ROTORAMA

CRSF-PWM-6

CRSF to 6× PWM converter
Matek Systems — user manual



Read the safety instructions in chapter 1 before wiring. Always remove the propeller during setup and set up the failsafe before the first flight.

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1. Safety instructions

1.1 Before you start

The CRSF-PWM-6 converter is an electronic component designed to be installed in an RC model. Read the whole manual before wiring, especially the chapters on power supply and failsafe setup. Keep the manual for future reference and pass it on with the product.

- The product is not a toy. It is not intended for children or for persons unfamiliar with operating RC models.
- Only carry out assembly and soldering if you are experienced in soldering electronics. Work in a well-ventilated area and beware of burns.
- The board has no enclosure. Protect it from moisture, dust, metal objects and mechanical damage; prevent short circuits between the pins.

1.2 Electrical connection

- Power the board only via the **5V** pad from an external source (BEC) in the range of **4–9 V**. The board has no voltage regulator for servos.
- The **Vbat** pin is used **only for measuring** the battery voltage (max. 36 V). The board is not powered from it.
- The voltage on the **4V5** pin is 0.3 V lower than the voltage on the 5V pad. Before connecting, make sure the voltage on the 5V pad does not exceed the rated supply voltage of the receiver and the GPS module.
- Observe the polarity. Swapping the G and 5V pins or connecting battery voltage to the signal pins will destroy the board and the connected devices.
- Always do the wiring with the battery disconnected.

1.3 Operating the model

- When setting up and testing on the bench, **remove the propeller** or disconnect the motor. The motor may start unexpectedly.
- Before the first flight, always set up and test the **failsafe** (chapter 4.2) — on signal loss, the throttle channel must go to a value at which the motor stops.
- Before every flight, check the direction and range of travel of all control surfaces.
- When operating the model, follow the regulations of the country in which you operate it.

2. Product description

2.1 What it is for

The Matek CRSF-PWM-6 converter turns the serial signal from a receiver using the CRSF protocol into 6 separate PWM outputs for servos and an electronic speed controller (ESC). It is especially useful for pilots of classic model aircraft without a flight controller (FC) who want to use an ExpressLRS or TBS Crossfire receiver. The converter works with any receiver using the CRSF protocol (including the 433 MHz, 868 MHz, 915 MHz and 2.4 GHz bands).

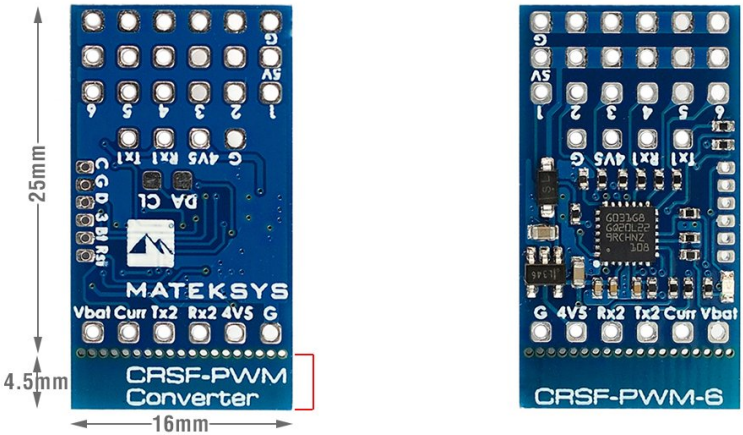
Besides converting the signal, the converter sends telemetry back to the radio: battery voltage, current and consumed capacity (with an external current sensor), and, with a GPS module connected, position, speed, heading, altitude and number of satellites. The converter can be configured via UART2 with the *Matek Configurator* software — you can change the PWM frequency, calibrate voltage and current measurement and remap output 5.

2.2 Package contents

Item	Qty
CRSF-PWM-6 converter	1 pc
Dupont pin headers, 2.54 mm pitch (unsoldered)	1 set

Not included: receiver, GPS module, current sensor, barometer, USB-TTL adapter or connecting cables.

2.3 Pinout



Bottom (left) and top (right) side of the board. The 4.5 mm edge with the label can be cut off.

