



User's Guide

Version 1.5

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Contents

Overview	3
Commissioning	5
Setting up the Access Point.....	6
Initial Connection.....	8
User Interface	9
Button Control.....	11
Touch Control.....	13
Accelerometer Control.....	13
Wheel Control.....	14
Settings	15
APP Settings.....	16
SSC Settings.....	19
Hardware setup	21
PiKoder/SSC wRX	21
PiKoder/PPM wRX.....	22
PiKoder settings	23

1

Overview

With the *udpRC4UAV* app and a *PiKoder/SSC wRX* or *PiKoder/PPM wRX* WLAN-receiver (jointly referred to as PiKoder wRX throughout this document) you can control an UGV (Unmanned Ground Vehicle or Rover) equipped with an autopilot such as the ArduPilot Mega (APM) with your Android™ Smartphone or Tablet. The PiKoder wRX replaces the standard RC receiver and provides the required input signals for the APM. The applications can be customized to interface to other autopilots and flight controllers also.

The remote function employs the smart phone's built-in WLAN module. The PiKoder receiver offers an access point (AP) to which the smart device would connect. Depending on the smart devices' wlan module spec your control range could be up to a few hundred meters.

Commissioning the app requires two simple steps:

- Install the app through the Google Play Store and
- Connect your Android device to the Access Point provided by the receiver following standard Android procedures

These initial steps are described in section 2; after commissioning the app you simply start the app like any other app on your device. Section 3 presents the user interface and section 4 illustrates the preferences and settings of the app.

Exhibit A covers the hardware setup based on the current APM 2.8.

Please note that a PiKoder firmware release < 2.7 requires a change in the PiKoder's default settings for the min. and max. pulse length. Please refer to exhibit B for more information.

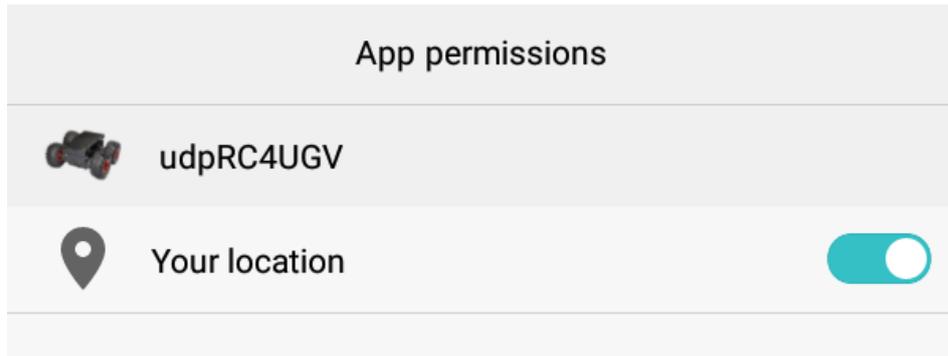
2

Commissioning

The *udpRC* app is available free of charge in the Play Store; the installation is started after hitting the button and does not require any user interference.



Please bear in mind though that you have to grant WLAN privileges to the app. Please note that Android version 6 (“Marshmallow”) and up additionally requires access to the location services due to a revised permission concept. This permission can be granted prior to starting the app under Settings/Apps/udpRC4UGV (please refer to the screen shot on the next page) or interactive before the initial connection to the receiver.

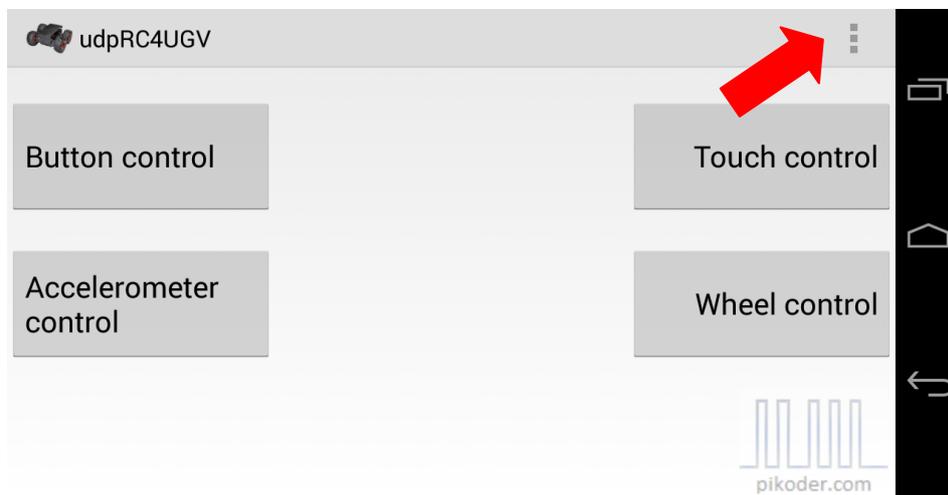


If you would use the PiKoder wRX (firmware 2.7 and up) in combination with an APM 2.8 which was programmed to “Rover Mode” by the “Mission Planner” then you don’t have to change any settings since this combination is reflected in the default settings.

