# FALCONPILOT SYSTEM
# USER'S MANUAL

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# Introduction

Falcon Pilot System is a system designed for falcon tracking purposes and is principally based on the pair of devices composed by the Tracking Receiver and Tracking Transmitter.
The Falcon Pilot Receiver has a robust design and an excellent sensitivity permit to the hunter to receive signals from their falcons in extreme conditions. The receiver front panel ensures a high flexibility using a set of LED indicators, knobs and buttons for controlling and displaying of receiver and radio signal parameters. The Yagi antenna mounted on the top side of receiver guarantees a good directionality of the system.
The transmitter is very small, strong, compact and the low power consumption offers a long battery life.

# Getting started

The system is composed by:

- 1 receiver
- 1 handle (fast lock connection)
- 1 YAGI 5 element antenna (fast lock connection)
- 1 Headphones
- 12V car supply cable
- 1 transmitter
- 1 C1/3N transmitter battery (3V)
- 6 AA Receiver batteries (1.5V)

## Falcon Pilot System Features

The Falcon Pilot system is composed by a high performance multi-channel receiver and by one or more high power transmitters to be attached to the falcons or other raptorial birds.
The receiver implements a 5 element Yagi antenna with a fast lock connection for top mounted on the receiver and with an innovative solution to open/close the antenna elements.
The transmitter has a small robust design; it is capable to transmit high power to achieve long distance tracking and has a Led indicator to show the correct operation and also to help the hunter to see the transmitter position in the night.

## Theory of operation

The transmitter emits a RF carrier with unique accurate frequency every 1.80 s with a duty cycle of 2.2 %. When the receiver tuned on the same RF channel using Channel Selectors and a Fine Tuning Knob receives the signal, it generates an audio beep and blinks the Tone LED.
There are three criterions implemented by the receiver that help the hunter to find the falcon direction:

- the audio beep loudness
- the Signal Level Indicator
- the Falcon Direction LED

The receiver user must, after properly Gain Knob adjustment, turn around while watching Signal Level Indicator and Falcon LED and hearing the audio beep loudness. The orientation in which the received signal intensity is the highest, the Falcon LED blinks and the heard audio beep is very loud and clear shows the falcon direction.

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## Receiver Front Panel Controls


***Volume Knob (switch On/Off):*** turn the volume knob to switch on the receiver. With Volume Knob it is possible to amplify the audio signal. This control allows to hearing the sound in particular noisy conditions. Increasing the volume there is no effect on the tracking distance.

***ON/Low Battery Status LED:*** this LED is turned on when the receiver is switched on. The colour assumed by the LED shows the state of the batteries:

- GREEN: the batteries are fully charged
- ORANGE: batteries charge reduced to the half value
- RED: low batteries charge
- BLINKING LED: very low batteries charge => change the batteries

***Channel Selectors:*** set the 3 thumbwheel switches on the RF channel equal to that of the transmitter. The receiver has the ability to select up to 1000 channels (from number 000 to 999). Push the + and – buttons for change the number showed on the switches.

***Fine Tuning Knob:*** after choosing the right channel, you must tune to your unique transmitter's frequency. Normally the frequency alignment is guarantee by a very stable frequency reference (implemented both in the receiver and in the transmitter) compensated over temperature range. But for a perfect reception of the signal a little adjustment could be done by the Fine Tuning Knob. As you get tuned in you will get the blink of the Tone blue led and you will hear the relative beep sound. If the frequency alignment is correct when you receive the signal from the transmitter a beep sound will be heard and a blink of the Tone led will be seen.

***Tone LED:*** this LED blinks when the receiver is accurately tuned (by the use of Channel Selectors and Fine Tuning Knob) on the transmitter RF channel and the transmitter transmits the audio beep.

***Gain Knob:*** adjust the sensitivity of the receiver by turning the Gain Knob. In this way the gain of the input receiver amplifier change their gain and the hunter can reduce the receiver sensitivity. The Gain Knob must be adjusted so that the Falcon LED blinks only in a restricted range of antenna orientation (angle of 45 degrees), for which the received signal has a maximum intensity, or the Signal Level Indicator shows three segment intensity in presence of maximum received signal. When the received signal has a very low intensity (the location of the falcon is far from the receiver) turn the Gain Knob clockwise increasing so the sensitivity of the receiver. When the received signal is very high (the location of the falcon is close to the receiver), turn the Gain Knob anticlockwise, reducing so the receiver sensitivity.

