CRSF-PWM-V10

Matek – CRSF to 10× PWM converter + vario
User manual



The board has no regulator for servos. Power the board and servos only via the BEC pins with 4–9 V. The Vbat pin is for voltage measurement only.

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1. Safety instructions

1.1 Before you start

Read the entire manual before installation and keep it for future reference. The CRSF-PWM-V10 converter is an electronic component that is installed in an RC model; incorrect wiring or configuration may result in loss of control of the model, property damage or injury.

- This product is not a toy. It is not intended for children; installation and configuration should be carried out by a person familiar with RC equipment and soldering.
- When soldering pins and wires, work in a well-ventilated area, protect your eyes and beware of the hot soldering iron tip.
- Carry out all wiring and rewiring **with the flight battery disconnected** and without USB power.
- During wiring, failsafe setup and ground tests, keep the **propeller removed** or the electronic speed controller (ESC) signal disconnected.

1.2 Power supply and wiring

- Power the board only via the **BEC** pins with **4–9 V**. A higher voltage will destroy the board.
- The board **has no built-in regulator for servos**. Servos are powered from the BEC pins, which must be connected to an external 5–9 V source (e.g. the BEC in the ESC or a separate BEC). The BEC voltage must not exceed the rated voltage of the servos used.
- The **Vbat** pin is only used to measure the flight battery voltage (max. 36 V) – do not power the board from it.
- The **Curr** input accepts only a 0–3.3 V signal from an external current sensor.
- The 5V outputs for the receiver and GPS supply a combined maximum of 300 mA. Do not connect servos or other loads to them.
- Before switching on for the first time, check the polarity of all connectors and make sure there is no short circuit between adjacent pins.

1.3 Model operation and legal regulations

The converter is used in RC aircraft, gliders and other models. The operation of models is governed by the regulations of the country in which you operate the model – for model aircraft in the European Union in particular Regulation (EU) 2019/947, but national implementing rules (registration, zones, insurance, permitted radio bands and transmitter power) differ from country to country. **The law of the country in which the product is operated always prevails.**

2. Product description

2.1 Intended use

The Matek CRSF-PWM-V10 converts the serial **CRSF** signal from a receiver into **10 separate PWM outputs** for servos and speed controllers. It is particularly suitable for classic model aircraft and gliders without a flight controller (FC): it lets you use a small ExpressLRS or TBS Crossfire receiver that has no PWM outputs of its own. The board is compatible with any receiver using the CRSF protocol (433 MHz, 868 MHz, 915 MHz and 2.4 GHz).

In addition to converting channels, the board sends telemetry to the transmitter: flight battery voltage and current, consumed capacity, data from a connected GPS module and, thanks to the **built-in barometer**, also altitude and vertical speed (vario). The board can be configured via UART2 in Matek Configurator – failsafe, PWM frequency, calibration of voltage and current measurement – and its firmware can be updated.

2.2 Package contents

Qty	Item
1×	Matek CRSF-PWM-V10 converter
1×	set of Dupont pins, 2.54 mm pitch (supplied unsoldered)

※ The receiver, GPS module, current sensor, servos and cables are not included.

2.3 Technical data

Parameter	Value
Type designation	CRSF-PWM-V10
Input protocol	CRSF (CRSF protocol receivers only)
Outputs	10× PWM (channels CH1–CH10)
PWM frequency	50 Hz (default), 100, 160, 330, 400 Hz
CRSF protocol PWM range	988–2012 µs
UART	2× (UART1 receiver, UART2 GPS / settings / firmware)
Power supply (BEC pins)	4–9 V
Voltage measurement (Vbat)	0–36 V (built-in 1K:10K divider)
Current sensor input (Curr)	0–3.3 V, external sensor
5 V regulator	LDO 300 mA for receiver and GPS
Servo regulator	none – servos are powered by an external 5–9 V source via the BEC pins