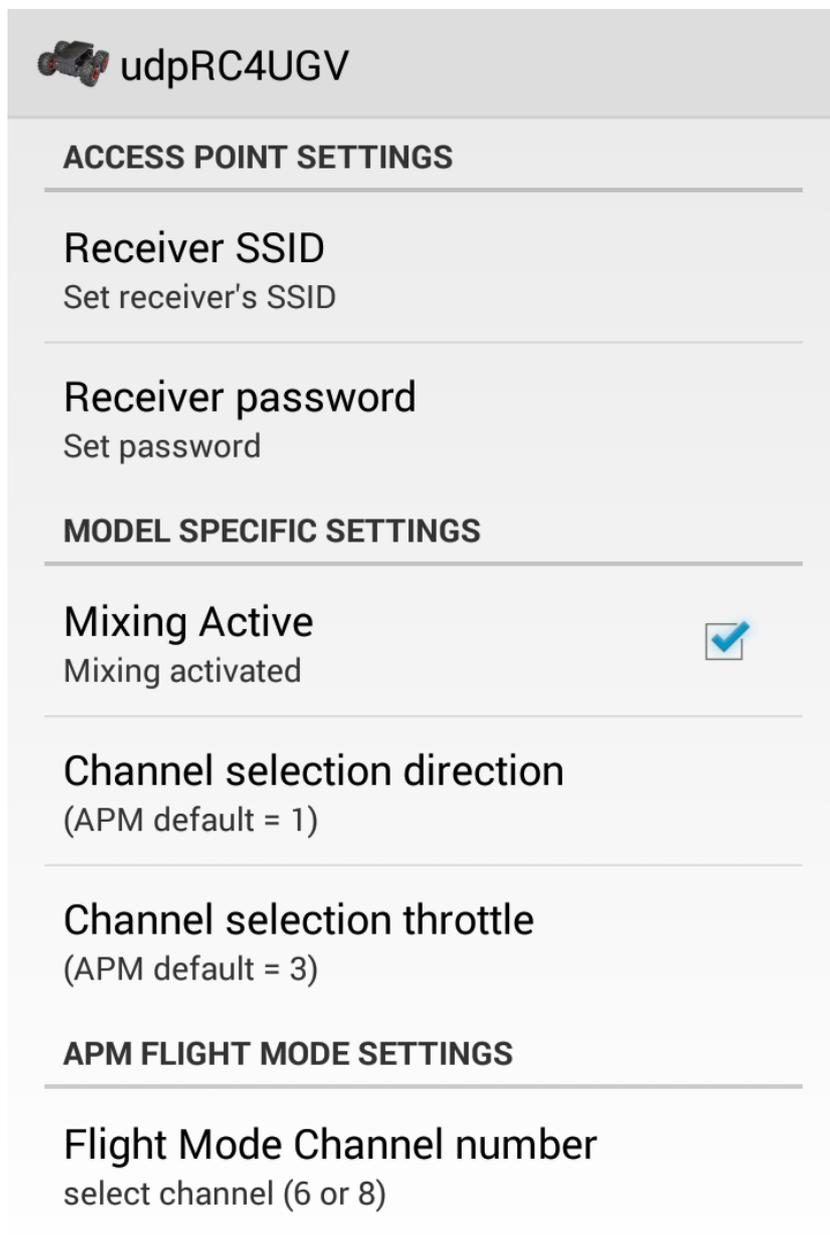
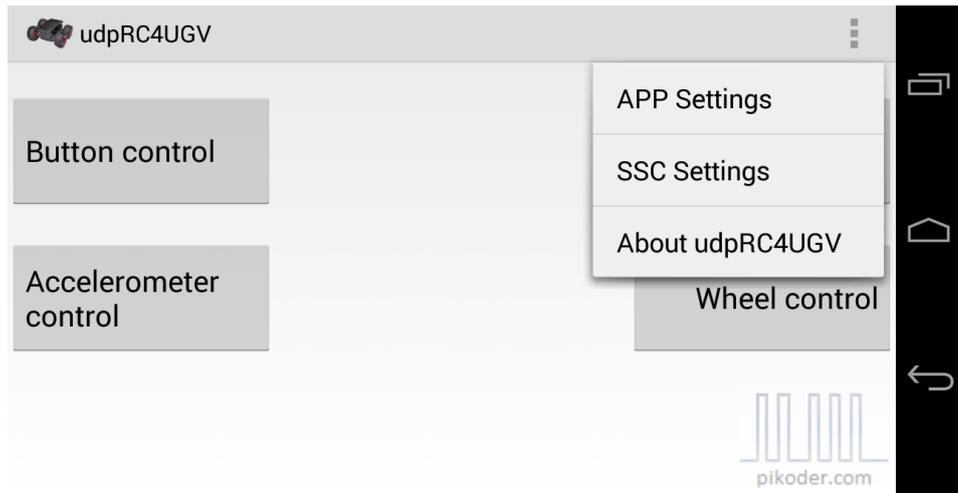
If you have changed the network settings of the PiKoder wRX’s radio then you would have to also make changes to the App’s preferences as described in the next section.

Setting up the Access Point

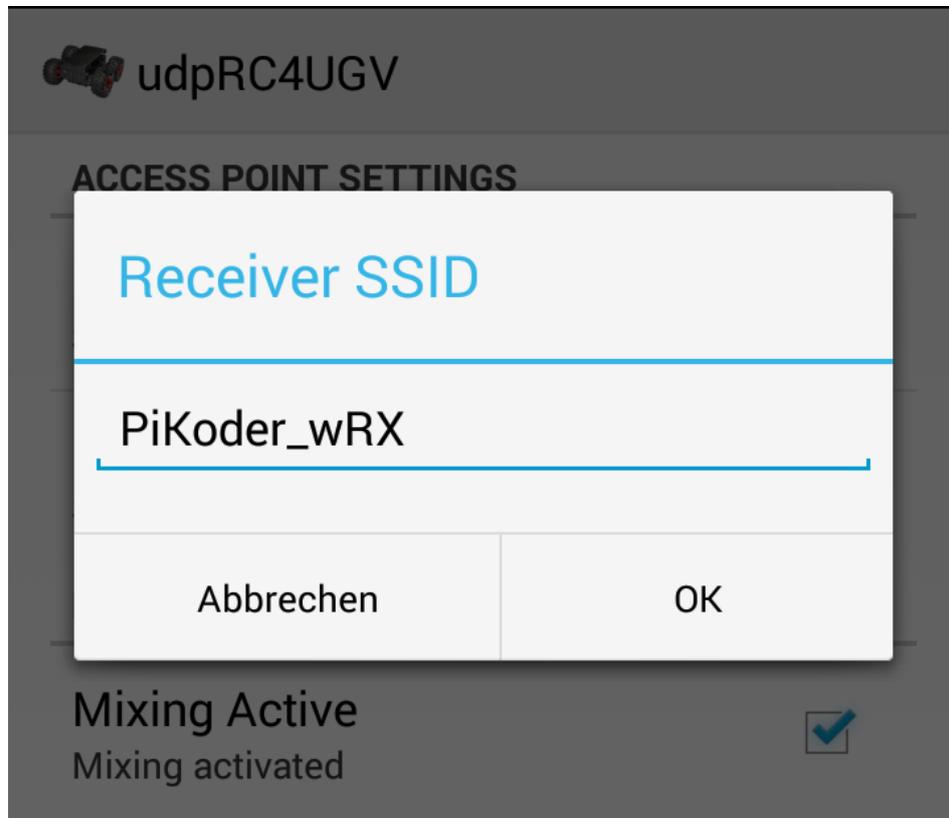
The preferences for the name and / or the password of the access point can be found in the App-settings (see red arrow in the image)



After selecting „App Settings“ the screen changes as shown on the next page. AP parameters are changed by selecting „APP Settings“.



To customize the AP name you would select „Receiver SSID“ and you will be offered a text input box as shown below. The input of the password follows a similar fashion after selecting “Receiver Password”.



