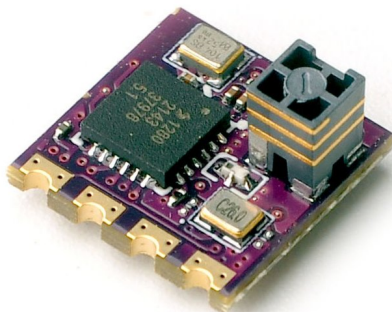




EP2 TCXO

Happymodel ELRS 2.4G EP2 TCXO
ExpressLRS 2.4 GHz receiver with ceramic antenna



Read this entire manual carefully before installation and first use, and keep it for future reference.

www.rotorama.com

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1. Safety instructions

1.1 General principles

- The receiver is intended for experienced users who can solder and configure the flight controller (FC) of a model. If you are unsure, ask a more experienced modeller for help.
- The product is not a toy and must be kept away from children. It contains small parts that can be swallowed.
- Protect the receiver from moisture, water, dust, impacts and extreme temperatures. Do not tamper with or modify the receiver in any way.
- Do not continue to use a damaged receiver (cracked board, broken antenna, signs of overheating).

1.2 Soldering and electrical installation

- Always disconnect the model's battery and the USB cable before soldering.
- Solder quickly and with a reasonable tip temperature. The ceramic antenna is fragile and can break off or be damaged by heat if you are careless when soldering.
- Power the receiver **only with 5 V** from the 5 V pad of the flight controller. Never connect it directly to the battery.
- Before applying power for the first time, check that there are no shorts between the pads and clean off any flux residue.

1.3 Operating the model

- **Always remove the propellers** during setup and bench tests.
- Before every flight, check the link between the radio and the receiver and the failsafe function (Chapter 6).
- Fly only in a safe place, away from people, animals, buildings, vehicles and power lines, and always in accordance with the regulations of the country in which you are flying (Chapter 3).
- The link range depends on the antenna placement, the surroundings and interference. Do not estimate it from data for other receivers.

2. Product description

2.1 What the receiver is for

The Happymodel EP2 TCXO is a miniature RC receiver for the **ExpressLRS** (ELRS) system in the 2.4 GHz band. ExpressLRS is an open-source RC system with low latency and a high refresh rate. The receiver receives control commands from a radio with an ExpressLRS 2.4 GHz TX module and passes them to the flight controller (FC) using the **CRSF** protocol over a serial line (UART). In the opposite direction, it sends telemetry from the flight controller to the radio.

The receiver has an integrated ceramic (SMD) antenna and measures 10 × 10 mm, which makes it suitable mainly for small and racing drones. The TCXO version contains a *temperature compensated crystal oscillator*, which according to the manufacturer keeps the frequency accurate even under large temperature changes. The manufacturer lists use in FPV drones, RC airplanes, cars and boats.

2.2 Package contents

Item	Quantity
Happymodel EP2 TCXO RC receiver	1 pc

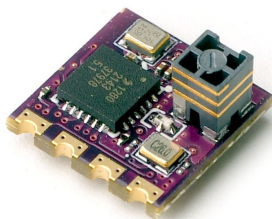
Not included: connecting wires, heat-shrink tubing, radio or ExpressLRS TX module, flight controller (FC).

2.3 Technical data

Parameter	Value
Designation	EP2 TCXO (Happymodel)
RC system	ExpressLRS, ISM 2.4 GHz band
Frequency range (manufacturer's data)	2400–2500 MHz
Processor (MCU)	ESP8285
RF module	SX1280 (SX1281) IMLTRT
Oscillator	TCXO (temperature compensated)
Antenna	ceramic SMD, on the receiver board
Antenna peak gain	3.7 dB
Receive refresh rate	25–500 Hz
Output protocol	CRSF (UART serial line)
Working voltage	5 V
Dimensions	10 × 10 × 6 mm
Weight	0.44 g
Firmware	ExpressLRS; target <i>HappyModel EP1/EP2 2.4GHz RX</i> in ExpressLRS Configurator

※ The manufacturer does not publish the maximum telemetry transmit power for the EP2 TCXO. The data apply to the EP2 TCXO version; they do not apply to the older EP2 version without TCXO or to the EP1.

