

Deviation Firmware User's Manual

Version 1.0

Table of Contents

Overview.....	3
Installation.....	4
USB & File-system.....	4
Main Page.....	5
Navigating.....	6
Menu Layout.....	6
Emulator.....	7
Version Page.....	7
Transmitter Configuration Page.....	8
Main Page Configuration.....	9
Preview.....	10
Trim Positions.....	10
Bar Graphs.....	10
Boxes.....	10
Toggle Icons.....	10
Mixer.....	11
Simple Template.....	12
Expo & Dual-Rate Template.....	12
Complex Template.....	13
Channel configuration.....	14
Trims.....	15
Model Page.....	15
Timer Page.....	16
Predefined Templates.....	17
Helicopter Setup.....	18
Step 1: Type and Swash.....	18
Step 2: Cyclic Setup.....	19
Step 3: Mixer Setup.....	19
Step 4: Aileron, Elevator, and Rudder Mixing.....	19
Step 5: Pitch Mixing.....	20
Step 6: Throttle Setup.....	21

Overview

Deviation is a replacement firmware for the Walkera Devo© series transmitters. The primary goal is to add support for multiple protocols, opening the full potential of this platform.

The core of the Deviation firmware is the mixer system, which is modeled after the system used in the Er9X firmware for the Turnigy/Flysky9x© transmitters.

Deviation also brings a USB file-system support, making it easy to manage the transmitter from any PC without the need for specialized upload/download tools.

Deviation has been designed for ultimate configurability. All model and transmitter configuration is controlled through text files which the firmware (or user) can read and write. It is easy to know exactly what is configured, as well as to modify the configuration either through the transmitter or with a text editor. The main screen is very configurable; any mix of inputs, switches, channel data, or timers can be displayed, and configured per-model. Deviation also supports customizable themes with full control over the images, fonts, and colors.

Deviation can store up to 255 different models, and uses a portable syntax that should allow sharing models between any transmitter supported by Deviation in the future.

Deviation has been internationalized. New language support can be added by simply copying a translation file into the appropriate directory on the transmitter.

Installation

Installation of Deviation is done just like upgrading the Walkera firmware. Note that Deviation will NOT overwrite Walkera models stored on the Tx. While they cannot be accessed by Deviation, they will be safely preserved should the Walkera firmware ever need to be reinstalled.

First install the deviation-x.yy.dfu using the Walkera ‘DfuSe USB Upgrade’ tool. There are 2 options on how to install the libraries.

If previously the Walkera firmware was installed, the fastest solution is to use the ‘DfuSe’ tool to install the deviation library.

Alternatively (or if this is an upgrade from a previous Deviation version) power off the Tx, and power back on holding the ‘Ent button (with the USB cable still plugged in). This will start the Tx in USB mode. Windows will now detect the transmitter as a USB drive. If the deviation lib was not installed, Windows will ask to format the drive. Format using the default options. Next unzip the deviation-lib-x.yy.zip to the Tx USB drive.

USB & File-system

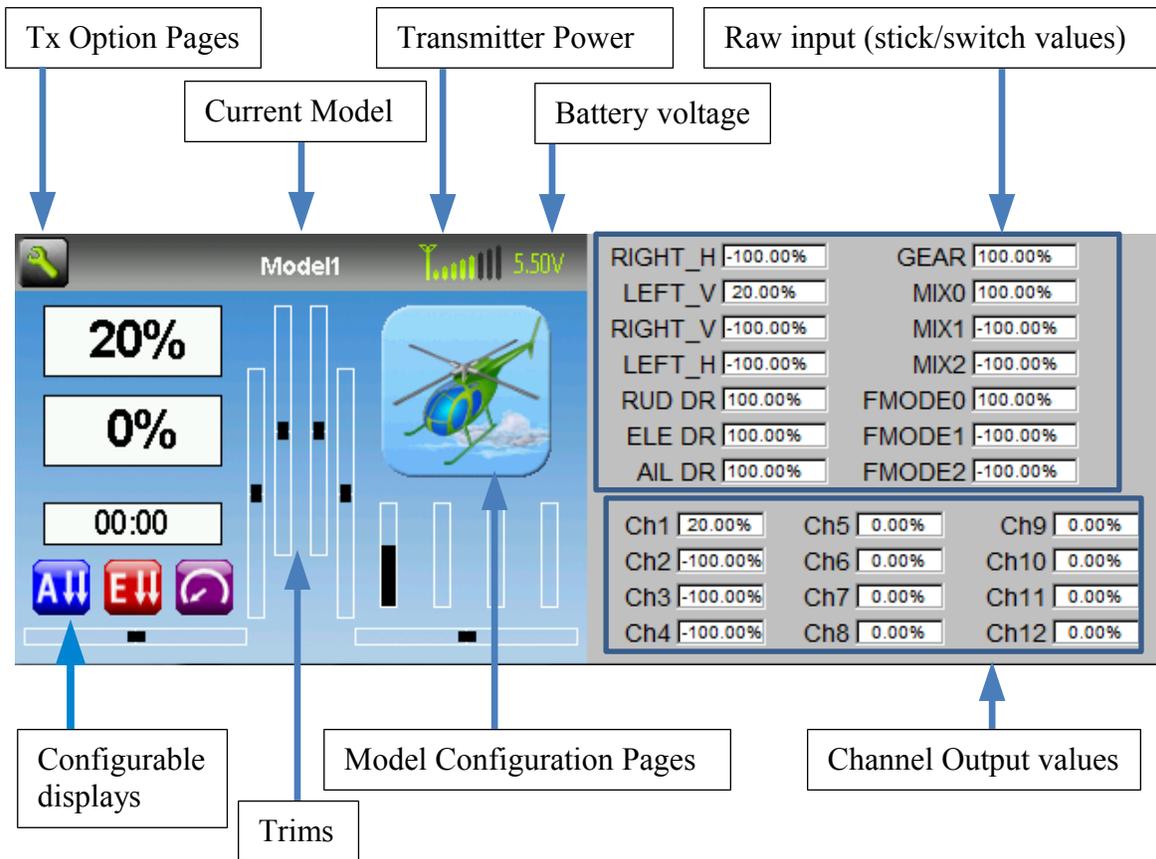
Deviation stores all configuration, bitmaps, and models as regular files on the USB file-system.