Initial Connection

After installing the App and optionally adjusting the AP settings, you would have to establish an initial connection between the smart device and your receiver on Android operating system level (like for every other AP you intend to use for the first time).

Turn on your receiver, select Android “SETTINGS” on your smart phone, then „WLAN“. Your receiver should be visible now meaning that e.g. „PiKoder_wRX“ should show up as active network in the respective list.

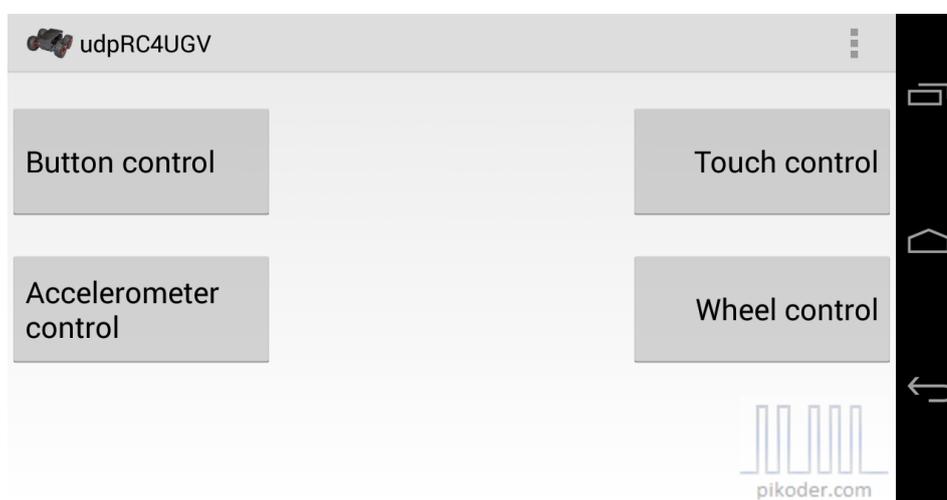
Select the AP and connect. After entering your password (the default password is *password* the AP would be available to your smart device and *udpRC4UGV* can now establish a connection to receiver when started.

Please note: It is highly recommended that you remove the existing Android network settings when you upgrade your software to avoid inconsistent data settings

3

User Interface

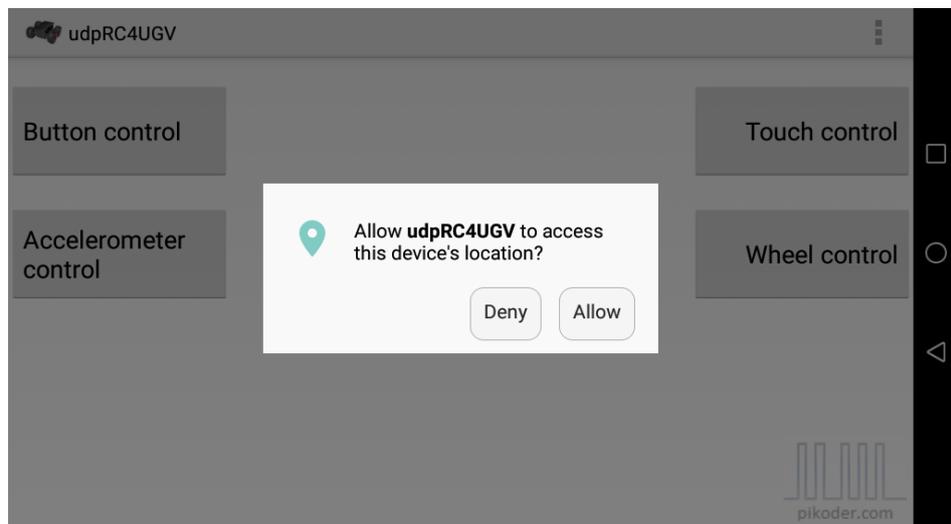
After starting *udpRC4UGV* you will be seeing the main screen which allows you to select from different user interfaces. Additionally, this screen would be your starting point for specific settings. Please note that all control related screens are fixed to a landscape format to simplify model control.



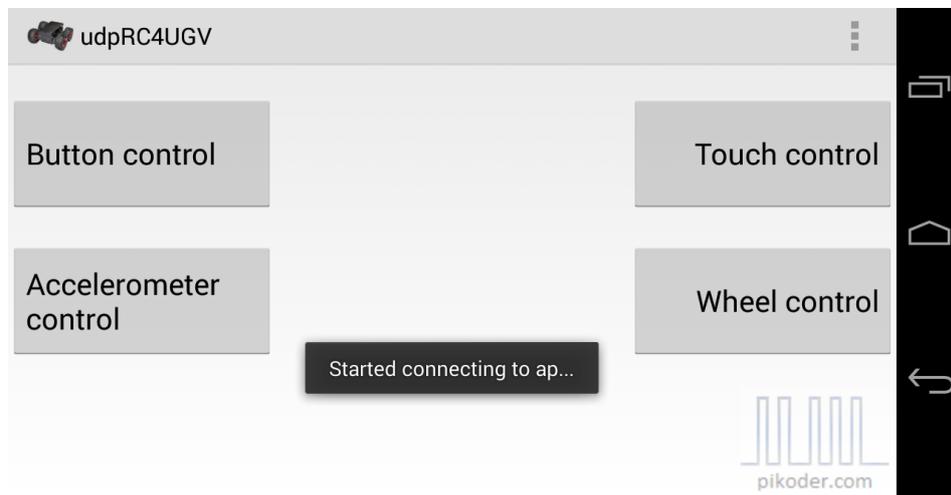
To start controlling your model you would hit one of the four buttons selecting your preferred interface. The basic functions and general UI elements are described in the “Button Control” – section.