Parameter	Value
Barometer	built-in
Telemetry	RxBt, Curr, Capa, Bat%, GPS, GSpd, Hdg, Alt, Sats, VSpd, Baro Alt
Dimensions	38 × 16 mm
Weight	1.8 g

2.4 Pinout



Top view of the board (pins not soldered)

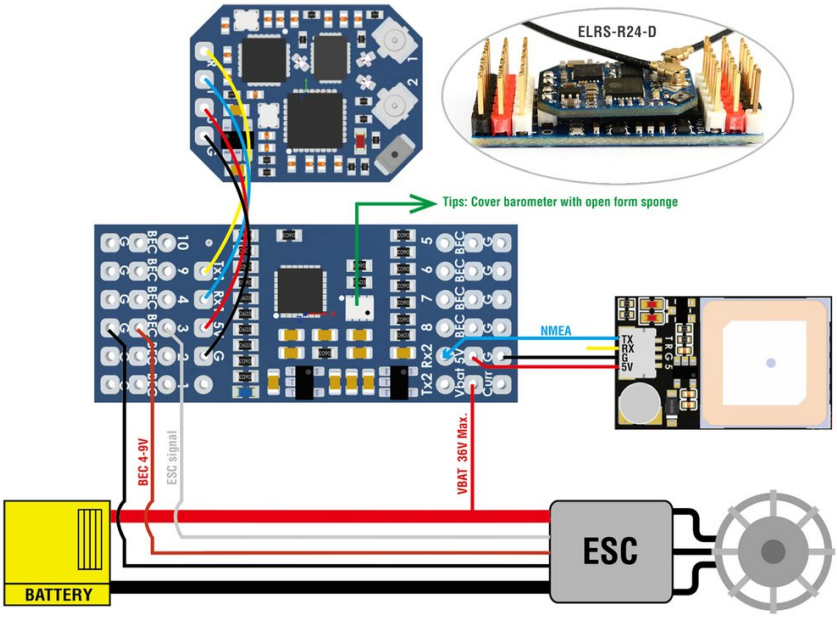
Pin	Function
1–10	PWM outputs of channels CH1–CH10; each channel has a row signal – BEC – G. Channel **CH3** is reserved for throttle, default failsafe 988 µs.
BEC	4–9 V power supply for the board and servos from an external source (all BEC pins are connected)
G	ground (−)
Tx1, Rx1, 5V, G	UART1 – CRSF receiver connection and its 5 V supply
Tx2, Rx2, 5V, G	UART2 – GPS module, settings in CLI mode, firmware update
Vbat	flight battery voltage measurement, max. 36 V
Curr	external current sensor signal 0–3.3 V

3. Wiring

3.1 What else you need

- a CRSF protocol receiver (ExpressLRS or TBS Crossfire) bound to your transmitter,
- a 4–9 V power source for the board and servos – typically the BEC in the ESC or a separate BEC,
- servos and, if applicable, an electronic speed controller (ESC) with motor,
- optionally an NMEA GPS module and an external current sensor with 0–3.3 V output,
- a soldering iron, solder and, for configuration, a USB-TTL adapter (e.g. CP210x, FTDI) or a flight controller (FC) running INAV or Betaflight.

3.2 Overall wiring diagram



Wiring diagram by the manufacturer: receiver on UART1, GPS on UART2, 4–9 V BEC and ESC signal on channel 3, Vbat voltage measurement (max. 36 V). Recommendation in the diagram: cover the barometer with open-cell foam. The ELRS-R24-D receiver shown is not included.

3.3 Soldering the pins

The 2.54 mm Dupont pins are supplied unsoldered. Solder only the rows you will actually use; the receiver, GPS and sensors can also be connected directly with wires. After soldering, check that no solder bridge has formed between adjacent pads.

3.4 Connecting the receiver

Connect the CRSF receiver to UART1. The signal wires are crossed:

Receiver	CRSF-PWM-V10
TX	Rx1
RX	Tx1
5V (power)	5V
GND	G

The receiver output protocol must be set to CRSF. Make sure the receiver can be powered with 5 V.

