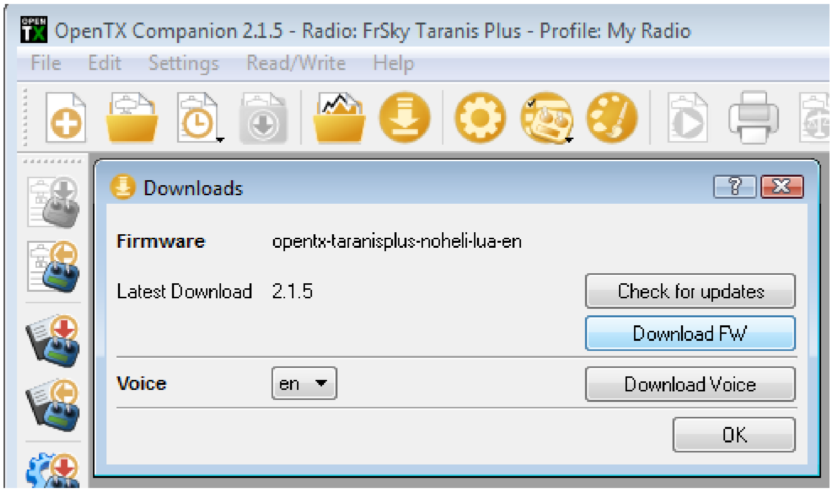
Menu Language en

Build Options
□ timer3 ☑ noheli □ nogvars ☑ lua □ massstorage
□ cli □ mixersmon □ eu □ internalppm □ ppmus
□ sqt5font □ nooverridech □ faichoice □ faimode