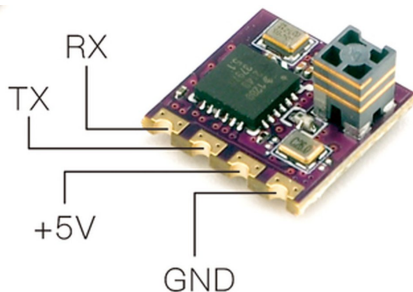
2.4 Receiver and solder pads



Side with the RF module and ceramic antenna



Side with the ESP8285 processor and the EP2 TCXO marking



Solder pads on the edge of the board (manufacturer's image)

Pad	Connection to the flight controller (FC)
RX	to the TX pad of the selected FC UART (telemetry from the FC to the receiver)
TX	to the RX pad of the same FC UART (control commands from the receiver to the FC)
+5V	to the 5 V pad of the flight controller
GND	to any ground pad (GND) of the flight controller

※ The manufacturer does not describe the small pads at the top edge of the board. Do not connect anything to them and do not bridge them.

3. Legal conditions of operation

3.1 The law of the country of operation applies

European Union regulations on radio equipment and on the operation of unmanned aircraft apply in all Member States, but the national implementing rules differ from country to country – permitted frequency bands, maximum transmit power, registration portals, geographical zones and mandatory insurance. The information in this chapter describes the situation in the Czech Republic. **If you operate the receiver in another country, you must comply with the regulations of the country in which you operate it.**

3.2 Radio frequencies and transmit power

The receiver is radio equipment – besides receiving commands, it also transmits telemetry. In the Czech Republic, operation in the 2.4 GHz band is governed by General Authorisation No. VO-R/10 of the Czech Telecommunication Office (ČTÚ):

Frequency band	Limit	Regulation (CZ)
2400–2483.5 MHz	25 mW e.i.r.p.	VO-R/10, Art. 3(j)

- The user is responsible for setting the transmit power of the radio and of the telemetry and for selecting the regulatory domain (*Regulatory Domain*) in the firmware. Select the regulatory domain according to the country in which you fly.
- Operate the receiver only with its built-in antenna, without additional amplifiers.
- Outside the Czech Republic, the bands and limits of the respective country apply.

3.3 Operation of unmanned aircraft and models

If the receiver is installed in a drone or another unmanned aircraft, operation is governed by Regulations (EU) 2019/947 and 2019/945 and by national regulations. In the Czech Republic, this mainly concerns operator registration (mandatory, among other things, for every drone with a camera), pilot competency, flying within visual line of sight, a maximum height of 120 m and respecting geographical zones. Up-to-date information is available on the website of the Civil Aviation Authority (www.caa.gov.cz).

4. Installation

4.1 What else you need

- A radio with an **ExpressLRS 2.4 GHz** TX module (internal or external).
- A flight controller (FC) with a free full UART and a 5 V pad, e.g. running Betaflight firmware.
- A fine soldering iron, solder, thin connecting wires and heat-shrink tubing or other suitable insulation.
- A computer with ExpressLRS Configurator and Betaflight Configurator, or a smartphone with Wi-Fi.

4.2 Placement of the receiver and antenna

- The antenna is located directly on the receiver board, so **the placement of the receiver also determines the placement of the antenna**.
- Do not cover the ceramic antenna with carbon and do not place it deep between electronics boards. According to the ExpressLRS documentation, such placement reduces the receiver's performance.
- Keep in mind that a ceramic antenna has a shorter range than a wire antenna. Heat-shrink tubing, a canopy or surrounding carbon parts attenuate the signal further.
- Mount the receiver so that it cannot move freely and the antenna is not mechanically stressed.