3.5 Power supply, servos and speed controller

- Connect the BEC output (5–9 V) and ground of the ESC or separate BEC to any pair of **BEC** and **G** pins. This powers the board and all servos.
- Plug the servos into rows 1–10 (signal – BEC – G). The channel order corresponds to the transmitter channels.
- Connect the ESC signal to channel **3** (throttle).
- If the ESC has its own BEC and you also use a separate BEC, do not connect both sources to the BEC pins at the same time.

3.6 Voltage and current measurement

- Connect **Vbat** to the positive terminal of the flight battery (e.g. to the ESC supply lead). The battery ground must be common with the board ground. The measured voltage must not exceed 36 V.
- Connect **Curr** to the signal output of an external current sensor (0–3.3 V). Set the sensor scale with the *set current_scale* command (Chapter 5.6).

3.7 GPS module

The board supports GPS modules using the **NMEA** protocol (1 Hz, baud rate 9600–115200). A single-wire connection is sufficient: the GPS module **TX** to the board **Rx2**, power to **5V** and **G**. Connecting the board Tx2 to the GPS RX is not required.

- u-blox series GPS modules usually output the UBX+NMEA protocol by default.
- Some u-blox modules do not output NMEA – in that case restore the module to its default configuration in u-center.

- If the board does not detect a GPS module on UART2 within 10 s after power-on, it switches to CLI mode (Chapter 5.1).

3.8 Barometer (vario)

The built-in barometer measures altitude and vertical speed. The manufacturer recommends covering the barometer with a piece of **open-cell foam** so that the readings are not affected by airflow and light. Position the board in the fuselage so that the barometer is not exposed to direct airflow.

4. Commissioning

4.1 Channel range in the transmitter

The CRSF protocol works with a PWM range of **988–2012 µs**. Set the channel outputs in the transmitter so that they stay within this range. Then fine-tune the servo end points in the transmitter so that the servos do not hit their mechanical stops.

4.2 LED indication

LED	Meaning
slow blinking	the board does not receive a CRSF signal – the receiver is not bound to the transmitter or not connected to UART1
8× quick blinks	the board has received a CRSF signal and saved the failsafe values
solid on	the board and receiver are working normally

4.3 Failsafe setup

Failsafe defines which values the board sends to the outputs when it stops receiving the CRSF signal (e.g. when the link to the transmitter is lost). Channel CH3 (throttle) has a default failsafe value of 988 µs. Save your own values for all channels as follows:

① Disconnect the ESC signal from the board (and remove the propeller).

② Bridge the signal pads of PWM outputs **1 and 2** (e.g. with a jumper).

③ On the transmitter, set the sticks and switches to the positions you want for failsafe – typically throttle at minimum, control surfaces centred.

④ Power on the board and receiver at the same time. As soon as the board receives the CRSF signal, the values are saved automatically and the LED blinks 8× quickly.

⑤ Remove the jumper between outputs 1 and 2. The board then works in normal PWM output mode.

⑥ Verify the function: with the propeller removed, switch off the transmitter and check the position of the servos and throttle.

※ Always set and verify the failsafe after a firmware update and after any change of wiring or channel assignment.

4.4 Telemetry in the transmitter

The board sends telemetry via the receiver to the transmitter. On an EdgeTX transmitter, start the sensor search (*Discover new*) on the model's *Telemetry* page. The sensors RxBt, Curr, Capa, Bat%, GPS, GSpd, Hdg, Alt, Sats, VSpd and Baro Alt will appear. Vario and Baro Alt telemetry is supported by current versions of EdgeTX and ExpressLRS – keep the firmware of the transmitter, TX module and receiver up to date.