4. Click on File >> Download...



5. Click on the “Download FW” button and save the resulting .bin file. Once the firmware is downloaded, press OK.


OpenTX Companion 2.1.5 - Radio: FrSky Taranis Plus - Profile: My Radio

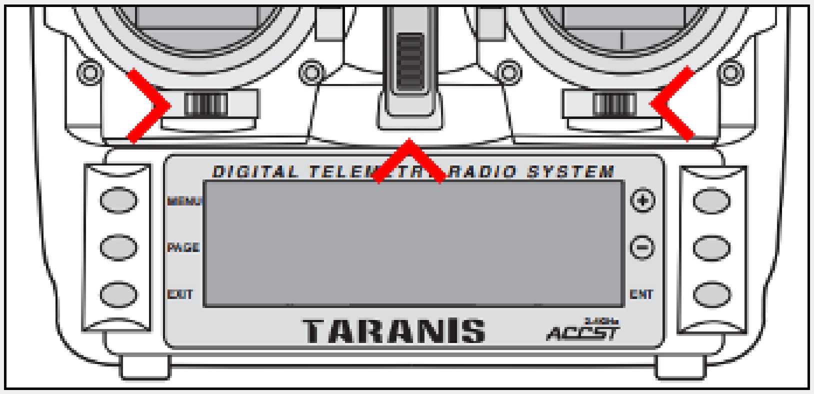
Downloads

Firmware opentx-taranisplus-noheli-lua-en

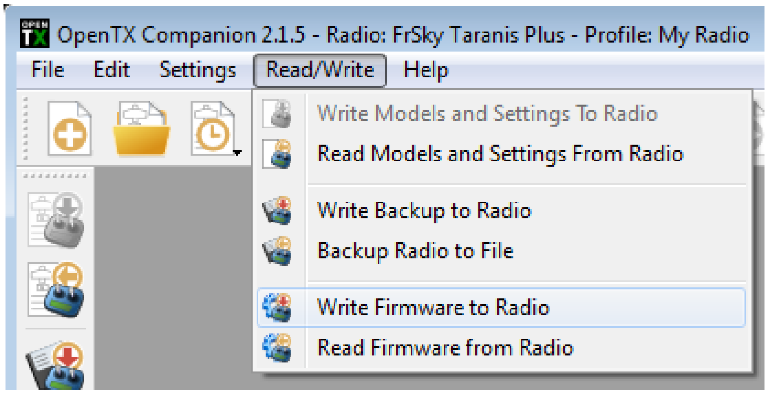
Latest Download 2.1.5

Voice en

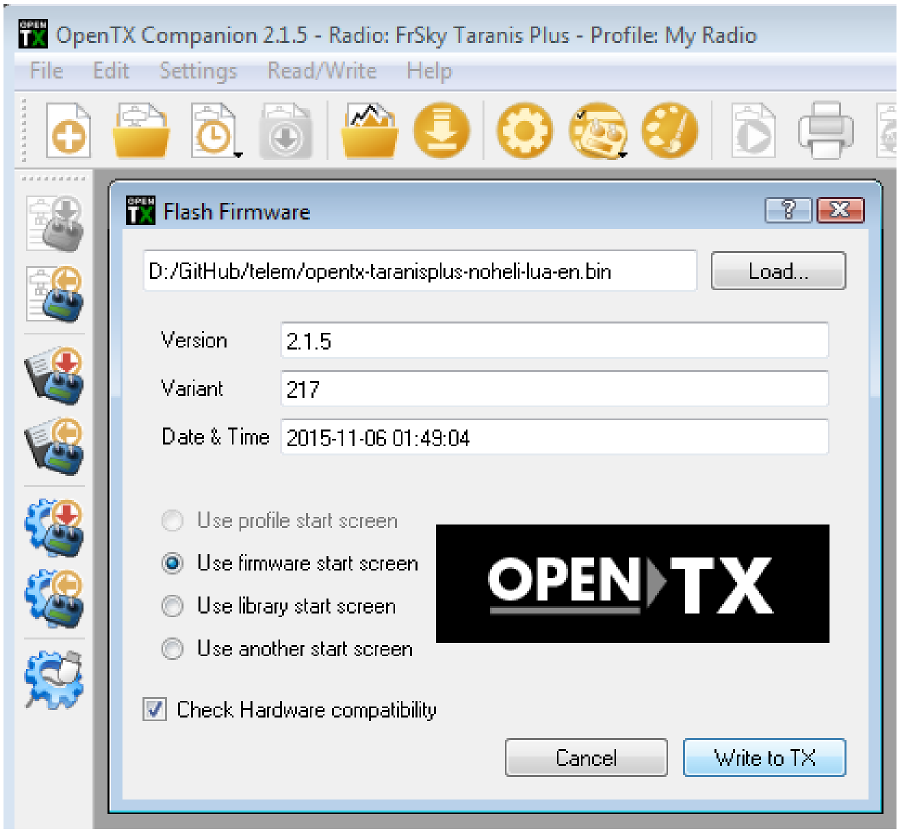
6. Enter bootloader mode on the Taranis by sliding both horizontal trims, each under the main sticks, to the center and then turning the Taranis on. The top of the Taranis LCD screen should now display “Taranis Bootloader.”



7. Connect a USB cable between the Taranis and the computer. “USB Connected” should appear in the center of the Taranis LCD screen. Click on Read/Write >> Write Firmware to Radio.


OpenTX Companion 2.1.5 - Radio: FrSky Taranis Plus - Profile: My Radio

8. Locate/load the firmware (.bin) which was downloaded earlier, then click on the “Write to TX” button. A popup window should display a progress bar which will eventually reach 100%. If flashing is successful, “Flashing done” will appear. Click on the “Close” button to close the popup window.



D:/GitHub/telem/opentx-taranisplus-noheli-lua-en.bin

Version: 2.1.5

Variant: 217

Date & Time: 2015-11-06 01:49:04

○ Use profile start screen
● Use firmware start screen
○ Use library start screen
○ Use another start screen

☑ Check Hardware compatibility

➢ Copy script files onto Taranis SD card

1. Retrieve the content of the “SDcard” folder from the zip file provided with your purchase.

2. With the Taranis still in bootloader mode and connected to the computer via USB, extract the contents of the “SDcard” folder to the Taranis SD card (the SD card should appear as a computer drive contains multiple folders, including one named SCRIPTS).