4.3 Wiring to the flight controller (FC)

Connect the receiver to any free full UART of the flight controller. Refer to the flight controller manual for the UARTs you can use.

- ① Receiver **GND** to any GND pad of the flight controller.
- ② Receiver **+5V** to the 5 V pad of the flight controller.
- ③ Receiver **TX** to the **RX** pad of the selected UART (e.g. RX1).
- ④ Receiver **RX** to the **TX** pad of the same UART (e.g. TX1).

Caution: some flight controllers have a resistor on the UART recommended for receivers (SBUS) that pulls the RX input to ground. The receiver then enters bootloader mode after power-up and its LED stays solid even with the radio switched off. In that case, connect the receiver to a different UART.

- KISS flight controllers may label their UARTs differently – always follow the flight controller manual.
- If you use a digital FPV system (e.g. DJI) connected to the flight controller, do not connect its SBUS/HDL wire to the receiver's UART.

- After soldering, do not insulate or permanently mount the receiver yet – first carry out the check described in Chapter 6.1.

4.4 Betaflight setup

Procedure in Betaflight Configurator (the location of items may differ between program versions):

- ① On the *Ports* tab, enable *Serial RX* on the UART the receiver is connected to.
 - ② On the *Receiver* tab, set *Receiver Mode* to *Serial* and *Serial Receiver Provider* to **CRSF**.
 - ③ Enable telemetry (*Telemetry*).
 - ④ If you use analog video or a system with MSP DisplayPort support, set *RSSI Channel* to *Disabled* and also disable *RSSI ADC*.
 - ⑤ On the *CLI* tab, use the command *get serialrx* to check that *serialrx_inverted* and *serialrx_halfduplex* are switched off (*off*). If necessary, set them with *set serialrx_inverted = off* and *set serialrx_halfduplex = off* and save with the *save* command.
- ※ The CRSF protocol requires a full UART without inversion and in full-duplex mode. After setup, close Betaflight Configurator and disconnect the USB cable – an open program could prevent the next steps, especially updating via Passthrough.

5. Binding and firmware

5.1 Compatibility with the TX module

The receiver only links with an ExpressLRS TX module for the 2.4 GHz band. **The first number of the firmware version (major version) must be the same on the TX module and on the receiver**, otherwise neither the link nor binding will work by any method. Both devices must also have the same binding phrase (if you use one) and the same regulatory domain.

5.2 Binding with a binding phrase

The recommended method is to set the same **binding phrase** on the TX module and on the receiver. It is entered in ExpressLRS Configurator when flashing the firmware, or via the receiver's web interface in Wi-Fi mode (Chapter 5.5). The ExpressLRS documentation recommends a unique phrase of at least 8 letters and digits, e.g. your pilot handle. It is not a password or an encryption key. With the same phrase, the receiver links with the module automatically, without further binding.

5.3 Binding without a binding phrase

Traditional binding works when no binding phrase is set on the receiver. With newer versions of ExpressLRS firmware, the receiver can be put into bind mode even with a phrase set – details are given in the documentation at expresslrs.org.

- ① Switch off the radio.
- ② Power-cycle the receiver three times in a row: apply power, the LED lights up, disconnect power within 2 seconds. 3× in total. Preferably with a flight battery, after checking the wiring and for shorts.
- ③ The receiver LED blinks twice quickly, pauses, and repeats – the receiver is in bind mode.
- ④ Switch on the radio and select *[Bind]* in the ExpressLRS Lua script.
- ⑤ When the receiver LED is solid, it is bound.

Newer versions of Betaflight also allow you to put the receiver into bind mode with the *Bind Receiver* button on the *Receiver* tab or with the *bind_rx* CLI command. Bind mode is cancelled by restarting the receiver or by successful binding.