- When a GPS module is connected, the GPS, GSpd, Hdg, Alt and Sats sensors blink on the telemetry page – the board is communicating with the module.
- With telemetry logging in the transmitter, you can later plot the flight path or locate a lost model.

4.5 Pre-flight check

- The board LED is solid on and the servos respond to the sticks in the correct direction.
- Control surface deflections match the settings and the servos do not hit their stops.
- The failsafe is set and verified (Chapter 4.3).
- The battery voltage telemetry shows a value that matches reality.
- Insert a **fully charged** battery before the flight: Li-Po 4.20 V/cell, LiHV 4.35 V/cell. End the flight at 3.5 V/cell at the latest (e.g. 3S Li-Po: fully charged 12.6 V, end flight 10.5 V).

5. CLI mode and parameters

5.1 Activating CLI mode

If the board does not detect a GPS module on UART2 within **10 seconds** after power-on, it switches to CLI mode. In this mode it can be connected to Matek Configurator via a USB-TTL adapter or via a flight controller (FC), parameters can be changed and the firmware updated. CLI mode has no effect on CRSF signal reception or the PWM outputs. Disconnect the GPS module from UART2 before configuring.

5.2 Connecting via a USB-TTL adapter

CRSF-PWM-V10	USB-TTL adapter
Tx2	RX
Rx2	TX
G	GND
BEC (4–9 V input)	5V – or power the board from the model BEC

① Connect the adapter to the computer. If you power the board from USB, disconnect the servos and ESC from it.

② After power-on, wait 10 s for CLI mode to activate.

③ Start Matek Configurator, select the adapter COM port, baud rate **115200** and click *Connect*.

④ Enter the *help* command – a list of commands is displayed.

5.3 Connecting via a flight controller (FC)

Connect the board Tx2 to the RX of any spare UART of the flight controller, Rx2 to the TX of the same UART and G to GND; power the board (e.g. from the 5 V output of the flight controller to a BEC pin).

① Connect the flight controller to the computer via USB and connect in INAV or Betaflight Configurator.

② After powering on the board, wait 10 s for CLI mode to activate.

③ On the *CLI* tab enter *serialpassthrough x 115200*, where x = UART number − 1. Example: board on UART4 → *serialpassthrough 3 115200*.

④ Enter the *help* command.

5.4 Command overview

Enter all commands in **lowercase**.

Command	Function
help	lists all commands

Command	Function
version	shows the firmware version
reboot	restarts the board
get failsafe	lists the saved failsafe values of all channels
get channel	lists the current PWM values of all channels; without a bound receiver the failsafe values are listed
get tim	lists the PWM frequency of the timers
get scale	lists the vbat_scale and current_scale values
get battery	lists voltage (mV) and current (mA)
get baro	lists barometer altitude (cm) and temperature (°C)
set tim[n] = [x]	sets the PWM frequency (Chapter 5.5)
set vbat_scale = [x]	voltage measurement scale (Chapter 5.6)
set current_scale = [x]	current sensor scale (Chapter 5.6)
set output_5 = ch[x]	remaps a channel to output 5 (Chapter 5.7)

5.5 PWM frequency

The outputs are divided into groups according to timers (TIM); the frequency is set for the whole group. The default frequency is 50 Hz, which is compatible with both older and modern servos and speed controllers.

Timer (n)	Channels	Command
TIM2 (2)	CH1, CH2, CH4	set tim2 = [x]
TIM16 (16)	CH3	set tim16 = [x]
TIM3 (3)	CH5, CH6, CH7, CH8	set tim3 = [x]
TIM1 (1)	CH9, CH10	set tim1 = [x]

Value [x]: 50, 100, 160, 330 or 400 (Hz). Example: *set tim16 = 400* – channel CH3 will run at 400 Hz; *set tim2 = 100* – channels CH1, CH2 and CH4 will run at 100 Hz.

❋ Analog servos usually work at 50 Hz only, some digital servos can handle 400 Hz. Before changing, check in the servo or ESC datasheet that it works reliably at the selected frequency.