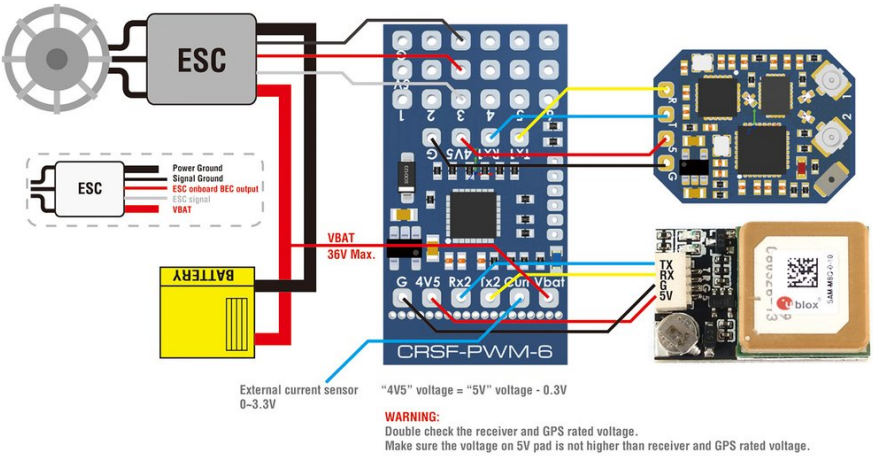
Pin	Function
1–6	PWM outputs of channels CH1–CH6 (signal)
5V	power for the board and servos from an external source (BEC), 4–9 V
G	ground (GND)
Tx1 / Rx1	UART1 — CRSF receiver connection
4V5	receiver / GPS power; voltage = 5V pad voltage − 0.3 V
Tx2 / Rx2	UART2 — GPS module, firmware update, parameter setup
Vbat	battery voltage sensing, 0–36 V
Curr	external current sensor signal, 0–3.3 V
DA / CL	I²C bus for an external barometer (bottom side)

2.4 Specifications

Manufacturer	Matek Systems
Model	CRSF-PWM-6
Input protocol	CRSF (ExpressLRS, TBS Crossfire and other receivers)
Outputs	6× PWM
PWM frequency	50 Hz (default), 100, 160, 330, 400 Hz
CRSF PWM signal range	988–2012 µs
UART	2× (receiver; GPS / setup)
Telemetry	RxBt, Curr, Capa, Bat%, GPS, GSpd, Hdg, Alt, Sats
Supply (5V pad)	4–9 V
Voltage sensing (Vbat)	0–36 V, built-in 1k:10k divider
Current sensor (Curr)	external, 0–3.3 V signal
Regulator for servos	none — servos are powered by an external source
Dimensions	25 × 16 mm (without the 4.5 mm removable edge)
Weight	1.3 g

3. Wiring

The figure shows a typical wiring of the converter with an ESC, battery, receiver and GPS module. The following sections explain the individual connections.



Wiring example: ESC on channel 3, receiver on UART1, GPS on UART2, Vbat and external current sensor.

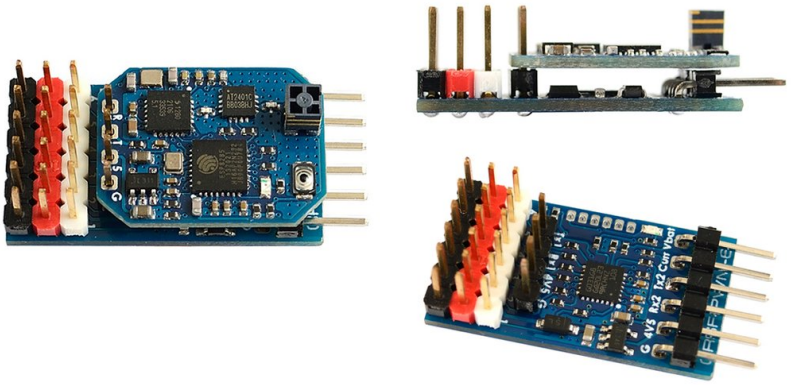
ESC wire labels in the figure: *Power Ground*, *Signal Ground*, *ESC onboard BEC output*, *ESC signal* and *VBAT* (battery voltage). Warning in the figure: check the rated voltage of the receiver and GPS; the voltage on the 5V pad must not be higher.

3.1 Power supply

- The converter and all servos are powered via the row of **5V** and **G** pads from an external 4–9 V source, typically the ESC's BEC or a separate BEC.
- The source must supply enough current for all connected servos. See the documentation of the servos and the BEC.
- The receiver and GPS are powered from the **4V5** pin (5V pad voltage − 0.3 V). If you power the board with more than 5 V, make sure the receiver and GPS can withstand it.

3.2 Connecting the receiver

Connect the CRSF receiver to UART1 — the receiver's **T** (TX) pin to **Rx1**, the receiver's **R** (RX) pin to **Tx1**, power to **4V5** and ground to **G**. A small receiver can be soldered directly onto the converter board using the pin headers from the package.



ExpressLRS receiver soldered onto the converter with pin headers (receiver not included).