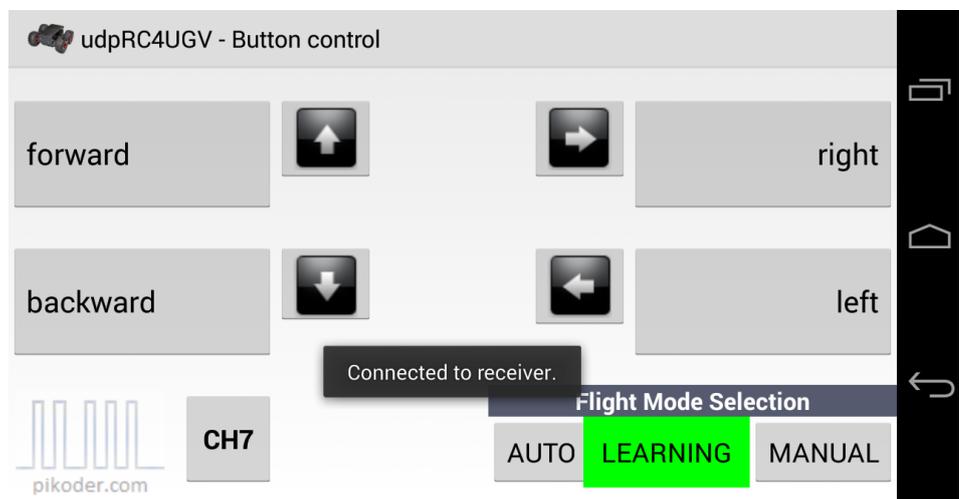
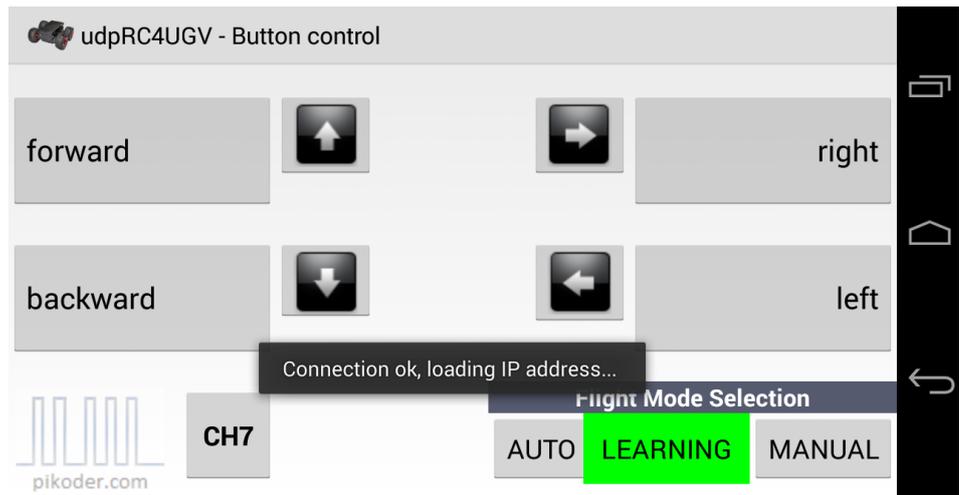
If the location permission would not be granted when you try to connect to the receiver through one of the user interfaces then a dialog box will appear and ask you to allow for location access. Please note that with the introduction of Android 6.0 the connection to the receiver cannot be established

without this permission. This means that the app will continue to display the opening screen until the permission is granted.



Once you approved you would connect by hitting the respective button again and the app will establish a connection to the receiver. This process will be reflected in status messages such as "Connecting to receiver..." and "Connected to receiver." (see below).



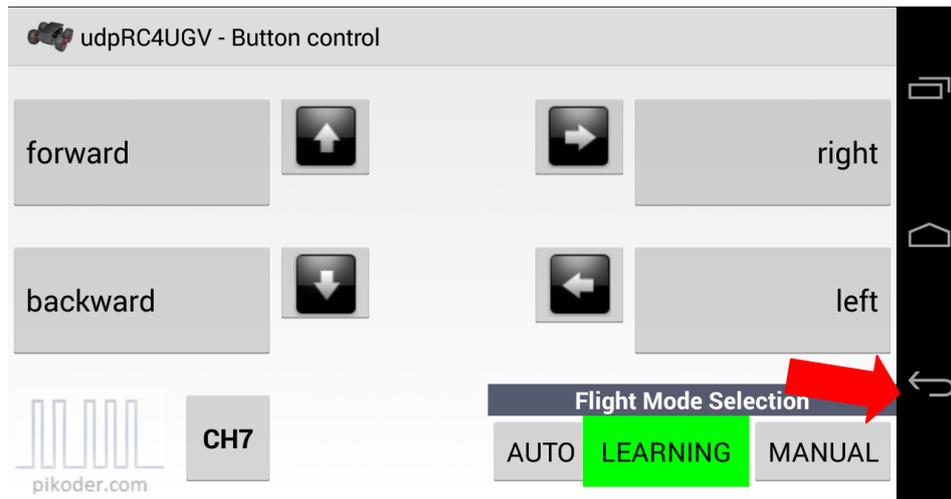


Once the connection is fully established (indicated by the „Connected to receiver.“ – message) the RC can be operated.

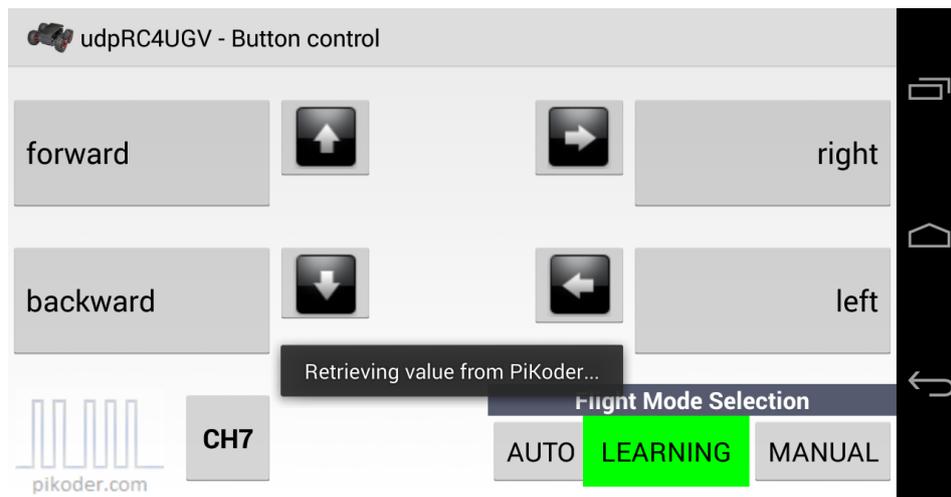
Button Control

Button Control offers a very simple user interface: you would control your model by simply hitting the command button.

Please note that hitting the home button (see red arrow) would always bring you back to the main menu.



Starting with version 1.2 the app offers a trim function similar to traditional R/C transmitters to set the neutral position for a channel. When pushing the gray error buttons initially for one direction (left/ right or forward/backward) the app will retrieve the actual value for this channel from the PiKoder (thus allowing to store and manage model specific parameter settings):



Once the channel specific value is known then every push of the arrow button will change the neutral position by $4 \mu\text{s}$ giving a range of 250 positions over the whole range of the servo movement.