USB can be most easily enabled by holding down the ‘ENT’ button while powering up the transmitter. Files can then be easily copied to or from the Tx.

The directory structure is as follows:

\tx.ini	Transmitter config. Includes trim settings, calibration data, and the last-used model number
\media\config.ini	The color scheme and fonts for the transmitter
\media\sound.ini	Contains notes to play for various alarms
\media*.bmp	Images used for the current Tx theme
\models\default.ini	The default model, loaded whenever a model is cleared
\models\model*.ini	Configuration files for each model. Due to a limitation in the firmware, Deviation cannot create new files. It is therefore necessary to have a modelxx.ini for each model regardless of whether it is currently in use.
\modelico*.bmp	All available model icons (must be 96x96 pixels)
\templates*.ini	Configuration files used when loading predefined templates. These are nearly identical to the model configuration files, however they do not necessarily define all parameters
\language\lang*.*	Language translation files. These are UTF-8 text files containing the original English string and the respective translated string

Main Page



Tx Option Pages: Selecting this icon provides access to the main-page configuration screen; the Channel-Test screen; the frequency scanner; and USB mode

Current Model: Selecting the model-name provides access to the Load-Model screen for quick-model switching

Transmitter Power: This indicates the currently selected transmitter power. It is configured from the Model Configuration page

Battery Voltage: Numerical representation of current Tx battery state

Configurable Displays: These can be text-boxes contacting input, channel, or timer data; bar graphs displaying channel data; or icons displaying specific states (e.g. gear, flaps,...)

Trims: The trim display can be configured to show either 4 or 6 trims

Model Configuration Pages: Selecting the model icon provides access to the model configuration pages

Navigating

The transmitter menus can be navigated via touch-screen or with the physical buttons. With the touch screen, simply touching any button on the screen will immediately activate it.

When using the physical buttons, it is necessary to 1st enter navigation mode before the buttons can be accessed.

On the main page, a long-press of the 'ENT' key will enter navigation mode.