Updating the receiver firmware: if the receiver is soldered directly onto the board, you may remove the two 0 Ω resistors (circled in red in the picture on the left) before flashing the receiver via UART. After flashing, bridge the pads again with a drop of solder. The receiver can also be flashed via Wi-Fi.

3.3 Servos and ESC

Plug the servos and the ESC into rows 1–6: signal to the numbered pin, power to the 5V row, ground to the G row. **Channel 3 (CH3) is reserved for the throttle** — connect the ESC signal to it. The other channels correspond to the radio channels in the same order.

❉ When using an ESC with its own BEC, connect the BEC output to the 5V row. Do not connect two BEC sources together.

3.4 Voltage and current sensing

- Connect **Vbat** to the battery positive (max. 36 V). The board has a 1k:10k voltage divider.
- Connect **Curr** to the signal output of an external current sensor with an output voltage of 0–3.3 V. Set the sensor scale with the *set current_scale* command (chapter 6.5).
- The ground of the sensor and the battery must be common with the board ground.

3.5 GPS module

- The converter supports GPS with the **NMEA** protocol, 1 Hz, 9600–115200 baud.

- Connect the GPS module's **TX** pin to **Rx2**. Connecting the converter's TX2 to the GPS RX is not required.
- Connect the GPS power to 4V5 and G.
- u-blox modules output the UBX+NMEA protocol by default. If the GPS does not output NMEA, restore its default configuration in *u-center*.

3.6 External barometer

An **MS5611** (I²C address 0x77) or **SPL06-001** (address 0x76) barometer can be connected to the **DA** (SDA) and **CL** (SCL) I²C pads on the bottom side of the board; this requires current converter firmware. The CRSF-PWM-6 board **has no I²C pull-up resistors** — the barometer module must have them. You can check this by measuring the resistance between SCL and 3V3 and between SDA and 3V3 on the module: with a pull-up resistor it is 1–10 kΩ.

4. Getting started

4.1 LED status

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

4.2 Failsafe setup

The failsafe defines which PWM values the converter outputs after signal loss. Channel 3 (throttle) has a default failsafe value of **988**. The values of all channels including CH3 can be changed as follows:

① **Disconnect the ESC signal** from the converter (for safety).

② Bridge the signal pins of channels **1 and 2** (e.g. with a jumper).

③ On the radio, set the sticks and switches to the position you want to save as failsafe — throttle to minimum, control surfaces usually centred.

④ Power on the converter and the receiver at the same time. Once the CRSF signal is received, the values are saved automatically and the LED blinks 8 times quickly.

⑤ Remove the jumper between channels 1 and 2. The converter then works in normal mode.

⑥ Check the saved values with the *get failsafe* command (chapter 6) and test the failsafe by switching the radio off — with the propeller removed.

※ Older firmware saved the failsafe automatically at every power-on. After every firmware update, set up and test the failsafe again.

4.3 Channel range

The CRSF protocol uses a PWM range of **988–2012 µs**. Set the channels on the radio to move within this range. The command *get channel* lists the current values of all channels.

4.4 Check before the first flight

- The converter LED is solid on (the receiver is bound and connected).
- All control surfaces move correctly and over their full range.
- The failsafe is tested — the motor stops when the radio is off.
- The voltage telemetry on the radio matches the actual battery voltage.

5. Telemetry

The converter sends telemetry back to the radio via the receiver. After connecting, start the search for new sensors (*Discover new*) on the *TELEMETRY* page of the radio. Once the converter has a GPS connection, the GPS sensors blink on this page.

Sensor	Meaning
RxBt	battery voltage (Vbat pin)
Curr	current (external current sensor)
Capa	consumed capacity
Bat%	remaining capacity in %
GPS	GPS coordinates
GSpd	GPS ground speed
Hdg	heading
Alt	altitude
Sats	number of satellites

With a barometer connected (chapter 3.6), the converter additionally sends barometric altitude (Baro Alt) and vertical speed (VSpd); this requires current versions of EdgeTX and ExpressLRS.

Telemetry logging on the radio lets you plot the flight path or find a lost model from the last GPS coordinates.

6. Configuration and firmware

6.1 CLI mode

If the converter does not detect a GPS module on UART2 within **10 seconds** after power-on, it enters CLI mode. In this mode it can be connected to the *Matek Configurator* to set parameters or update the firmware. CLI mode has no effect on the receiver signal or the PWM outputs.

6.2 Connecting via a USB-TTL adapter

Converter	USB-TTL adapter (e.g. CP210x, FTDI)
TX2	RX
RX2	TX
4V5	5V
G	GND

① Connect the adapter to the computer and wait 10 s for CLI mode to activate.