***Signal Level Indicator:*** the LEDs on the LED bar show the level of the received signal. When the intensity of the received signal is low the lighted on LEDs are located on the left portion of the bar. When the intensity of the received signal increases the lighted on LEDs shift from left to right position proportionally to the signal level. The receiver implements a special function that controls the LEDs brightness depending on the environmental light. This feature is implemented using a light sensor and a dimmer circuit. When the environmental light is high (e.g. when the receiver is used under the sun) the LEDs brightness is incremented so that they are visible also in this poor condition. When the environmental light is very poor (e.g. twilight), the LEDs brightness is reduced, because their too high brightness may be annoying for the user.

***Falcon Direction LED:*** the LED located in the eye of the drawing falcon blinks when the receiver is accurately tuned (by the use of Channel Selectors and Fine Tuning Knob) on the transmitter RF channel frequency and the received signal exceeds certain intensity.

# System settings

## Initial settings

In this section the step-by-step procedure for the initial system setting is described:

***Transmitter antenna assembly:*** Screw the transmitter antenna on the antenna connector placed on the top side of the transmitter like shown in Figure XX (insert the figure). On the transmitter case is printed own transmitted channel, that must correspond to the received channel set on the Channel Selectors of the receiver.

***Transmitter battery installation:*** Place the 3V lithium CR1/3N in the bottom cover of the transmitter like shown in Figure XX (insert the figure) and screw it in the top part of the transmitter like shown in the Figure XX (insert the figure). Verify if the transmitter is switched on: this is confirmed by transmitter LED blinking. Each LED blinking correspond to one transmission by the transmitter and occurs one time each 1.8 s.

***Transmitter switching off:*** Unscrew the bottom cover until the LED stops blinking.

***Transmitter attach to the falcon…***

***Receiver handle assembly:*** Install the handle to the bottom side of the receiver using the small wheel to attach it to the receiver case. The procedure is shown in Figures: put the receiver and handle in like shown in the Figure. Insert the handle in the receiver rail located on the bottom side.

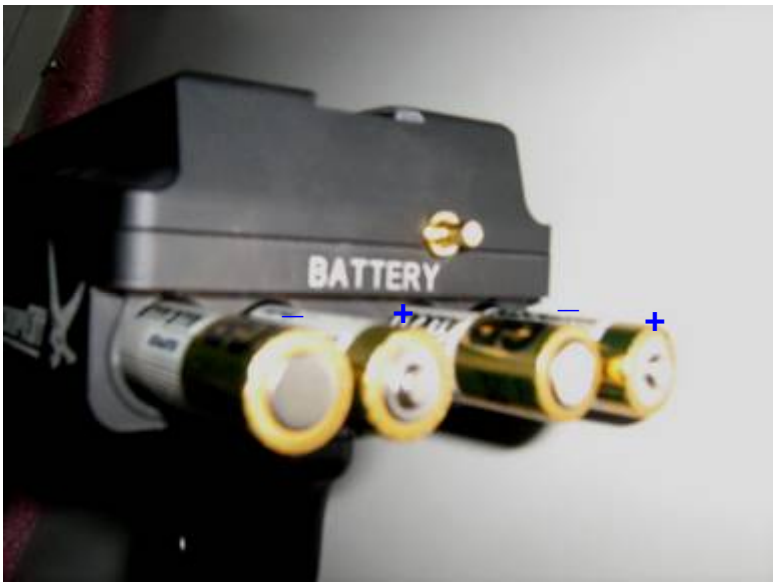

Move the handle through the rail toward the front of the receiver.


Fix the handle on the receiver turning the small wheel mounted on the handle.

***YAGI antenna assembly:*** Install the Yagi antenna on the top side of the receiver. Connect the antenna cable to the gold SMB connector of the receiver like shown in the Figure XX (insert the figure). Open the Yagi antenna following the procedure shown in the Figures XX (insert the figures). Turn the Antenna knob mounted on the top of antenna structure, until the mechanical constraints block further antenna movements. The five antenna elements in the final position must be parallel aligned and maximum spaced.
There is the possibility to connect the mobile car antenna with magnetic base for the searching of the falcon during car displacement. It is advisable to use Yagi antenna in all cases where is possible, because this antenna is designed in particular for falcon tracking application.