➢ Configure Taranis to discover emulated sensors and execute scripts

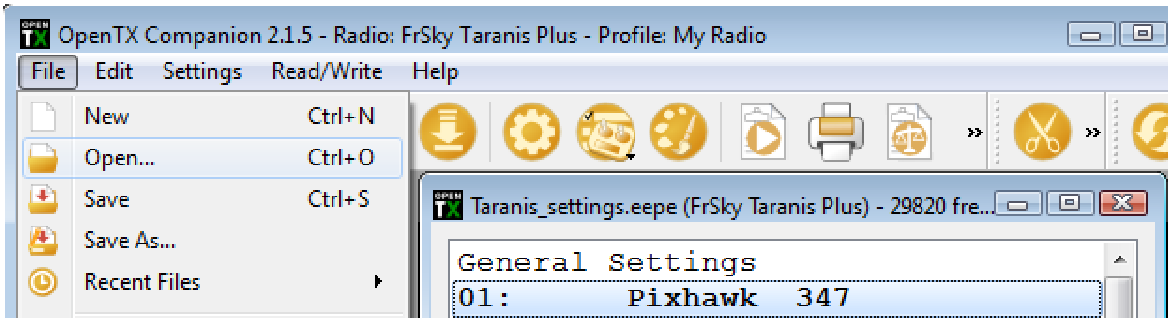
Two options (A or B) are offered depending on whether the Taranis already has a model configured for your multicopter which you want to keep.

Option A. If you are willing to start with a new Taranis configuration (simple):

For convenience, a Taranis settings file is provided, which alleviates the need for any of the steps shown in Option B. The drawback is that you will lose any settings currently on the Taranis (which can be backed up using OpenTX Companion before overwriting them).

1. Retrieve Taranis_settings.eepe from the zip file provided with your purchase or download from http://github.com/craftandtheory/FrSkyTelemetry

2. In OpenTX Companion, click on File >> Open... Locate and select the Taranis_settings.eepe file and press the "Open" button. A window showing the "Pixhawk" model should appear in OpenTX Companion.