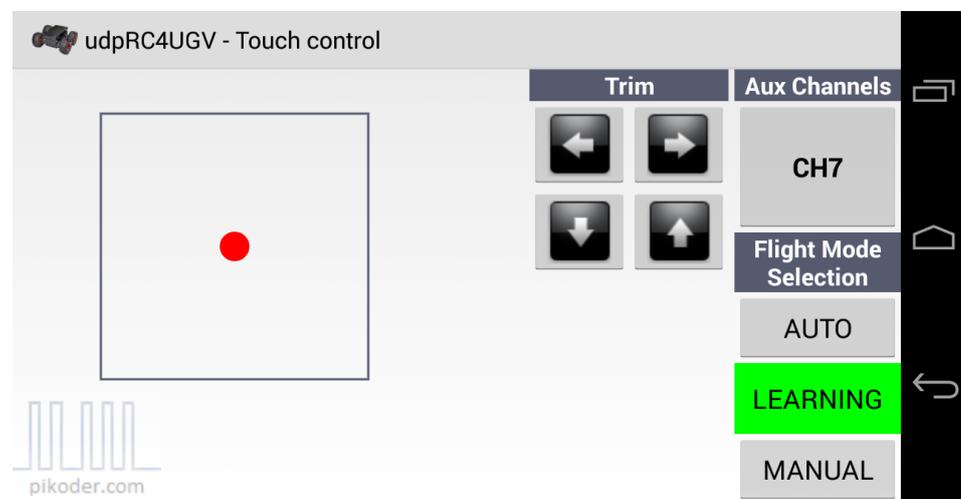
In addition to the control buttons for the UAV's movement described above the user interface offers additional buttons to enable for special functions of the APM 2.8. First off all you can select the „Flight Mode“. The APM offers three modes for a Rover: AUTO (Execute a pre-programmed mission), LEARNING (Teach in of a mission by executing the mission through manual remote control and MANUAL (direct control of the Rover by the RC). The mode is selected by touching the respective button.

The „CH7-button triggers the receiver to output a preconfigured pulse length on Channel 7 which the APM interprets as a switch on signal. When in LEARNING mode then touching the CH7 button stores the current GPS coordinates as a waypoint.

You can find additional information covering the customization of the APP in section 4.

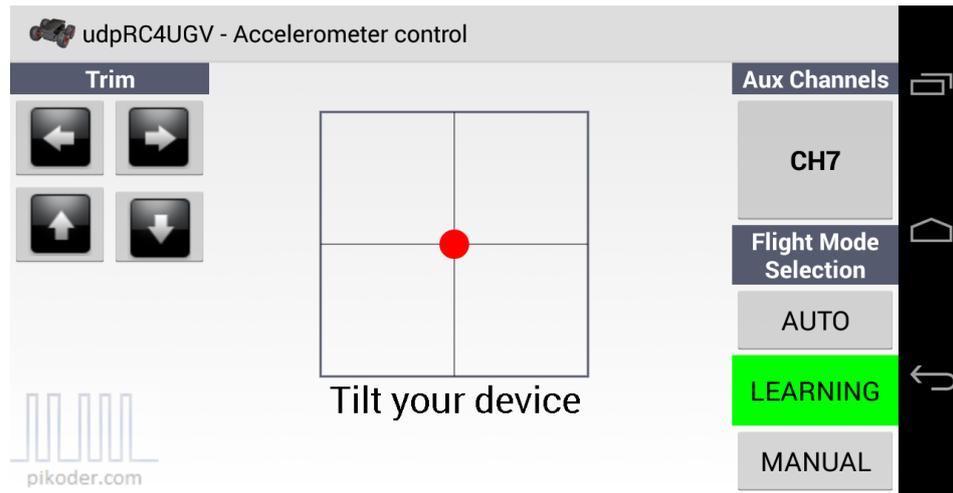
Touch Control

Touch Control implements a virtual thumb stick: you would control your model by touching and moving the red button. In this screen you also find back the additional buttons for the APM specific functions described above.



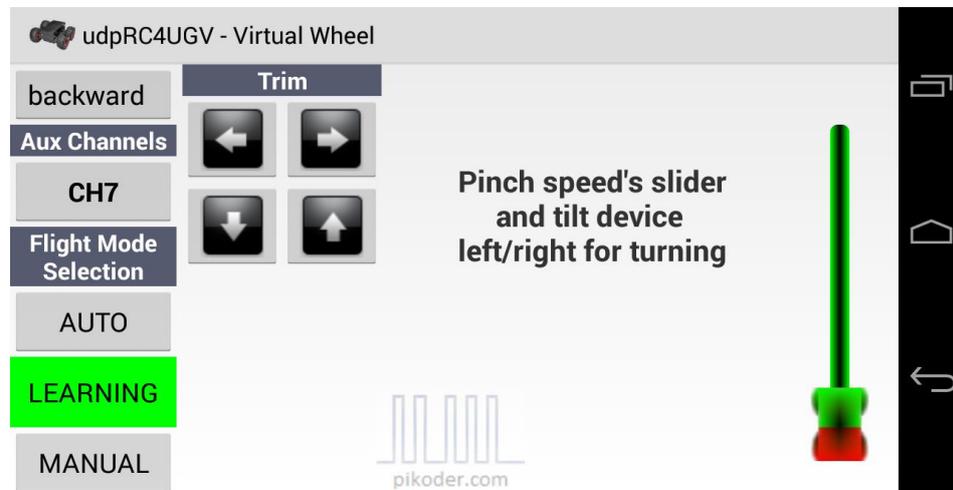
Accelerometer Control

In selecting this user interface you would move your device to control your model; the app does evaluate these movements and translates them into the respective commands. The position of the virtual stick is shown on the screen in a coordinate system.