On all other pages, pressing 'UP' or 'DN' will enter navigation mode

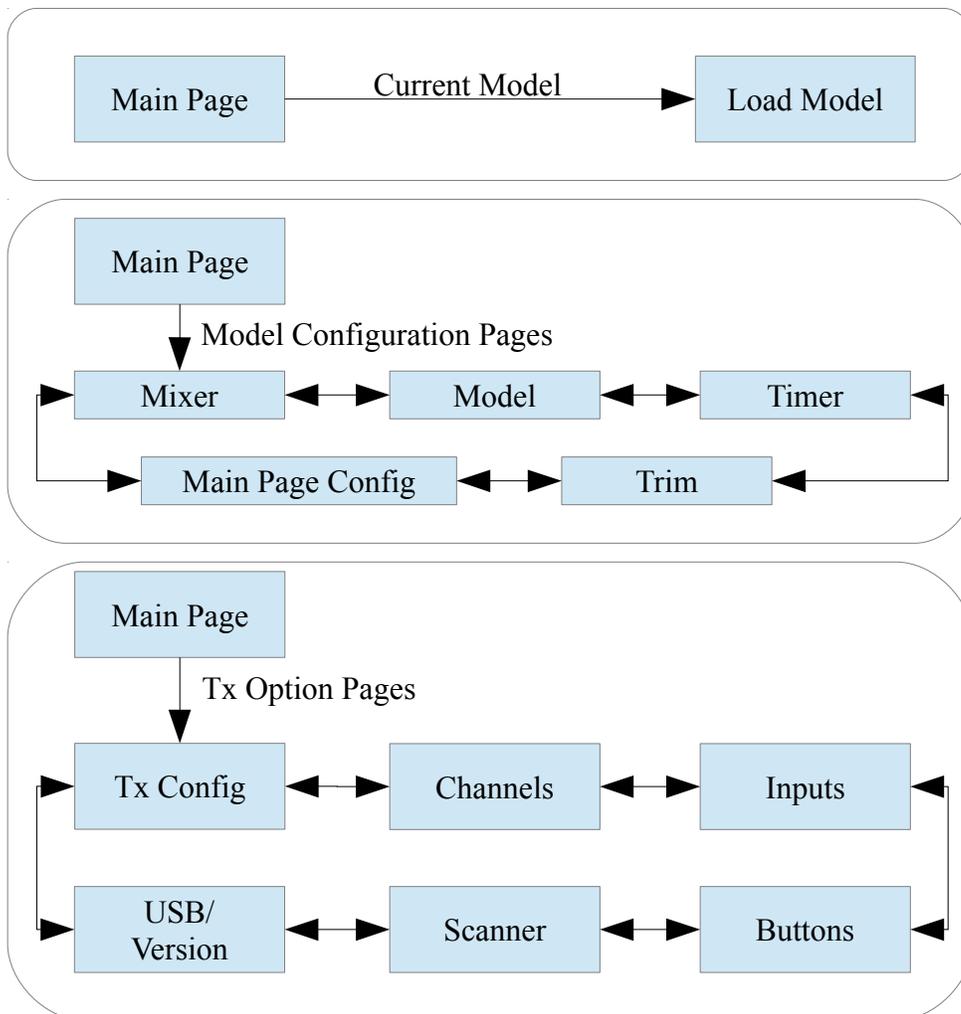
Once in navigation mode, the current widget will be highlighted, and UP/DN will select the next/previous widget.

The 'R+' and 'L-' buttons are used on spin-box widgets to increase or decrease the selected value. In some cases holding down the button will use larger step values to move more quickly to the desired value.

For Buttons and gray spin-boxes, pressing ENT' will press the button

Pressing 'ESC' will exit navigation mode. If pressed when not in navigation mode, it will move back to the main screen

Menu Layout



Emulator

The emulator provides a side-screen displaying the current virtual-stick/switch states as well as the Channel output that would be received by the servos

The emulator controls are as follows:

q/a	Throttle (Mode 2)
Q/A	Left-Vertical trim
w/s	Rudder (Mode 2)
W/S	Left-Horizontal trim
e/d	Elevator(Mode 2)
E/D	Right-Vertical trim
r/f	Aileron (Mode 2)
R/F	Right-Horizontal trim
z	Gear
x	Rudder Dual-Rate switch
c	Elevator Dual-Rate switch
v	Aileron Dual-Rate switch
b	Mix 0/1/2 switch
n	FMode 0/1/2 switch
\	Power off
Left-arrow	Left
Right-arrow	Right
Up-arrow	Up
Down-arrow	Down
Enter	Ent
Escape	Exit

Version Page

The Deviation release version can be accessed by selecting the Configuration icon from the main page, and moving left two pages. If it is ever necessary to report bugs with the Deviation firmware, include the version string found here with your report. It is also possible to enable USB from this page. **Note that doing so should never be done while the model is bound, as USB will disrupt signal transmission!**

Transmitter Configuration Page



The Configuration page defines various transmitter functions.

Language: Select an appropriate language for all text

Stick Mode: Select one of Mode 1-4.

- Mode 1 is common in Europe. Elevator and Rudder on left, Throttle and Aileron on right.
- Mode 2 is common in North America. Throttle and Rudder on left, Throttle and Aileron on right.
- Mode 3 has Elevator and Aileron on left, Throttle and Rudder on right
- Mode 4 has Throttle and Aileron on left, Elevator and Rudder on right

Backlight: Set screen brightness

Battery Alarm: Set battery voltage at which alarm will sound

Touch Screen: Enter calibration or test mode

Sticks: Calibrate the range of all analog sticks and dials

Main Page Configuration

The image displays two screenshots of the 'Main Page Config' screen, illustrating different configuration options. The top screenshot shows settings for Trims, Bars, and Boxes. The bottom screenshot shows settings for Toggles and Bar graphs.

Top Screenshot Configuration:

- Trims:** 6 Trims
- Bars:** 4 Bars
- Box 1:** Ch1
- Box 2:** Ch6
- Box 3:** Timer1
- Box 4:** Timer2
- Box 5:** Timer1
- Box 6:** Timer1
- Box 7:** None
- Box 8:** None

Bottom Screenshot Configuration:

- Toggle1:** None
- Toggle2:** None
- Toggle3:** None
- Toggle4:** None
- Bar 1:** Ch1
- Bar 2:** Ch2
- Bar 3:** Ch3
- Bar 4:** Ch4
- Bar 5:** None
- Bar 6:** None
- Bar 7:** None
- Bar 8:** None

Navigation and control elements include: 'Return to main screen', 'Main Screen Preview', 'Next Page', 'Prev Page', 'EXIT', and 'Main Page Config' header.