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

③ Type the command *help*.

6.3 Connecting via a flight controller (serial passthrough)

Connect TX2 to any spare UART_RX of the flight controller (FC), RX2 to UART_TX, 4V5 to the FC's 5V or 4V5 and G to GND. Connect the FC to the computer via USB and wait 10 s. In the INAV or Betaflight configurator, open the *CLI* tab and type *serialpassthrough x 115200*, where x = UART number − 1 (e.g. UART4 → *serialpassthrough 3 115200*). Then type the command *help*.

6.4 CLI commands

※ Type all commands in lowercase.

Command	Function
help	list of all commands and allowed ranges
version	converter firmware version
reboot	restart the converter
get failsafe	saved failsafe values
get channel	current PWM values of all channels; without signal, the failsafe values are shown
get tim	PWM frequency per timer
get scale	voltage and current scales

Command	Function
get battery	measured voltage (mV) and current (mA)
get baro	barometer altitude and temperature
set tim[n] = [x]	PWM frequency of timer n (chapter 6.5)
set vbat_scale = [x]	voltage scale, 60–210
set current_scale = [x]	current scale
set output_5 = ch[x]	remap output 5 to another channel

6.5 PWM frequency and calibration

The PWM frequency is set for groups of channels according to the timers (TIM). The default is 50 Hz, the allowed values are 50, 100, 160, 330 and 400 Hz.

Timer	CRSF-PWM-6 channels
TIM2	CH1, CH2, CH4
TIM16	CH3
TIM3	CH5, CH6

- Example: *set tim16 = 400* sets 400 Hz on channel 3, *set tim2 = 100* sets 100 Hz on channels 1, 2 and 4.
- Analog servos usually work at 50 Hz only; some digital servos can handle 400 Hz. Check the servo and ESC documentation to make sure they work reliably at the selected frequency.
- **vbat_scale** — default 110 (1k:10k divider). Because of component tolerances, adjust it so the reading matches a multimeter.
- **current_scale** — default 150. If telemetry shows 10 A and a current meter 10.8 A, set (10.8 / 10) × 150 = 162. For an external sensor, set the value according to its scale.
- Even with no current flowing, *get battery* may show a small current — this is due to the offset and tolerance of the sensor.
- **set output_5 = ch[x]** — e.g. *set output_5 = ch11* outputs the signal of channel 11 on output 5. The allowed range is listed by the *help* command.

6.6 Firmware update

The firmware (file *CRSF_pwm_vx.x.x.bin*) and the *Matek Configurator* software are available on the product page at www.mateksys.com.

① Connect the converter via a USB-TTL adapter (chapter 6.2) or via an FC (chapter 6.3). With an FC, after entering the *serialpassthrough* command, disconnect the INAV/Betaflight configurator but keep the USB cable and the converter power connected.

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

③ Click *OpenFile*, select the firmware file and click *Upgrade*.

④ After the update, set up and test the failsafe again (chapter 4.2).

6.7 Further documentation

The converter works with ExpressLRS receivers and with radios running EdgeTX. Official documentation is available at www.expresslrs.org and www.edgetx.org.

7. Maintenance and troubleshooting

7.1 Maintenance and storage

- After a crash, check the board, solder joints and connectors; do not continue to use a damaged board.
- Keep the board dry and clean. Remove dirt with a dry soft brush.
- Store in a dry place, away from direct sunlight and out of the reach of children, ideally in an antistatic bag.

7.2 Troubleshooting

Problem	Cause and solution
LED blinks slowly	The receiver is not bound to the transmitter or not connected to UART1. Check the binding and the wiring T → Rx1, R → Tx1.
Servos do not respond, LED solid on	The servos have no power — check the BEC on the 5V pad and the polarity of the connectors.
Motor does not stop after signal loss	The failsafe is not set correctly. Follow chapter 4.2 and check with get failsafe.
Servo jitters or gets hot	The servo cannot handle the set PWM frequency. Set the relevant timer back to 50 Hz.
No GPS telemetry	Check the GPS TX → Rx2 wire. The module may not output NMEA — restore its default configuration in u-center.
Cannot connect to CLI	CLI mode activates only 10 s after power-on and only without GPS on UART2. Check the TX2/RX2 wiring and the 115200 baud rate.
Telemetry voltage is wrong	Adjust vbat_scale according to a multimeter reading (chapter 6.5).
No barometer telemetry	The barometer module has no I²C pull-up resistors or the firmware needs updating (chapter 3.6).

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-6) is printed on the removable edge of the circuit board. If you cut the edge off, keep this manual and the proof of purchase, which allow the product to be identified.

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.