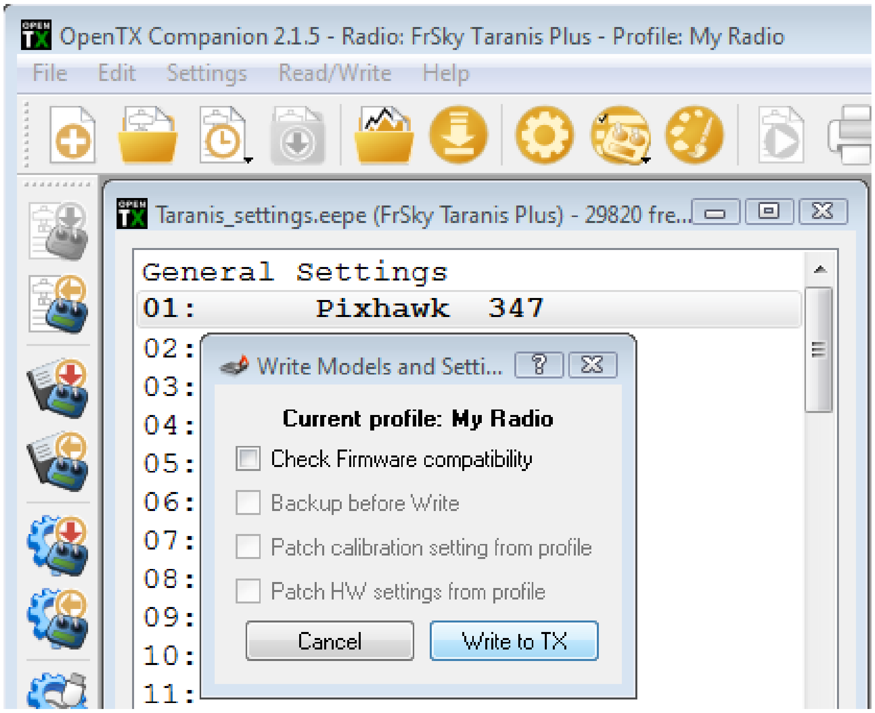


OpenTX Companion 2.1.5 - Radio: FrSky Taranis Plus - Profile: My Radio

Taranis_settings.eepe (FrSky Taranis Plus) - 29820 fre...

General Settings
01: Pixhawk 347

3. With the Taranis still connected in bootloader mode to the computer via USB, click on Read/Write >> Write Models and Settings To Radio. Click on the "Write to TX" button. A popup window should display a progress bar which will eventually reach 100%. Once complete, click on the "Close" button to close the popup window. Unplug the USB cable and turn off the Taranis.



OpenTX Companion 2.1.5 - Radio: FrSky Taranis Plus - Profile: My Radio

Taranis_settings.eepe (FrSky Taranis Plus) - 29820 fre...

General Settings
01: Pixhawk 347
02:
03:
04:
05:
06:
07:
08:
09:
10:
11:

Write Models and Setti...

Current profile: My Radio

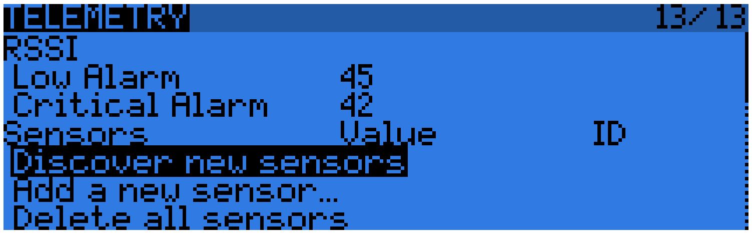
☐ Check Firmware compatibility
☐ Backup before Write
☐ Patch calibration setting from profile
☐ Patch HW settings from profile

4. The Taranis may need to be binded to the receiver since the Taranis settings have been overwritten. Other settings may differ from your previous configuration, so you are advised to check all settings before any flight.

Option B. If you want to keep your Taranis configuration/models (advanced):

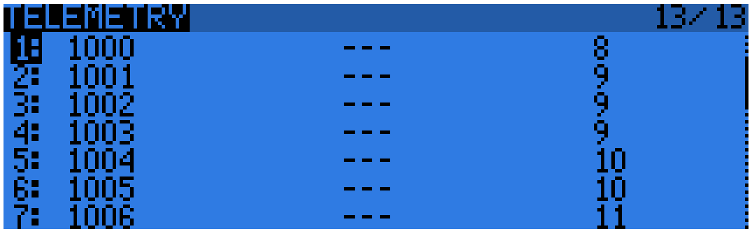
1. The Pixhawk emulates FrSky sensors and OpenTX 2.1.x requires the sensors connected to the FrSky receiver to be discovered. To discover the emulated sensors, unplug the USB cable, turn off the Taranis, then turn it back on normally (not in bootloader mode). Repeat the following steps for each model with which you want to use the FrSky Telemetry capability:

2. Press the MENU button, then long press the PAGE button to get to the TELEMETRY page. Press the - button to select "Discover new sensors" and press ENTER. The Taranis LCD screen should display "Stop discovery."



```
TELEMETRY                                        13/13
RSSI
 Low Alarm              45
 Critical Alarm         42
Sensors                 Value            ID
 Discover new sensors
 Add a new sensor...
 Delete all sensors
```

3. Power on the Pixhawk and make sure the FrSky receiver is powered. Wait approximately 15 seconds. The Taranis should discover the emulated sensors based on the data transmitted by the Pixhawk. The sensors must all be properly discovered for the scripts to run. The Taranis LCD screen should show the following sensors as discovered, in addition to one named "RSSI":