The Main Page Configuration page provides customized control of the main-page layout. The display of boxes, bars, icons, and trims along with their contents can all be controlled from here.

Preview

The preview box portrays an approximation of the current configuration, and can be used as a reference to see how changing options will effect the main screen.

Trim Positions

There are 3 options for the Trim Positions:

- 4 outside: Only 4 trims are shown, and they will be placed at the screen edges
- 4 inside: Only 4 trims are shown, and they are placed at the middle of the screen
- 6 Trims: 6 trims are shown., all placed towards the inside

Bar Graphs

Bar graphs are used to visualize the state of up to 8 output channels. There are 3 possible configurations:

- None: Bar graphs are disabled and will not be displayed
- 4 bars: Up to 4 bars will be displayed using one side of the screen
- 8 bars: up to 8 bars will be displayed using both sides of the screen

Bar-graphs will only be displayed if there is room for them. For '4 bars' mode, either boxes 3&4 or 7&8 need to be disabled. For '8 bars', four boxes: 3, 4, 7 and 8 all need to be disabled.

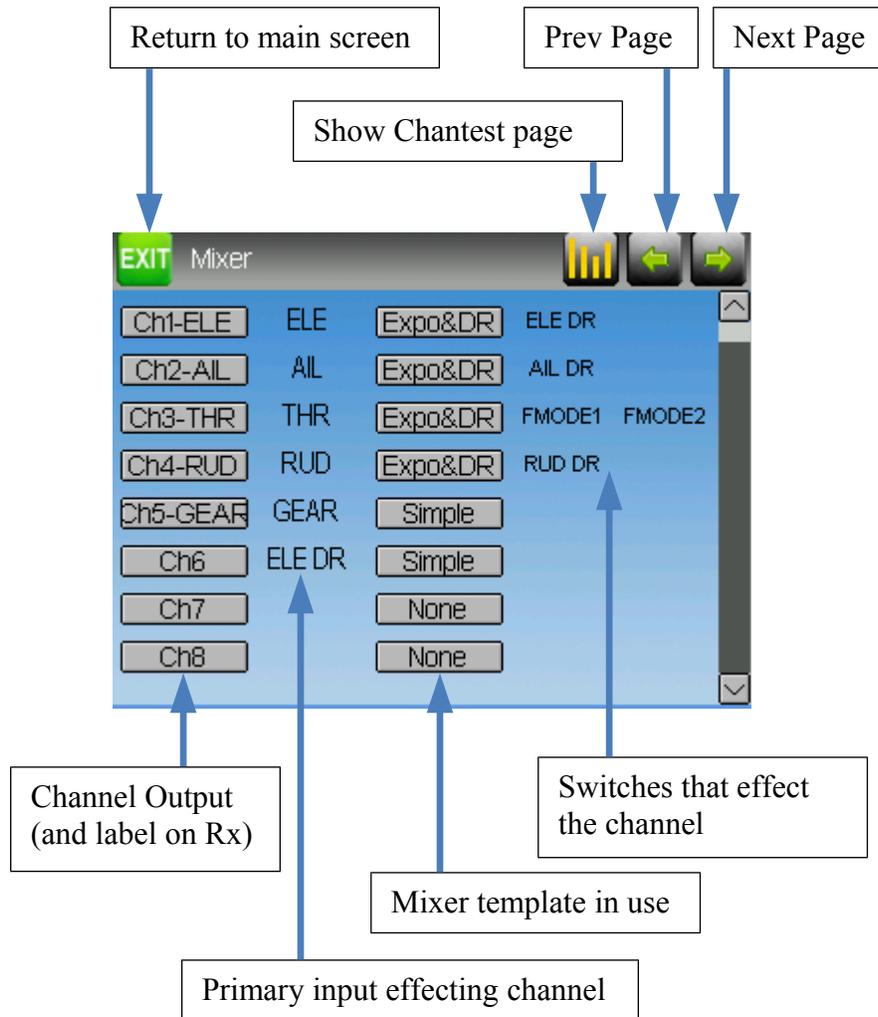
Boxes

Boxes are used to display interesting text values Boxes 1, 2, 5, and 6 are large boxes with a big font. Boxes 3, 4, 7, and 8 are smaller and use a smaller font. Currently a box can display one of the timers or one of the output channels.

Toggle Icons

Toggle icons are used to display the state of an input or output channel. A toggle is either on (value > 0) or off (value <= 0). Each toggle can have a different icon shown when it is active. Up to 4 toggles can be displayed. If only 4 trims are shown, the 4 toggles will replace the area used by trims 5&6. If 6 trims are shown, only 3 toggles can be shown and they will be placed either in place of box 4 or box 8. The toggles will only be shown if there is room for them (no box or bar-graph is using that space).