***Receiver batteries installation:*** Insert the six 1.5V AA batteries on the rear panel of the receiver like shown in the Figures XX. Remove the panel below the writing BATTERIES on the rear of the panel, turning the wheel. Insert the first two batteries like shown in Figure.


Then insert the other 4 batteries like shown in the next Figure:




Push the battery cover on the rear side of the receiver and fix it to the case by tuning the wheel.

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***Receiver switching on:*** Switch on the receiver by turning the Volume Knob clockwise until the desired volume of audio is reached. Verify the batteries state by checking of ON/ Low Battery Status LED. If is necessary, change the batteries.

***Receiver switching off:*** Switch off the receiver by turning the Volume Knob anti-clockwise until ON/ Low Battery Status LED is turned off.

***Channel selection:*** Push the buttons on the Channel Selectors to choose the received channel that must be equal to the channel number printed on the transmitter case attached to the falcon. Don't change Channel Selectors configuration once the correct channel is selected.

***Frequency tuning:*** Turn the Fine Tuning Knob until the heard audio beep is loud and clear, the Tone LED blink in the presence of the audio beep and the received signal level is the highest. Generally these three conditions are satisfied in the same setting of the Fine Tuning Knob that corresponds to the Knob turned in the mid position.

***Gain setting:*** Set the Gain Knob to the minimum value, because the transmitter is very close to the receiver.

***Application with more transmitters:*** In some applications is necessary the use of one receiver and more transmitters, each attached on single falcon. In these cases all the channels of used transmitters must be checked on the receiver like explained above. Generally it is not necessary to perform Fine Tuning Knob adjustments for each channel because the transmitter channels are set on frequencies that correspond to the mid position of receiver Fine Tuning Knob. Both transmitter and receiver have very stable frequency reference. In some cases however the transmitted frequency may slightly shift and a little adjustment may be necessary.

## Use of the receiver

In this section the use of the receiver during hunting is described.

***Frequency tuning:*** Ensure that the Tone LED blinks in the presence of the audio beep and the beep is loud and clear. If this not occurs adjust the Fine Tuning Knob around the mid position until the Tone LED blinks in the presence of audio beep. Generally it is not necessary to perform further Fine Tuning Knob adjustment if it is in mid position and the Tone LED blinking was checked in initial setting. It is possible that when the flacon is very far from the receiver the LED not blinks in presence of the barely audible audio beep. In this case the Fine Tuning Knob must be adjusted so that the audio beep reaches the maximum loudness.

***Falcon direction finding:*** For falcon direction finding, the Gain Knob must be adjusted so that the Falcon LED blinks only in a restricted range of antenna orientation (angle of 45 degrees), for which the received signal has a maximum intensity, or the Signal Level Indicator shows three segment intensity in presence of maximum received signal. This operation must be made in all cases. The hunter must then turn around while watching Signal Level Indicator and Falcon LED and hearing the audio beep loudness. The orientation in which the received signal intensity is the highest, the Falcon LED blinks and the heard audio beep is very loud and clear shows the falcon direction.
If more than one transmitter is used, change the Channel Selectors configuration when wish search another transmitter direction.

***Signal Level Indicator configuration:*** The receiver implement three different operating mode of Signal Level Indicator:

- 2 LEDs (default): in this mode the receiver turns on two adjacent LEDs at a time for display the received signal level
- 1 LED: in this mode the receiver turns on only one LED at a time for display the received signal level
- All LEDs: in this mode the receiver turns on only all LEDs for display the received signal level

For change the operation of the Indicator select the number 899 on the Channel Selectors. Then choose the number 299 into 4 seconds and at the end of this time-out the successive operating mode is selected. When the operating mode is changed this is confirmed by a light play of the Signal Level Indicator and an audio tune generation in base of selected mode.