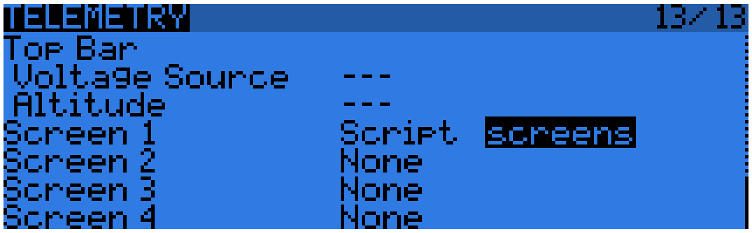


```
TELEMETRY                                        13/13
1:  1000                ---              8
2:  1001                ---              9
3:  1002                ---              9
4:  1003                ---              9
5:  1004                ---              10
6:  1005                ---              10
7:  1006                ---              11
```

If you intend to use a FrSky SP-FLVS Smart Port LiPo voltage sensor, make sure the FLVS sensor (named "Cels") gets discovered too.

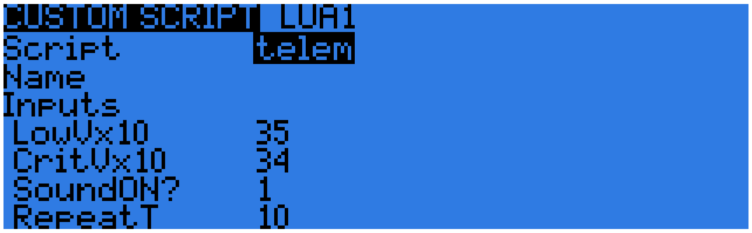
4. Once the sensors are discovered, scroll down using the - button, and highlight the "none" entry next to "Screen 1." Once Screen 1 is highlighted, press ENT, then navigate the choices with the +/- buttons until "Script" appears. Press ENT to validate, then press - to move to the right (highlighting "- - -"). Press ENT to select which lua script to run. Select "screens" using the +/- buttons, then press ENT to

validate. The “screens” lua script handles all the display capabilities. The Taranis LCD display should then look like this:



```
TELEMETRY                                    13/13
Top Bar
 Voltage Source       ---
 Altitude             ---
Screen 1              Script  screens
Screen 2              None
Screen 3              None
Screen 4              None
```

5. Press EXIT, long press PAGE to get to the CUSTOM SCRIPT page, then press ENT to edit LUA1. On the LUA1 page, press ENT to select which lua script to run. Select “telem” using the +/- buttons, then press ENT to validate. The “telem” lua script handles all the data parsing and sounds capabilities.



```
CUSTOM SCRIPT  LUA1
Script         telem
Name
Inputs
 LowVx10       35
 CritVx10      34
 SoundON?      1
 RepeatT       10
```

From this screen, several parameters can also be configured:

- LowVx10: defines the cell voltage level at which the low voltage alarm will blink and sound (default: 3.5V),
- CritVx10: defines the cell voltage level at which the critical voltage alarm will blink and sound (default: 3.4V),
- SoundON?: defines whether the sound alarms are on (default: ON; set to 0 to turn off),
- RepeatT: alarms defines the period in seconds at which the following will sound: critical cell voltage, battery failsafe, and EKF failsafe.

6. Once configuration is complete, turn off the Taranis or press EXIT several times to get back to the main Taranis page.