Wheel Control

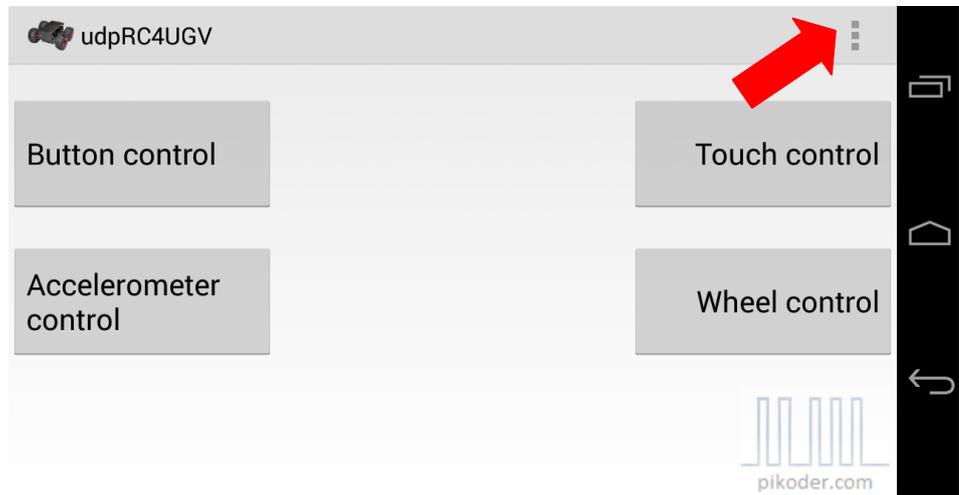
Wheel Control represents a combination of the Accelerometer and the Touch Control: directional control is based on movement of your device similar to the Accelerometer Control and speed is controlled by a slider.



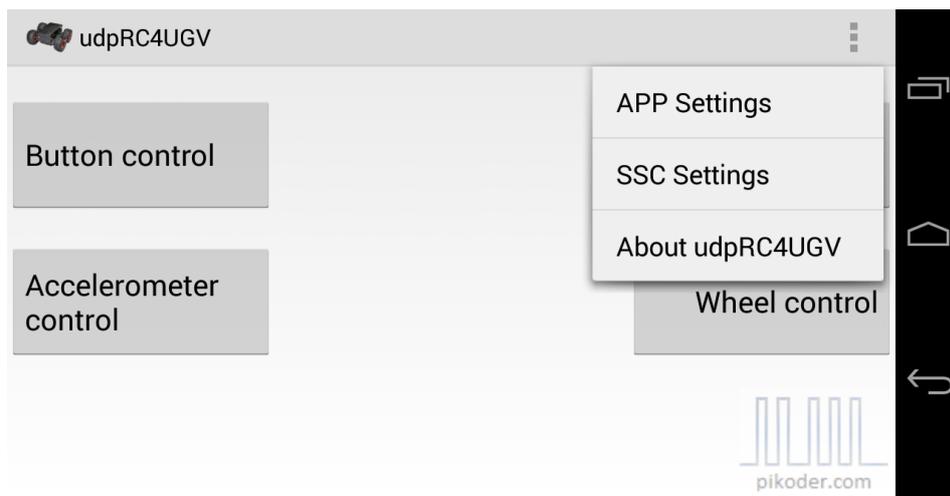
4

Settings

Your starting point for settings would also be the main screen (s. red arrow).

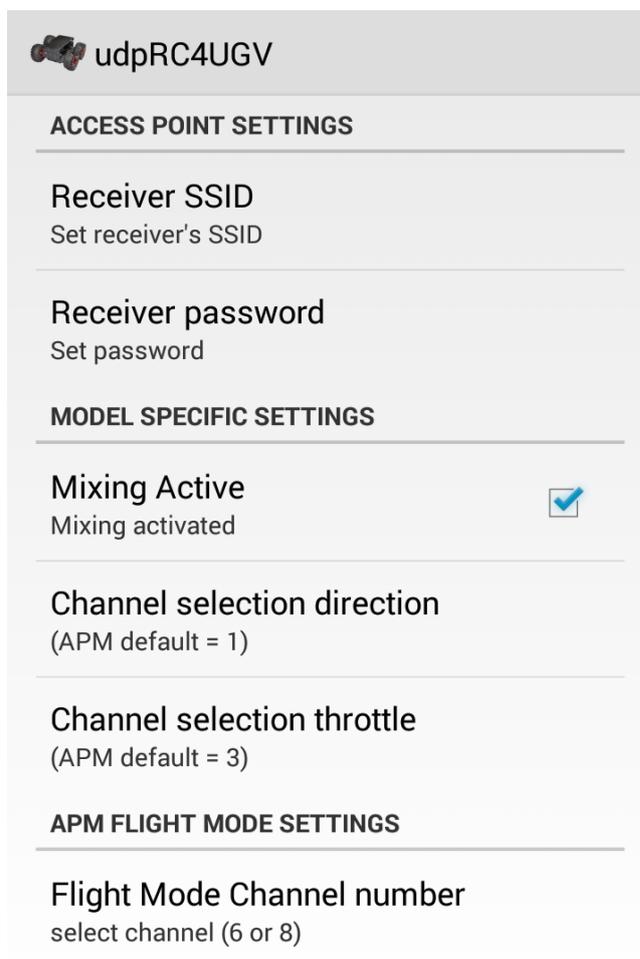


After activating the preference menu you are presented another menu offering APP Settings, SSC Settings, and the general help link to the PiKoder web page.