5.6 Calibrating voltage and current measurement

- **set vbat_scale = [x]**, range 60–210, default 110 (1K:10K divider). Because of component tolerances you can adjust the value so that the telemetry matches the multimeter reading.
- **set current_scale = [x]**, default 150. The range is shown by the *help* command (current firmware 50–2000, older 50–500). Set the value according to the scale of the current sensor used.

- Example: telemetry shows 10 A, current meter 10.8 A → new scale = (10.8 / 10) × 150 = **162**.
- Even with no current flowing, *get battery* may show a small current – this is due to sensor offset and tolerance.

5.7 Remapping output 5

With the **set output_5 = ch[x]** command you can route a different receiver channel to output 5, in the current firmware in the range 1–16. Example: *set output_5 = ch11* – output 5 will carry the channel 11 signal.

6. Firmware and further manuals

6.1 Firmware update

The firmware (CRSF_PWM_fw.zip file) and Matek Configurator are available on the manufacturer's product page www.mateksys.com/?portfolio=crsf-pwm. The update is carried out in CLI mode.

▶ Via a USB-TTL adapter

① Connect the adapter according to Chapter 5.2 and wait 10 s for CLI mode to activate.

② In Matek Configurator select the COM port, baud rate 115200 and click *Connect*.

③ Use *OpenFile* to select the firmware file (.bin) and click *Upgrade*.

▶ Via a flight controller (FC)

① Follow Chapter 5.3 up to the *serialpassthrough* command.

② Disconnect INAV/Betaflight Configurator from the flight controller; leave USB plugged in and the board powered.

③ In Matek Configurator select the flight controller COM port, baud rate 115200 and click *Connect*.

④ Use *OpenFile* to select the firmware file (.bin) and click *Upgrade*.

❉ Do not disconnect the board during the update. After the update, set and verify the failsafe again (Chapter 4.3).

6.2 EdgeTX and ExpressLRS manuals

The converter is most often used with ExpressLRS receivers and EdgeTX transmitters. The official documentation is available at edgetx.org and expresslrs.org.

7. Maintenance and troubleshooting

7.1 Maintenance and storage

- After a crash, inspect the board, solder joints and connectors; do not continue to use a damaged board.
- Protect the board from moisture, water, dust and conductive dirt (e.g. carbon dust).
- Regularly check that wires do not rub against sharp edges and that connectors are seated firmly.
- Store the model with the board in a dry place; disconnect the flight battery and store it separately at 3.8 V/cell (3S: 11.4 V).

7.2 Troubleshooting

Problem	Possible cause and solution
LED blinks slowly, servos do not respond	The receiver is not bound to the transmitter or not connected to UART1. Check binding, TX/RX crossing and that the receiver output protocol is set to CRSF.
Board does not light up at all	No power on the BEC pins (4–9 V). Check the BEC source, polarity and solder joints.
Servos jitter or overheat	Unsuitable PWM frequency – set the timer frequency back to 50 Hz. Check that the BEC source can supply sufficient current.
No GPS telemetry	Check the GPS module TX → Rx2 wire. The module must output NMEA; restore a u-blox module to default settings in u-center.
Cannot connect in CLI	A GPS module is connected to UART2 or you did not wait 10 s. Check the Tx2/Rx2 crossing and the 115200 baud rate.
Voltage in telemetry is incorrect	Adjust vbat_scale according to the multimeter (Chapter 5.6).
Vario / Baro Alt sensors do not appear	Update EdgeTX and the firmware of the ExpressLRS TX module and receiver, then search for sensors again.

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@rotorama.cz
Phone	+420 252 252 098
Website	www.rotorama.com

8.2 Product conformity

CE

- 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@rotorama.cz.
- **Product identification:** the type designation (CRSF-PWM-V10) is given in this manual and on the product packaging; the firmware version is shown by the *version* command in CLI mode (Chapter 5).

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.