3. Display description and usage

Turn on the Taranis. From the main page, long press on the PAGE button. If the Taranis is configured properly, the LCD display should show this screen:

Press PAGE
to continue

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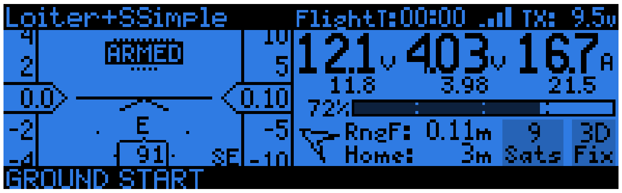
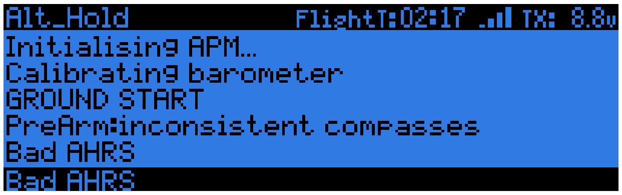
Press PAGE to continue. There are two display screens provided in the user interface. Press PAGE to cycle between the Flight screen and the MAVLink screen.



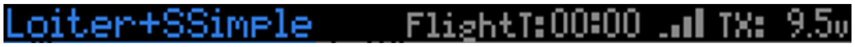
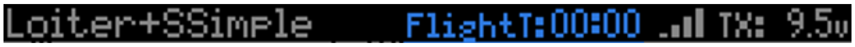
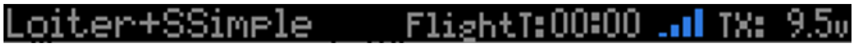
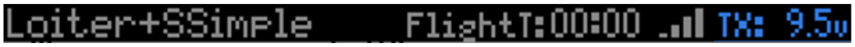
Flight screen

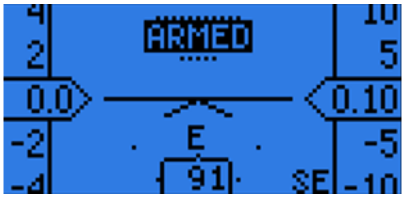

Alt_Hold FlightT:02:17 TX: 8.8v
Initialising APM...
Calibrating barometer
GROUND START
PreArm:inconsistent compasses
Bad AHRS
Bad AHRS

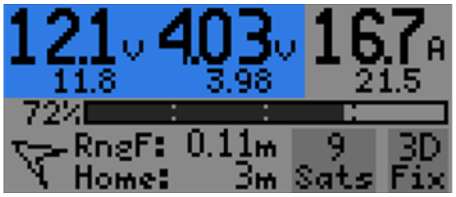
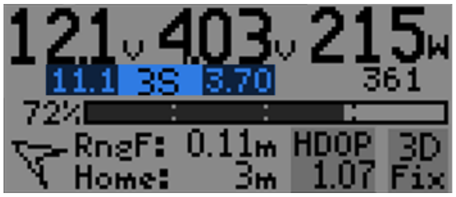
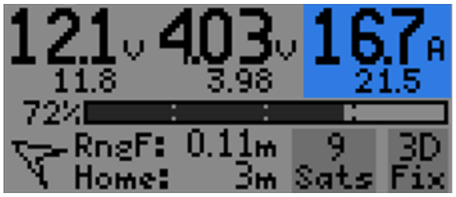
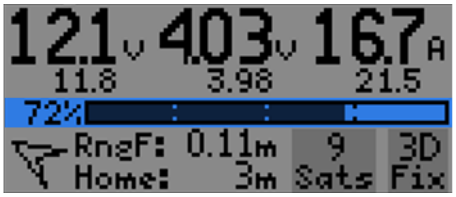
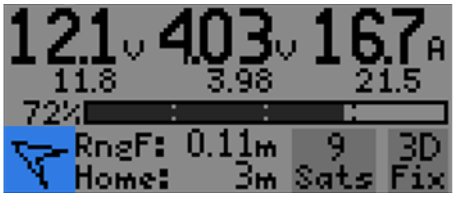
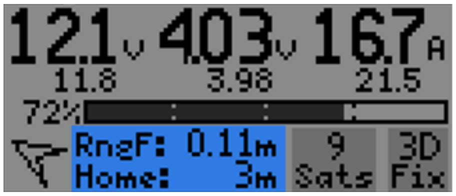
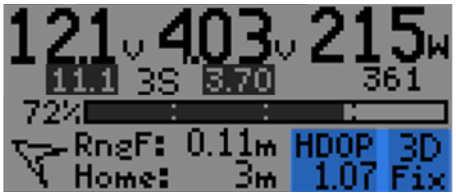
MAVLink screen