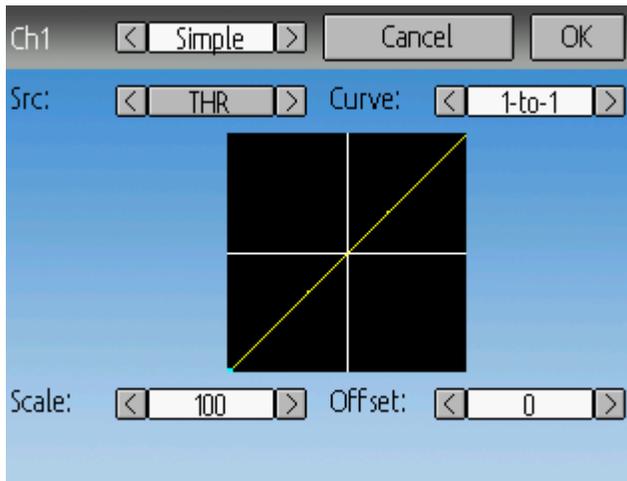
Mixer



The Deviation mixer is modeled after the Er9x implementation. Each output channel is composed of a series of one or more mixers each of which consists of a single input, an activation switch, and a function/curve that modifies the mixer output. This is a very powerful capability, but it requires a lot of understanding to make full use of. In order to simplify implementation, there are 3 templates that have been defined to make defining channels easier.

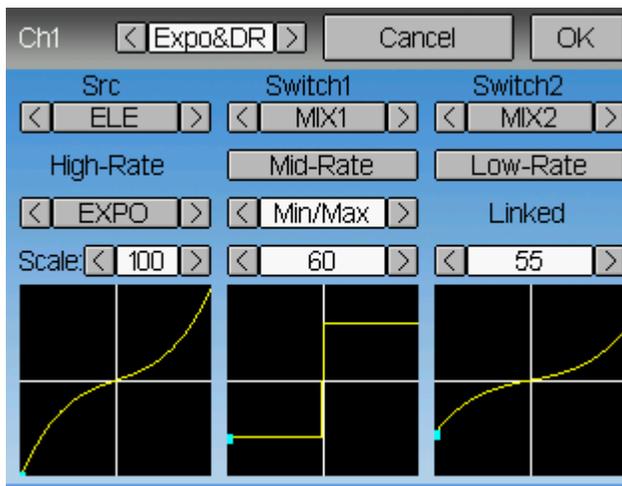
The number of channels available is dependent on the number of channels selected on the Model Page. Additionally there are 10 Virtual channels that can be used as an intermediate step for complex setups (see Predefined Templates for an example)

Simple Template



The simple template is the simplest manner of defining a channel. It allows defining a primary-input (stick, switch, or other channel), and applying a curve or function to that input. The result can also be scaled or have an alternate zero-offset. Selecting the 'Curve' spin-box or the graph will allow configuring the Curve in the case that a multi-point curve or Expo-rate are chosen.

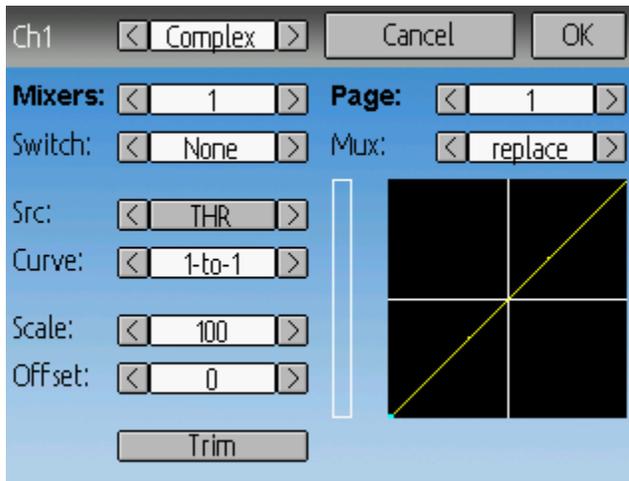
Expo & Dual-Rate Template



The Expo/Dual-Rate template is a more sophisticated template designed to allow use of toggle or 3-way switches to manipulate an input. The primary-input (stick, switch, or other channel), can have a different curve/function and scaling for each toggle-switch position.

Selecting the 'Curve' spin-box or the graph will allow configuring the Curve in the case that a multi-point curve or Expo-rate are chosen.

Complex Template



The Complex template unlocks the full power of the mixer system. For a given channel, any number of mixers can be applied to affect the final result. Each mixer is applied based on whether the specified switch is active, and can either replace, add to, or multiply to the previous mixers for this channel. Using this system it should be possible to define an output channel as a combination of any number of inputs.

Selecting the 'Curve' spin-box or the graph will allow configuring the Curve in the case that a multi-point curve or Expo-rate are chosen.

