

## **Trainer-Students Advanced Settings for OpenTx**

There are a few different ways of doing settings for Trainer-Student radio. What I'm writing here is not about "Is it better to share access or to completely swap between trainer and student". This is something I haven't agreed on with myself yet.

At our club we are intending to do much more student training so I was looking for a way to use multiple planes, different student radios and also sharing models on different Frsky radios. So the idea is to do a copy of a model and have all the settings for student radios inside the model settings (not using the calibration/multiplier of the basic trainer radio functionality). It should also be very easy for complex models.

This should enable us to do a very fast switch from one combination to another.

Following is a description of how this can be achieved. Why this may look a little be complex at the first glimpse it is in fact rather easy because 90% is all the same for every configuration. So the actual variation is mainly done in four mixers. The rest can be done by copy and paste in companion or (for experts: doing some Lua scripts). And we are not touching the normal mixer lines of the model so the risk of messing something up is reduced.

### **Example F (my favorite)**

After some testing this is my personal favorite.

The example is a mixture of Example B and E.

The control of rudders (A/E/R) and throttle are handled separate.

To switch the plane to student the trainer has to set a hardware switch in the required position and also move the sticks (aileron, elevator, rudder) in neutral position. As soon as the trainer moves a stick (aileron, elevator, rudder) he has control again (100%). Control goes back to student when the sticks (aileron, elevator, rudder) are in neutral position again.

The same is done with throttle but independent of A/E/R . Student controls throttle only if the throttle stick of the trainer is at -100%.

It's best to set student completely off by hardware switch when starting or landing.

**Warning: When trainer sticks are in idle position but student sticks are not then engine is running. So if you want to take control over throttle as trainer while flying you have to move the throttle stick a little away from the idle position.**

#### **Step F.1**

On my Taranis x8lite S I select the trainer page of the basic radio configuration. It's important that there is no student radio connected. You set Mutliplier to 1.0 and calibrate. So everything should show zero. (Mode, weight and source on this page you do not care because they are not used in our settings.)

So we end up with values of TR... that are exactly how they transmitted from the student radio. We do not adapt this to the different student radios anymore in the basic settings of the radio. (This has to be done only once on every Master radio.)

Setup	Global Functions	Trainer	Hardware	Calibration															
		<table border="1"> <thead> <tr> <th>Mode</th> <th>Weight</th> <th>Source</th> </tr> </thead> <tbody> <tr> <td>Rud := (Replace)</td> <td>100</td> <td>CH3</td> </tr> <tr> <td>Ele := (Replace)</td> <td>100</td> <td>CH2</td> </tr> <tr> <td>Thr := (Replace)</td> <td>100</td> <td>CH4</td> </tr> <tr> <td>Ail := (Replace)</td> <td>100</td> <td>CH1</td> </tr> </tbody> </table>	Mode	Weight	Source	Rud := (Replace)	100	CH3	Ele := (Replace)	100	CH2	Thr := (Replace)	100	CH4	Ail := (Replace)	100	CH1		
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Rud := (Replace)	100	CH3																	
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Ail := (Replace)	100	CH1																	
		Multiplier 1,0																	
		Calibration 0	0	0															

## Step F.2

You are defining four mixers (channel 25, 26, 27, 28). Sources are TR1, TR2, TR3, TR4. By choosing the order you are doing the channel mapping. By defining a weight we achieve a range of 200% (-100% to +100%). Last step is to define an offset so that the center-position of the trainer sticks shows 0%. You can easily monitor the values by watching channel or mixer monitor.

The results are four channels calibrated to this specific student radio. (In this screenshot it is a very old Multiplex Pico. So the channel Tr4 is throttle, mapped to channel 27 in my Taranis. Also there is a very wide spectrum of weight I have to use. Shouldn't be like that for a modern quality radio.)

I use AETR so (Ch25=aileron, Ch26=elevator, Ch27=throttle, Ch28=rudder).