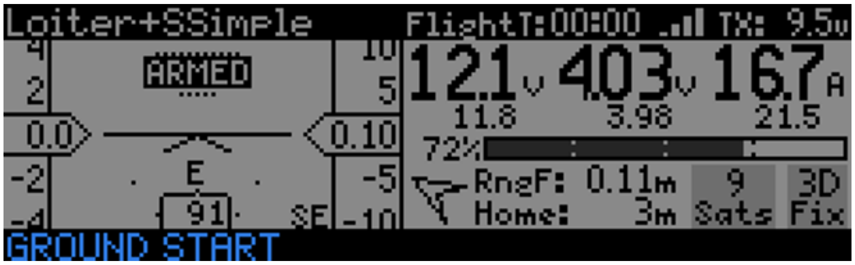
Flight screen

The first screen contains the following flight and safety information from the Pixhawk:

Top bar	
Flight mode + simple/super simple mode.	 Loiter+SSimple FlightT:00:00 TX: 9.5v
Flight timer showing actual flight time based on landing detector.	 Loiter+SSimple FlightT:00:00 TX: 9.5v
Radio link quality between Taranis and receiver (link starts to become unreliable at 2 or less bars).	 Loiter+SSimple FlightT:00:00 TX: 9.5v
Taranis battery voltage.	 Loiter+SSimple FlightT:00:00 TX: 9.5v

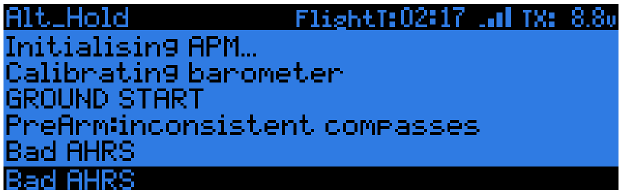
Left panel		
HUD showing vehicle attitude (each line is 10° pitch increments), horizontal speed on left, altitude on right, and heading with rotating compass bezel at the bottom.	 ARMED 4 2 0.0 -2 -4 10 5 0.10 -5 -10 E 91 SE	Additionally, ARMED/DISARMED appears for five seconds in the HUD. Battery failsafe and EKF failsafe alerts are shown blinking in the HUD.

Right panel		
Battery pack voltage from power module (left) and the lowest LiPo cell voltage (right). Cell voltage from SP-FLVS sensor (if present), otherwise calculated based on the battery pack voltage.	 12.1 V 4.03 V 16.7 A 11.8 3.98 21.5 72% RngF: 0.11m 9 3D Home: 3m Sats Fix	By default, the lowest recorded voltage is represented below in smaller font.
	 12.1 V 4.03 V 21.5 W 11.1 3S 3.70 361 72% RngF: 0.11m HDOP 3D Home: 3m 1.07 Fix	If ENT is pressed, the nominal voltage levels are displayed instead, along with the number of cells in the battery pack.
Current or power draw from power module. Press ENT to toggle between current and power.	 12.1 V 4.03 V 16.7 A 11.8 3.98 21.5 72% RngF: 0.11m 9 3D Home: 3m Sats Fix	The highest recorded current/power draw is represented below in smaller font.
Battery bar with percentage remaining (retrieved from ArduCopter). Blinks if below 25%.	 12.1 V 4.03 V 16.7 A 11.8 3.98 21.5 72% RngF: 0.11m 9 3D Home: 3m Sats Fix	Pixhawk must be configured for the power module and the battery capacity (in mAh) used: http://planner.ardupilot.com/wiki/common-3dr-power-module
Vehicle orientation relative to home position (e.g., arrow pointing straight down means Copter facing home)	 12.1 V 4.03 V 16.7 A 11.8 3.98 21.5 72% RngF: 0.11m 9 3D Home: 3m Sats Fix	Home position is determined by the Pixhawk based on a valid GPS signal.
Rangefinder distance and distance from home	 12.1 V 4.03 V 16.7 A 11.8 3.98 21.5 72% RngF: 0.11m 9 3D Home: 3m Sats Fix	Rangefinder distance will be reported only if a rangefinder is connected and configured.
Left: Number of satellites or HDOP. Press ENT to toggle between the two.	 12.1 V 4.03 V 21.5 W 11.1 3S 3.70 361 72% RngF: 0.11m HDOP 3D Home: 3m 1.07 Fix	Right: GPS fix status (no GPS, no fix, 2D, or 3D).