Note that while the scale value is limited to 100%, the mixer may provide a value larger than 100% if an offset is set or if the trim value is non-zero.

A given mixer can be considered to have the general form:

$$M(x) = \text{if}(\text{Switch}) \{ \text{Src} * \text{Curve} * \text{Scale} + \text{Offset} \} \text{ else } \{ 0 \} + \text{Trim}$$

The combination of mixers for a given output channel is defined by the Mux type:

For a 'Replace' mux:

$$C_x = \text{if}(\text{Switch}_n) \{ M_n \} \text{ else if } (\text{Switch}_{n-1}) \{ M_{n-1} \} \dots \text{ else if } (\text{Switch}_0) \{ M_0 \}$$

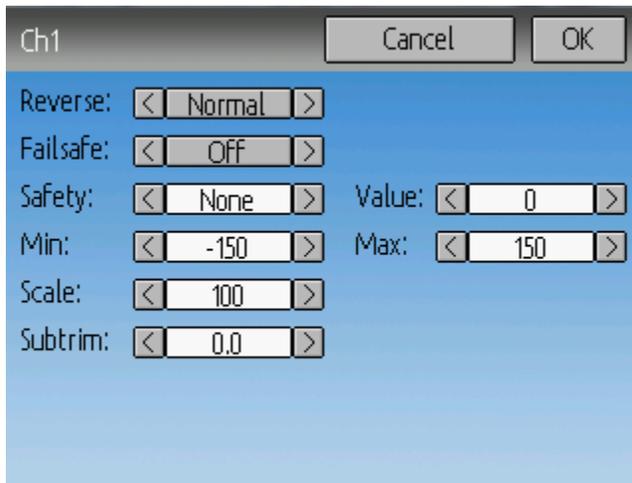
For a 'Multiply' mux:

$$C_x = \text{if}(\text{Switch}_n) \{ M_n \} \text{ else } \{ 1 \} * \text{if}(\text{Switch}_{n-1}) \{ M_{n-1} \} \text{ else } \{ 1 \} * \dots * \text{if}(\text{Switch}_0) \{ M_0 \} \text{ else } \{ 1 \}$$

For an 'Add' mux:

$$C_x = \text{if}(\text{Switch}_n) \{ M_n \} \text{ else } \{ 0 \} + \text{if}(\text{Switch}_{n-1}) \{ M_{n-1} \} \text{ else } \{ 0 \} + \dots + \text{if}(\text{Switch}_0) \{ M_0 \} \text{ else } \{ 0 \}$$

Channel configuration



The Channel configuration provides the ability to configure the final channel outputs. Capabilities such as channel reverse and failsafe-values are applied here. Also available are controls for end-points, scaling, sub-trim, and a safety switch (which could be used to ensure that a motor cannot spin-up while working on a model)

Reverse: Reverse the direction of servo rotation

Failsafe: Specifies a value that the Rx should use when it loses signal from the transmitter. Not all receivers support this capability.

Safety: Specifies a switch that will override all mixers and force the channel output to 'Value' when flipped.

Min/Max: These values define the minimum and maximum values that the transmitter will ever send to the receiver (after all scaling and trims are applied). If a calculated value is outside the min/max range, it will be clipped to either the min or max value as appropriate.

Scale: This is a final scalar to adjust the servo throw.

Sub-trim: Adjust servo zero position

Trims



The trim page allows assigning the trim buttons and trim step. Under normal circumstances it should not be necessary to modify the trim configuration, however in some cases it may be desirable to re-purpose unused trims. The Trim-step defines how sensitive the trims are to input. The maximum number of trim steps is +/-100. So a step size of 0.1 will allow a full +/- 10% of trim adjustment on the servo.

Model Page



The model page provides various model configuration options.

File: The File spin-box allows loading a new model, copying the existing model to a new location, resetting the current model to the default (all configuration is lost), and loading templates (see Predefined Templates)

Model Name: Set the model's name

Model Icon: Choose the model's icon

Model Type: Set the model type. Some models (e.g. helicopter) have additional configuration options that can be accessed by clicking the Model type.

Protocol: Set the type of Rx being used

Number of channels: Sets the number of channels to transmit.

Tx Power: Specify the radio output power when applicable.

Fixed ID: The Fixed ID sets a unique code to ensure that the Tx will only bind to a specific model. This is useful to ensure that the Tx is not accidentally bound to the wrong model.

Bind: Depending on the protocol and Fixed-ID setting, the Tx may bind with the model on start-up, or may need to be manually bound once.