5.4 LED states

LED	Meaning
solid on	connected to a transmitter, or bootloader mode (solid even with the transmitter off – see Chapter 4.3)
double blink then pause	bind mode
slow blink (500 ms)	waiting for connection from the transmitter
triple blink then pause	connected, but Model Match configuration mismatched
medium speed blink (100 ms)	radio chip not detected
fast blinking (25 ms)	Wi-Fi mode enabled

5.5 Firmware update via Wi-Fi

The receiver has Wi-Fi, so the firmware and settings can be changed without a computer cable:

- ① In ExpressLRS Configurator, select *Device Category: Happymodel 2.4 GHz, Device: HappyModel EP1/EP2 2.4GHz RX* and the *WiFi* method.
 - ② Set the *Regulatory Domain* (mandatory, according to the country of operation) and, recommended, the *Binding Phrase*; optionally your home Wi-Fi credentials. Click *Build* and do not unzip the *firmware.bin.gz* file.
 - ③ Switch off the radio and power up the receiver. Without a signal from the transmitter, it enters Wi-Fi mode after approximately 60 s (the LED blinks rapidly). On a bound receiver, Wi-Fi can also be enabled from the Lua script: *Wifi Connectivity → Enable RX WiFi*.
 - ④ Using a phone or computer, connect to the **ExpressLRS RX** network with the password **expresslrs** and open the address **10.0.0.1** in a browser. If your home Wi-Fi is stored in the receiver, the ExpressLRS RX network will not appear.
 - ⑤ On the *Update* tab, upload the firmware file and click *Update*. Do not disconnect the receiver during the upload. When finished, the LED blinks slowly again.
- ※ Because of its size, the receiver's Wi-Fi antenna is weak – keep your phone or computer close to the receiver when connecting.

5.6 Update via Betaflight Passthrough

If the receiver is wired and configured as described in Chapter 4, the firmware can be flashed through the flight controller:

- ① Close Betaflight Configurator, disconnect and reconnect the flight controller to USB. If the receiver is not powered from USB, connect a battery and make sure the video transmitter (VTX) is cooled, or disconnect it temporarily.

- ② In ExpressLRS Configurator, select the same device as in Chapter 5.5 and the *BetaflightPassthrough* method, set the firmware options and click *Flash*.
- ③ After the green success message appears, the receiver LED starts blinking slowly after a while.

5.7 Further guides

The official ExpressLRS documentation is available at expresslrs.org.



Official ExpressLRS documentation

www.expresslrs.org

6. Checks before the first flight

6.1 Bench test

- Remove the propellers. Check that there are no shorts between the pads, and only then apply power – preferably with a flight battery.
- After switching on the radio, the receiver LED must be solid (connected).
- On the *Receiver* tab in Betaflight Configurator, check that the movements of the sticks and switches correspond to the correct channels and directions.
- Check that telemetry is being received by the radio. With a ceramic-antenna receiver, expect lower signal strength values than with a wire antenna.
- Check that the ceramic antenna is not damaged and is properly soldered. Only then insulate and mount the receiver.

6.2 Failsafe check

With the **propellers removed**, check that the flight controller enters failsafe (the safe state on loss of link) when the signal is lost: connect the model, Arm (start the motors) according to your setup and switch off the radio. The flight controller must activate failsafe and the motors stop according to its settings. Repeat the check after every change of firmware or settings.

7. Maintenance and troubleshooting

7.1 Maintenance

- After a crash, check the ceramic antenna, the solder joints and the wires.
- Keep the receiver dry and clean; remove dirt with a dry brush.
- Always update the firmware on the TX module and the receiver at the same time so that the major version matches.