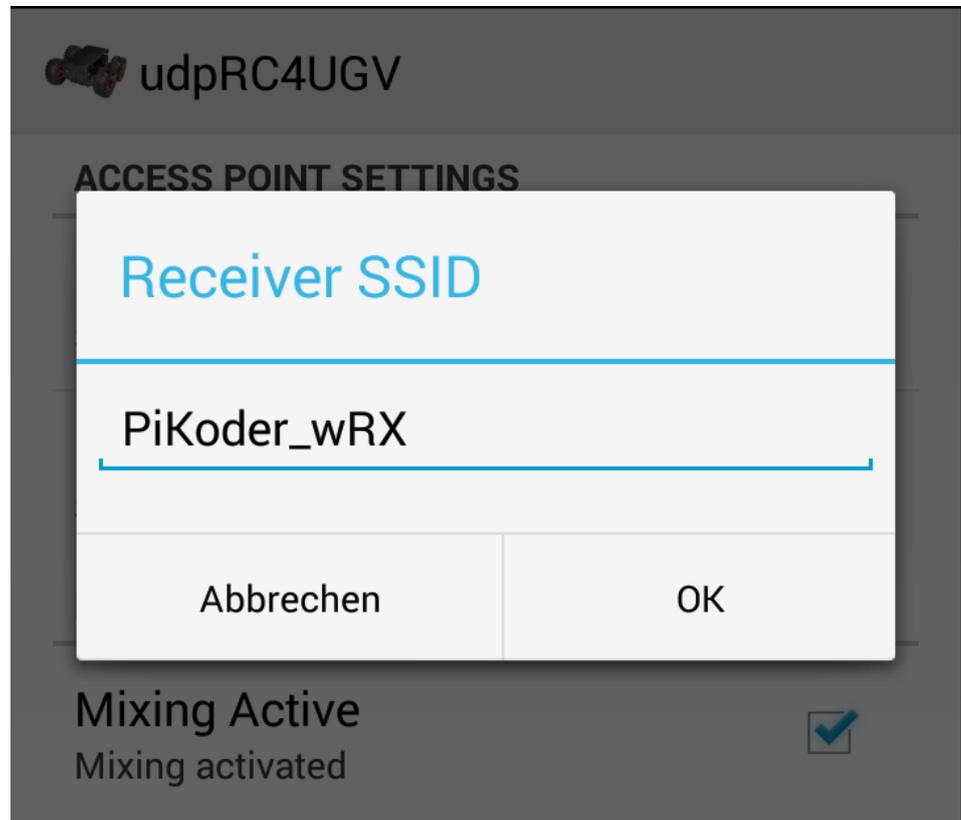


APP Settings

In this section you would be able to review basic settings of the app. This covers the access point's name (Receiver SSID) and password, a checkbox for mixing and the setting of pulse lengths to control the APM features.



The default SSID (AP name) would be *PiKoder_wRX* reflecting the PiKoder wRX standard configuration. If you are employing another device then you can adapt the device name by tapping the field.



The setting of the Receiver Password works in a similar fashion.

Mixing is a specific feature required to control „two motor models“, such as tanks („Mixing Active“); if your model requires a conventional control (one channel for direction, one channel for speed control), then uncheck the box.

The next two settings allow you to select the receiver channels for direction and throttle. The default setting would be 1 for direction and 2 for throttle. If you would use the udpRC4UGV app with an APM flight controller and a PiKoder/PPM wRX then you would have to move the throttle to channel 3 in the PPM frame.

The following settings allow you to program the app to the APM needs. Please note that that you have to mirror these settings in your Mission Planner (please see screen print of Mission Planner).

APM FLIGHT MODE SETTINGS

Flight Mode Channel number

select channel (6 or 8)

Default Flight Mode

select Flight Mode (1-3)

PWM AUTO mode

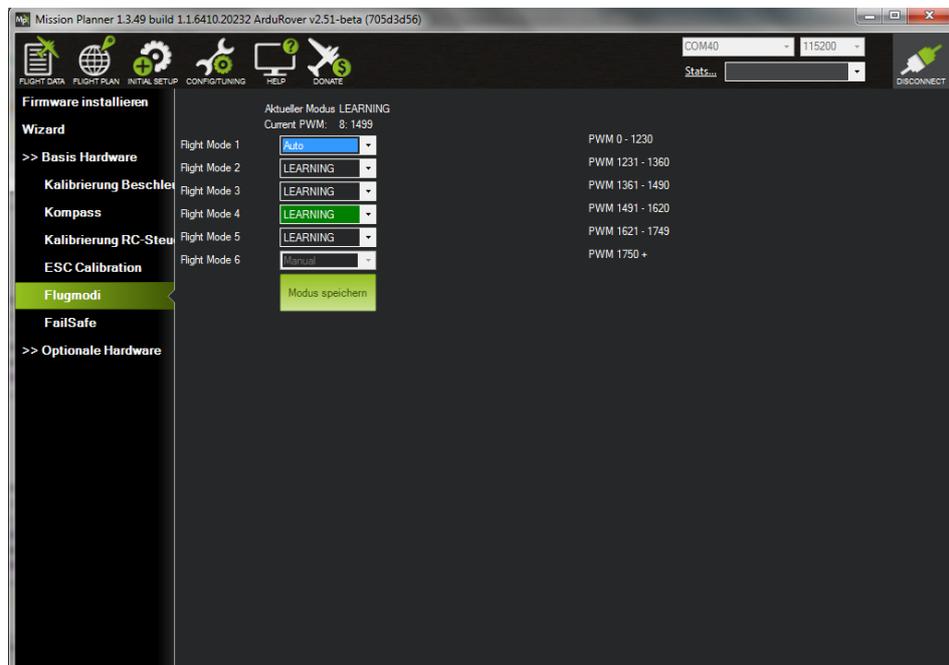
value in μ s

PWM LEARNING mode

value in μ s

PWM MANUAL mode

value in μ s

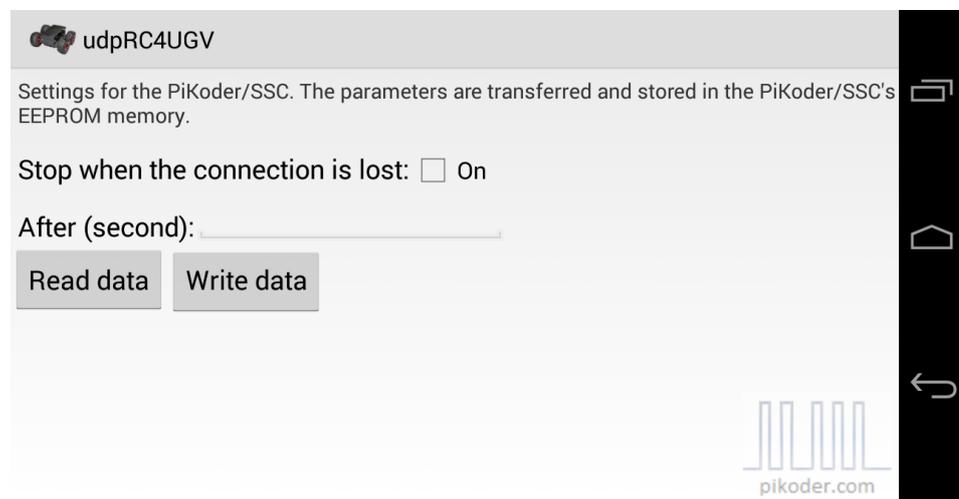


The number in „Flight Mode Channel Number“ defines which channel of your receiver outputs the flight mode information. The default channel for the app and the APM is channel 8.

The next three menu items „PWM AUTO mode“, PWM LEARNING Mode“, and „PWM MANUAL mode“ define which pulse lengths will be applied to the receiver output when the respective mode is selected. The default values of the app reflect the default settings of the APM (see screen dump above).

SSC Settings

SSC Settings are receiver specific settings and are therefore stored in the PiKoder/SSC's EEPROM.



The *udpRC4UGV* app features a „fail-safe“-function (in combination with the *PiKoder/SSC mRX*): if within a given time frame no new command would be received then all channels will be set to a neutral position. Since you can pre-program these neutral positions for your model (refer to [PiKoder/SSC User's Manual](#) for mode details), you can ensure that a safe status is warranted (e.g. motors shut off).