Protocol	Fixed ID = None	Fixed ID set
Devo	Bind on start-up	Manually bind with button
WK2801	Bind on start-up	Manually bind with button
WK2601	Bind on start-up	Bind on start-up
WK2401	Bind on start-up	Bind on start-up
DSM2	Manually bind with button	Manually bind with button
J6Pro	Manually bind with button	Manually bind with button
Flysky	Bind on start-up	Manually bind with button

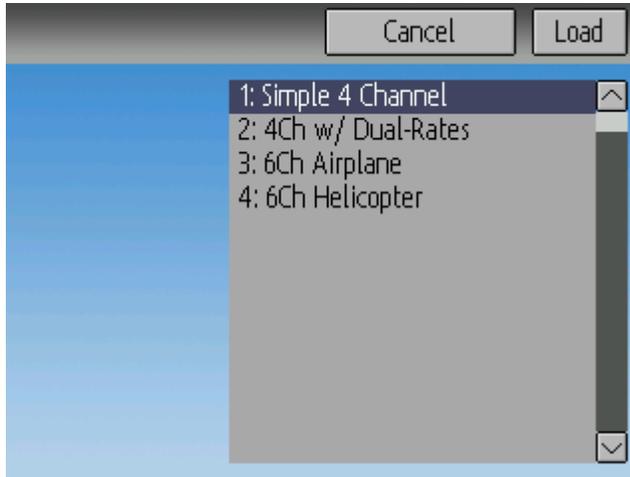
Timer Page



The timer page defines the 2 available timers. Timers can count either up or down, and can be enabled either manually from the main screen or by an input trigger (stick or switch)

Predefined Templates

The Deviation firmware supports user-customizable predefined templates. By Selecting 'Template...' From the Model page, it is possible to select one of these options



Additional templates can be added via USB to the '\template' directory. A template does not completely replace your existing model, but instead only a portion of it. The currently supported templates will replace the mixer and trim definitions, but will not affect the display layout. In the future Deviation will support templates that only affect the display layout without affecting the mixers as well.

Helicopter Setup

Deviation has several configuration options to make setting up a helicopter easier. These settings are primarily for enabling 6-channel CCPM helicopters. 4-channel helicopters do not need to follow these instructions.

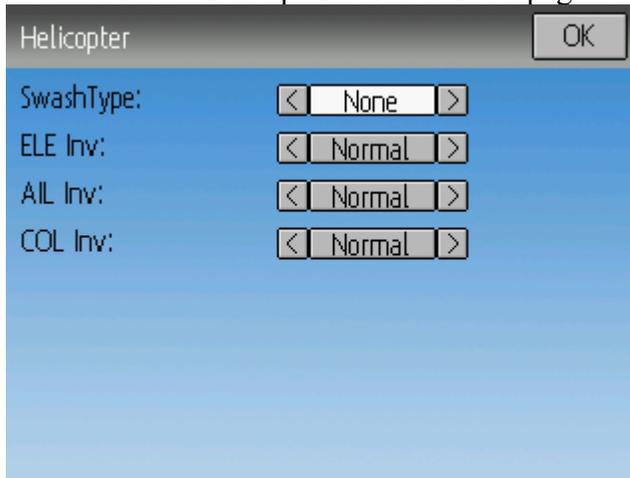
The easiest way to configure a helicopter is to select '6 Ch Helicopter' from the 'Template' section of the model page. This will provide a good starting point for configuring a helicopter.

However, the following documents step-by-step instructions for configuring a helicopter from scratch to explain what the template is doing.

Step 1: Type and Swash

Select 'Helicopter' as the model-type on the Model Page.

Next click on 'Helicopter' on the Model page to open the Helicopter Options page:



The Swash type can be one of:

- None: Use for most flybarless helicopters
- 120: The most common setup for flybar helicopters. 3 servos in 120 degree configuration
- 120x: The same as 120 but with the 'aileron' and 'elevators' servos swapped
- 140: An alternative, less-used configuration
- 90: Servos at 90 degrees apart

The ELE Inv, AIL Inv, and COL Inv options let you invert the direction of each primary input during the Cyclic mixing

Make sure you have at least 6 channels selected on the Model page.

Step 2: Cyclic Setup

Next go to the Mixer page, and set the following channels to the corresponding template (there are no configuration options for the Cyclic templates)

- Channel 1 (or 'ELE' channel) to 'Cyclic1'
- Channel 2 (or 'AIL' channel) to 'Cyclic2'
- Channel 5 to 'Cyclic 3'