Message bar	
Latest MAVLink message (of type statustext, sys_status, or ekf_status_report) shown for 10 seconds (blinking for the first 3 seconds).	 Loiter+SSimple FlightT:00:00 TX: 9.5v ARMED 4 2 0.0 -2 -4 10 5 0.10 -5 -10 E 91 SE 12.1v 40.3v 16.7A 11.8 3.98 21.5 72% RngF: 0.11m Home: 3m 9 Sats 3D FixGROUND START

MAVLink screen

A second screen is accessed by pressing the PAGE button from the first screen. On the main panel of this screen, the last five MAVLink messages are shown, in the order in which they were received:



```
Alt_Hold                FlightT:02:17 TX: 8.8v
Initialising APM...
Calibrating barometer
GROUND START
PreArm:inconsistent compasses
Bad AHRS
Bad AHRS
```

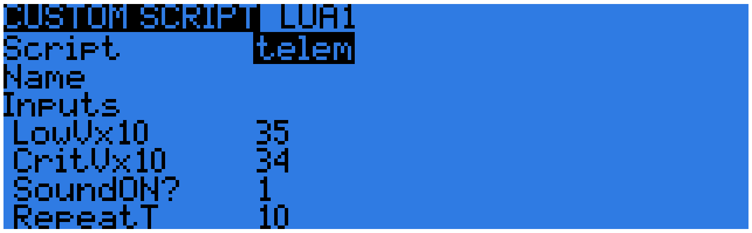
This allows the user to see the messages usually displayed in Mission Planner, including:

statustext	system_status	ekf_status_report
GROUND START	Bad GPS Health	Error velocity variance
Arm: Safety Switch	Bad Gyro Health	Error compass variance
Arm: Mode not armable	Bad Accel Health	Error pos horiz variance
PreArm: inconsistent compasses	Bad Compass Health	Error compass variance
PreArm: RC not calibrated	Bad Baro Health	Error terrain alt variance
PreArm: Compass not calibrated	Bad LiDAR Health	
Locate Copter Alarm!	Bad OptFlow Health	
...	Bad or No Terrain Data	
	Geofence Breach	
	Bad AHRS	

Sounds

The “telem” lua script will play sounds regardless of which page the Taranis screen is displaying. These sound alarms can be disabled by setting SoundON? to 0. The audible alarms consist of:

- Flight mode (e.g., “stabilize,” “loiter”),
- “Normal/simple/super simple mode,”
- “Armed”/“disarmed,”
- “Landing complete” each time the copter lands (which pauses the flight timer)
- “Message received” each time a MAVLink message of the type shown in the table above is transmitted by the Pixhawk,
- “Battery at 50%,”
- “Battery warning” when 25% is left,
- “Battery low” if the lowest cell voltage is below the LowVx10 value,
- “Battery critical” if the lowest cell voltage is below the CritVx10 value,
- “Battery failsafe” which repeats every RepeatT seconds if triggered,
- “EKF failsafe” which repeats every RepeatT seconds if triggered.



```
CUSTOM SCRIPT LUA1
Script        telem
Name
Inputs
 LowVx10      35
 CritVx10     34
 SoundON?     1
 RepeatT      10
```

“telem” script configuration screen