The monitoring cycle can stretch from 0.1 to 99.9 seconds. To read the current receiver setting, you would hit the “Read data” key (s. above). This command will read the value from the PiKoder store and display it; the checkbox will be set automatically when a time out value > 0 is found. If you want to maintain this value then simply hit “Write data”. This will sync the app and the receiver starting the fail-safe function.

If you want to change the value then hit the input field and the keyboard would appear allowing you to edit the field content. For disabling the time out you would have to uncheck the box. Please note that a change only becomes effective after hitting the „Write data“-button.

For enabling the „fail-safe“-function you would check the box and then enter the time out value. As with all other changes you would have to hit the „Write data“-button to put this change into effect.

A

Hardware setup

The setup of the APM for a rover is documented well (<http://ardupilot.org/rover/docs/apmrover-setup.html>). Therefore the following description will focus on connecting the PiKoder/SSC wRX resp. the PiKoder/PPM wRX with the APM.

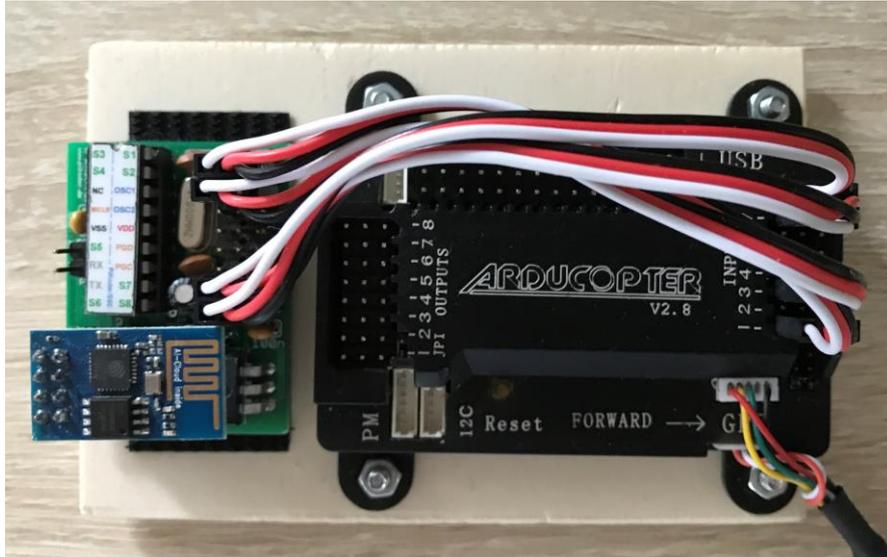
Please bear in mind that both setups are based on the default configuration of the APM and the PiKoder unless indicated otherwise. If you had changed the configuration by e.g. changing the flight mode channel then you would have to adopt the cabling respectively.

PiKoder/SSC wRX

Start by replacing the standard RC receiver by the *PiKoder/SSC wRX*. The power supply for the PiKoder is provided by the APM following the standard APM setup, which uses the BEC (Battery Elimination Circuit) of the ESC (Electronic Speed Controller) to step down the voltage of the rover's battery to a range suitable for receivers 4.8 - 6 Volts. The picture on the following page shows the wiring:

In total you would have to hook up four connections using a standard three-wire servo cables:

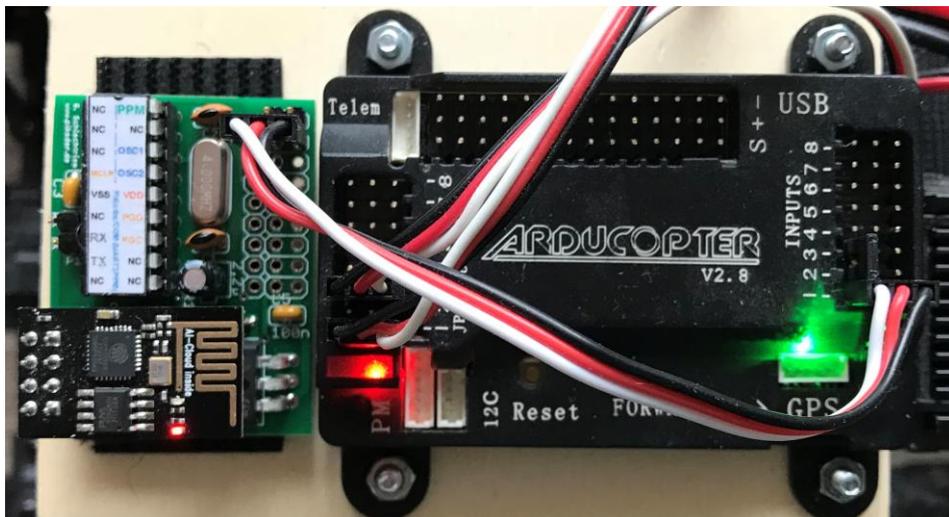
1. PiKoder/SSC wRX Channel 1 <-> APM 2.8 INPUT 1
2. PiKoder/SSC wRX Channel 2 <-> APM 2.8 INPUT 3
3. PiKoder/SSC wRX Channel 7 <-> APM 2.8 INPUT 7
4. PiKoder/SSC wRX Channel 8 <-> APM 2.8 INPUT 8



PiKoder/PPM wRX

Start also by replacing the standard RC receiver by the *PiKoder/PPM wRX*. You would then hook up the receiver to the FC using a standard three-wire servo cable connecting PiKoder/PPM wRX PPM out with the APM 2.8 INPUT 1 serving also as a power supply line from the APM to the receiver greatly simplifying the setup compared to the PiKoder/SSC wRX.

Additionally, you would have to add a jumper between the signal pin of the APM input channel 2 and 3 to make the FC accept a PPM input (please refer to the related APM documentation for more information). **You would also have to configure the throttle to be on the third position (channel 3) in the PPM frame as described in the settings section.** The following picture shows the wiring:



B

PiKoder settings

Controlling an APM with a receiver with a *PiKoder/SSC* or *PiKoder/PPM* firmware version < 2.7 requires you to adjust the limits for the minimal and maximal pulse length because the APM may not execute requests if the pulse lengths are outside of the predefined limits of the APM.

If you are uncertain about the firmware version of your PiKoder, then you can connect your receiver to the PCC (PiKoder Control Center) as described in the User's Manual of your PiKoder wRX and check the release version as well as the current parameter settings. When using the *udpRC4UGV* app your PiKoder's values should equal the one shown in the following image.