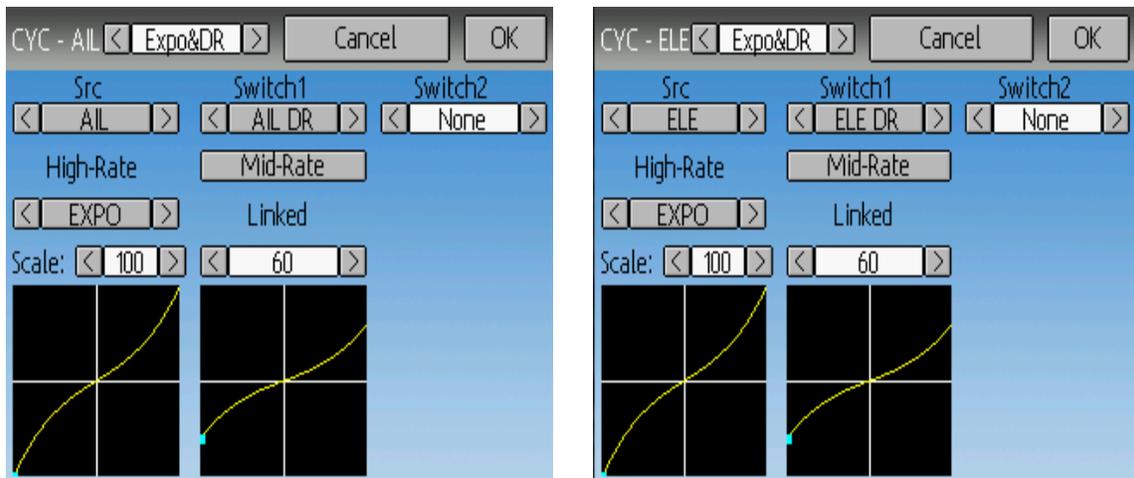
Step 3: Mixer Setup

Once any channel has been set to a Cyclic template, the mixer page will show new virtual channels:



Step 4: Aileron, Elevator, and Rudder Mixing

The following documents the Dual-rate settings for Aileron, Elevator, and Rudder



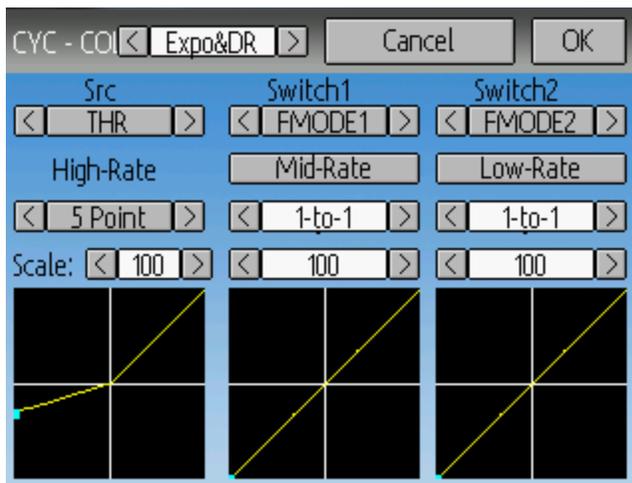
The settings for all 3 are nearly identical (only the channel and switches are different). The above images show the Aileron and Elevator settings (Rudder is not shown).

	Aileron	Elevator	Rudder
Channel	CYC-AIL	CYC-ELE	Ch3
Template	Expo&DR		
Src	AIL	ELE	RUD
Switch1	AIL DR	ELE DR	RUD DR
Switch2	None		
Mid-Rate	Linked		
Curve	Expo – 45%		
Scale(Src)	100%		
Scale(Switch1)	60%		

This configuration enables low-rates with the dual-rate switches separately for elevator and aileron channels, with some expo. The low rates have the same curve as the high-rates, but with 60% throw.

Step 5: Pitch Mixing

The pitch is setup to enable 3D with Fmode1 and Fmode2. In this example, there is no difference between using FMODE1 and FMODE2.



The Pitch is setup as follows:

Template = Expo&DR		
Src	Switch1	Switch2
THR	FMODE1	FMODE2
5pt: -30, -15, 0, 50, 100	1-to-1	1-to-1
Scale=100%	Scale=100%	Scale=100%

Step 6: Throttle Setup

The throttle uses a Complex mixer in order to support the throttle-hold. When THOLD is enabled, the throttle will cut to zero, but the Collective will continue to function.

Page	1	2	3	4
# Mixers	1			
Switch	None	FMODE1	FMODE2	GEAR
Src	THR			
Curve	5pt: -100,-20,30,70,90	5pt: 80, 70, 60, 70, 100	5pt: 100, 90, 80, 90, 100	Fixed
Scale	100			-100
Offset	0			
Trim	Enabled			

Ch3 < Complex > Cancel OK

Mixers: < 4 > Page: < 1 >

Switch: < None > Mux: < replace >

Src: < THR >

Curve: < 5 Point >

Scale: < 100 >

Offset: < 0 >

Trim

Ch3 < Complex > Cancel OK

Mixers: < 4 > Page: < 2 >

Switch: < FMODE1 > Mux: < replace >

Src: < THR >

Curve: < 5 Point >

Scale: < 100 >

Offset: < 0 >

Trim

Ch3 < Complex > Cancel OK

Mixers: < 4 > Page: < 3 >

Switch: < FMODE2 > Mux: < replace >

Src: < THR >

Curve: < 5 Point >

Scale: < 100 >

Offset: < 0 >

Trim

Ch3 < Complex > Cancel OK

Mixers: < 4 > Page: < 4 >

Switch: < GEAR > Mux: < replace >

Src: < THR >

Curve: < Fixed >

Scale: < -100 >

Offset: < 0 >

Trim