***DNL configuration:*** The receiver implement a DNL (Dynamic Noise Limiter) circuit that increments the SNR of audio signal so that the hunter can better find the direction of the falcon. By default the DNL circuit is enabled, but it can be disabled using a particular command sequence on the Channel Selectors. For disabled/enabled the DNL circuit select the number 899 on the Channel Selectors. Then choose the number 199 into 4 seconds and at the end of this time-out the state of DNL circuit is toggled respect to the previous state. When the DNL circuit is enabled this is confirmed by a inside-outside followed by outside-inside scrolling of LEDs on the bar and a sequence of audio beep from low to high tune. When the DNL circuit is disabled, the receiver generates a left-right followed by right-left scrolling of LEDs on the bar and a sequence of audio beep from high to low tune. It is advisable to leave the DNL circuit enabled.

# Accessories

***External power plug and 12 V car supply cable:*** connecting the 12 V car supply cable at one side to the external power plug mounted on the left side of the receiver (indicated by writing 12 V DC and shown in Figure XX) and at other side at car cigarette lighter allows the saving of batteries charge. The power supply cable will not recharge the batteries inside the receiver. This input is protected against polarity inversion.


External power plug

***Headphone jack:*** in presence of high environmental audio noise use the headphones to easier hear the received audio beep. Connect the headphones to the headphone jack present on the right side of the receiver indicated by writing HEADPHONES and shown in Figure XX. The connection of the headphones will automatically disable the loudspeaker.

Headphone jack

# Specifications

## Receiver Specifications:

| *Parameter* | *Min.* | *Tip.* | *Max.* | *Units* |
|---|---|---|---|---|
| External power supply | +8 | +12 | +16 | V |
| Internal power supply | 6 x 1.5 V batteries STILO – AA – LR6 – | | | |
| Power consumption | - | 100 | 200 | mA |
| Estimated battery life | - | 72 | - | h |
| Sensitivity (weak sound among the noise) | - | -150 | - | dBm |
| Temperature | -10 | - | +55 | $^{0}$C |
| Number of channels | - | 1000 | - | - |
| Channel spacing | - | 10 | - | kHz |
| | | - | | |
| Weight :- receiver only | - | | - | |
| - receiver with antenna | - | | - | g |
| - receiver with antenna and handle | - | | - | |
| Dimensions | - | | - | |

## Transmitter Specifications:

| *Parameter* | *Min.* | *Tip.* | *Max.* | *Units* |
|---|---|---|---|---|
| Power supply | One 3V lithium battery CR1/3N – DL1/3N – | | | |
| Supply voltage | 2.2 | - | - | V |
| Power consumption during transmission | - | 65 | - | mA |
| Mean power consumption | - | 1.43 | - | mA |
| Estimated battery life | - | 168 | - | h |
| Transmission time interval | - | 40 | - | ms |
| Transmission duty cycle | - | 2.2 | - | % |
| Transmission period | - | 1.8 | - | s |
| Temperature | -10 | - | +55 | $^{0}$C |
| Irradiated power (ERP) | - | + 18 | - | dBm |
| Frequency stability in temperature | - | - | 100 | Hz |
| Weight | - | | - | g |
| Dimensions | - | | - | |
| Antenna length | - | | - | cm |

# Precautions

Please consider the following precautions to prevent malfunction or failures of the system.

## Receiver

- Use always new AA batteries preferably alkaline type. Do not use old batteries: if the remaining charge of used batteries is low, the receiver may switch off in unexpected way. In any case the receiver can be supplied with external power.
- Insert the batteries only in the way shown in section System Settings.
- Keep the batteries separate to prevent shortage. Use insulation material case for the storage of the batteries.
- Do not use dirty or leakage batteries: this may damage internal circuits or contacts.

## Transmitter

- Use always new CR1/3N batteries. Do not use old batteries: if the remaining charge of used batteries is low, the transmitter may switch off in unexpected way with the risk to lose the falcon.
- Insert the batteries only in the way shown in section System Settings. Avoid especially the inversion of battery polarity.
- Keep the batteries separate to prevent shortage. Use insulation material case for the storage of the batteries.
- Do not use dirty or leakage batteries: this may damage internal circuits or contacts. At each use of the transmitter check, if the battery contacts are clean.
- Pay attention to the installation of the antenna, since the transmitter circuit may damages if excessive force is applied.
- Protect the transmitter from extreme mechanical shocks or electrostatic discharges.
- Pay attention when attach the transmitter to the falcon; the transmitter must be attached in correct way to prevent that it is detached during the flight of the bird.