**Safety issue:** Do carefully check that the channel for throttle really achieves -100% at the minimum position!!!

Setup	Heli	Flight Modes	Inputs	Mixes	Outputs	Curves	Logical Switches	Special F
CH25				TR1 Weight(+125%) NoTrim Offset(-8%) [Tr-ail]				
CH26				TR2 Weight(+140%) NoTrim Offset(7%) [Tr-ele]				
CH27				TR4 Weight(+126%) NoTrim Offset(-9%) [Tr-thr]				
CH28				TR3 Weight(+117%) NoTrim Offset(3%) [Tr-rud]				

## Step F.3

We do need a few logical switches. The results of these are:

L13 on: means student has access to trottle

L14 on: means Student has access to aileron/elevator/rudder

L15 on: means student has access to A/E/R and SA- is switched on (60% weight for student)

L16 on: means student has access to A/E/R and SAV is switched on (80% weight for student)

Setup	Heli	Flight Modes	Inputs	Mixes	Outputs	Curves	Logical Switches	Special Functions	Telemetry	Custom Screens
L11	a <x	Ail	4		ISA↑	0,0				
L12	a <x	Ele	2		L11	0,0				
L13	a<x	Thr	-98		ISA↑	0,0				
L14	a <x	Rud	2		L12	0,0				
L15	AND	L14	SA-		----	0,0				
L16	AND	L14	SA↓		----	0,0				

#### Step F.4

For the student we need two mixer lines for every function (one for 60% and one for 80% weight).

Throttle (CH31) needs an additional mixer line for student, switched by L13.

Setup	Heli	Flight Modes	Inputs	Mixes	Outputs	Curves	Logical Switches	Special Functions
CH29	Ail Weight(+100%) NoTrim [M-Ail] := CH25 Weight(+80%) Switch(L15) NoTrim [T-Ail1] := CH25 Weight(+100%) Switch(L16) NoTrim [T-Ail2]							
CH30	Ele Weight(+100%) NoTrim [M-Ele] := CH26 Weight(+50%) Switch(L15) NoTrim [T-Ele1] := CH26 Weight(+70%) Switch(L16) NoTrim [T-Ele2]							
CH31	Thr Weight(+100%) NoTrim [M-Thr] := CH27 Weight(+100%) Switch(L13) NoTrim [T-Thr]							
CH32	Rud Weight(+100%) NoTrim [M-Rud] := CH28 Weight(+60%) Switch(L15) NoTrim [T-Rud1] := CH28 Weight(+80%) Switch(L16) NoTrim [T-Rud1]							

#### Step F.5

We change the sources of our inputs. I use AETR so it's (Ail to Ch29), (Ele to Ch30) ....

Be aware that by this you lose the Trims in the input line (from ON to OFF). So you have to edit the inputs and select the proper trim-source manually. (Example for Ail select TrmA)

(The weight and Expo you use in inputs are affecting both trainer and student accordingly. They are not part of trainer-student settings)

Setup	Heli	Flight Modes	Inputs	Mixes	Outputs	Curves	Logical Sv
I1:Ail			CH29 Weight (+100%) Expo (50%) TrmA				
I2:Ele			CH30 Weight (+100%) Expo (50%) TrmE				
I3:Thr			CH31 Weight (+100%) TrmT				
I4:Rud			CH32 Weight (+100%) Expo (50%) TrmR				

That's it.

We do not have to modify anything of the other existing settings like mixers for servos.

## If you have:

To use same model but new student radio:

- Make a copy of the model
- Adapt mixer channel 25 to 28 to new student radio

Prepare new model:

- Copy logical switches (11 to 16) (only example B and C)
- Copy mixer channel 25 to 32
- Adapt mixer channel 25 to 28 (only if other student radio)
- Modify inputs

That's if you don't want to use the scripts.

## Safety

## Security

The greatest safety risk in trainer/student operation is the unintentional engine start-up (particularly on the ground before takeoff or after landing).

It is therefore essential that you

- unlock the engine safety switch when starting only and immediately secure it after landing again.

- Switch off student operation immediately using a switch if you don't want the student to be in control.

## Reasons for unintentional motor starting

The termination of the trainer/student connection is fundamentally a potential danger. The motor could start uncontrollably.

I have found that the behavior of different connection types is quite different and cannot be predicted with certainty.

Here are some examples (disconnection, causes and consequences):

### Bluetooth, Para system:

Cause: Distance between the transmitters is too great (just a few meters are enough)  
Or the student switches off the transmitter.

Consequence: Trainer transmitter assumes the value ZERO for the student signals.  
With throttle, ZERO means half throttle.  
**The engine immediately runs at half throttle.**

### Radio with receiver (e.g. receiver with Sbus or CPPM, or via PWM/PPM converter)

Cause: Student switches off the transmitter, DSC cable disconnected, power supply for receiver switched off...