7.2 Troubleshooting

Problem	Possible cause and solution
LED solid even with the radio off	The receiver is in bootloader mode – the flight controller UART pulls the RX input to ground. Connect the receiver to a different UART (Chapter 4.3).
LED blinks slowly, no link	Different binding phrase, regulatory domain or major firmware version. Unify the settings (Chapter 5.1) or bind the receiver again.
LED blinks three times and pauses	The Model Match settings in the radio and the receiver do not match – adjust them in the Lua script.
LED blinks at medium speed (100 ms)	Radio chip not detected – contact the seller.
Channels do not move on the Receiver tab	TX/RX wires swapped, <i>Serial RX</i> not enabled on the correct UART, protocol is not CRSF, or inversion is enabled (Chapter 4.4).
The ExpressLRS RX network does not appear	Switch off the radio and wait about 60 s; move the phone closer to the receiver. If a home Wi-Fi is stored, the receiver connects to it instead.
Short range or dropouts	The antenna is covered by carbon or electronics, or it is damaged. Change the placement of the receiver (Chapter 4.2).

8. Information for the EU and Czech Market

8.1 Importer and responsible person in the EU

The product is placed on the European Union market by the importer stated below, who is at the same time the responsible person within the meaning of Article 16 of Regulation (EU) 2023/988 of the European Parliament and of the Council on general product safety (GPSR).

Importer / responsible person in the EU	Rotorama, s.r.o.
Company ID (IČO)	051 57 692
VAT ID (DIČ)	CZ05157692
Registered office	Okrajová 1351, 674 01 Třebíč, Czech Republic
E-mail	info@rotorاما.cz
Phone	+420 252 252 098
Website	www.rotorاما.com

8.2 Product conformity



- The product bears the **CE** marking and complies with the requirements of the applicable European Union harmonisation legislation.
- A copy of the **EU Declaration of Conformity** is available from the importer at the address stated above or at the e-mail address info@rotorاما.cz.
- **Product identification:** the type designation (EP2 TCXO) is printed on the circuit board of the receiver.

8.3 Disposal of electrical equipment



- The crossed-out wheeled bin symbol on the product, its packaging or in the documentation means that at the end of its service life the product **must not be disposed of together with mixed municipal waste.**
- Hand it over at a take-back point for electrical equipment – at a collection yard, at a take-back point of a collective system, or at the retailer when purchasing a new equivalent product. Take-back is free of charge for the end user.
- The obligations under Act No. 542/2020 Coll., on end-of-life products, are fulfilled by the importer through a collective take-back system.
- Proper disposal helps prevent negative impacts on the environment and human health and contributes to the reuse of secondary raw materials.

Through its contractual partner **ASEKOL a.s.**, the company ensures the take-back of waste electrical equipment from households and the separate collection of waste electrical equipment, batteries and accumulators in accordance with the applicable legislation. The customer is entitled to hand over old electrical equipment or a battery or accumulator at any collection point of the above contractual partner. The addresses of these take-back points are listed at www.asekol.cz, www.ecobat.cz and also <https://visoh2.mzp.cz/RegistrMistZO/RegistrMistZOPublic/MapaMistZpetOdberu>.

9. Warranty and rights arising from defective performance

The rights and obligations of the contracting parties are governed by Czech law, in particular by Act No. 89/2012 Coll., the Civil Code, and Act No. 634/1992 Coll., on consumer protection.

- The seller is liable to the buyer for the product being free of defects on receipt. If the buyer is a consumer, a defect may be notified **within two years of receipt** of the product (Section 2165 of the Civil Code).
- If a defect appears within **one year** of receipt, the product is deemed to have been defective already at the time of receipt (Section 2161(5) of the Civil Code).
- When purchasing online, a consumer has the right to **withdraw from the contract within 14 days** of receiving the goods without giving a reason (Section 1829 of the Civil Code).
- Claims should be made with the retailer from whom you purchased the product. The importer's contact details are given in Chapter 8.1.
- The competent body for out-of-court settlement of consumer disputes is the **Czech Trade Inspection Authority**, Štěpánská 796/44, 110 00 Prague 1, www.coi.cz.