Consequence: not predictable, depends on the receiver (e.g. failsafe setting) or on the behavior of the converter.

### Cable connection:

Cause: Cable accidentally disconnected or student switches off the transmitter.

Consequence: Trainer transmitter assumes the value ZERO for the student signals.  
With throttle, ZERO means half throttle.  
**The engine immediately runs at half throttle.**

### Countermeasure:

In general, it is important to examine the possible effects of your own constellation before putting it into operation. **To do this, you should first remove the propeller and explore all the options.**

You can then see what happens when you observe the behavior of the engine. But if you want to identify the cause, it is best to also look at the values in the channel monitor (channels 25-29).

### Technical solution for Bluetooth connection:

A Bluetooth connection failure has actually led to the engine starting twice for me (once when the student switched off, once because I went to the model to align it on the runway again after a false start).

To secure this technically, I programmed the following on my transmitter:

The student radio transmits 100% (maximum) on channel 5.

In the trainer transmitter, channel 24 is set up with source TR5.

A logical switch checks whether CH24 > 99%.

An additional mixer line has been added for throttle (CH31), which always sets the throttle to trainer for throttle via “replace ” if the logical switch is set to “not on”. (see picture)

CH31	Thr Weight(+100%) NoTrim [M-Thr]
	:= CH27 Weight(+100%) Switch(L13) NoTrim [T-Thr]
	:= Thr Weight(+100%) Switch(!L17) NoTrim [M-Thr]

This can also work with other types of connection, but it doesn't have to.

## Throttle control with additional switch

If you want to control the transfer of throttle to the student with a switch, the easiest way to do this is with the following additional mixer line :

CH31	Thr Weight(+100%) NoTrim [M-Thr]
	:= CH27 Weight(+100%) Switch(L13) NoTrim [T-Thr]
	:= Thr Weight(+100%) Switch(!L17) NoTrim [M-Thr]
	:= Thr Weight(+100%) Switch(!SC↓) NoTrim [M-Thr]

Here, whenever the switch is “not SCv position ”, it is switched to trainer mode, as “ replace ” overwrites all previous mixer lines .

## Use of scripts

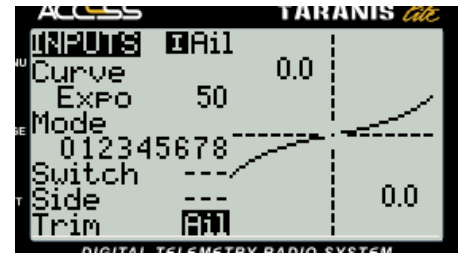
If you want to make the basic settings using a script, as described here in steps F.1 to F.5, you must proceed as follows:

- It is best to back up the model data or create a copy of the model.
- Select the desired model as active.
- Switch to the basic settings station in menu 2/7
- Start the script “SCRIPTS/TOOLS/trainer/ 0Bud\_5.lua”.

- Pressing the EXIT button takes you back to the normal menu.



- Up to and including openTx 2.3.15, the trim must be assigned manually to the inputs. The reason is a bug in the LUA API that was fixed with 2.3.16. ( see picture last line, example aileron)



- With the student transmitter connected, carry out the calibration for the student transmitter. (This only happens the first time for a student radio). To do this, start the scripts “ calAil.lua , calEle.lua , calRud.lua , calTHr.lua ) one after the other from the SD card. The calibration is similar to the calibration of a simulator (such as Phoenix). (Sometimes you have to do throttle manually.)
- Check all calibration values in the “Channel Monitor Channel 25 to 28)”. Value range should be from -100% to +100%, zero position of the rudder should really be at zero . It is very important that the throttle reaches -100% (real idle). Please also check that the direction of the deflections corresponds to that of the trainer transmitter.
- If the settings are correct, you can save them in a script. For other models for this student radio, you just start the script from the SD card and the calibration channels (25-28) are overwritten with these values.

Start the script “SCRIPTS/TOOLS/ stuRadio / stuRadio.lua ”.

A script named “radio.lua ” is stored in the same folder.

It's best to change the name of this script to something appropriate for the student radio.

- If you use a model for different student transmitters, you can easily switch from one student transmitter to another by calling the appropriate script.

## Generally

**I assume no responsibility or liability for the use of the general procedure and the function of the scripts. Every pilot is responsible for testing the settings sufficiently before putting into operation.**

ChrisOHara 8-Oct-2023