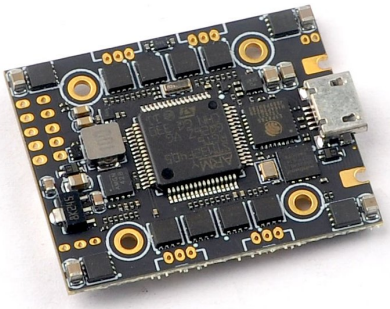
CruxF405HD ELRS

AIO flight controller F405 + 20 A 4-in-1 ESC +
ExpressLRS 2.4 GHz receiver
User Manual



Read this entire manual carefully before installation and first use, especially the safety instructions.

Importer: Rotorama, s.r.o. · www.rotorama.com · info@rotorama.cz

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1. Safety Instructions

1.1 Before You Start

The Happymodel CruxF405HD ELRS is an electronic component for installation in a radio-controlled model (FPV drone). Installation requires soldering and basic knowledge of electronics and flight controller setup. Read the entire manual before first use and keep it for future reference.

- This product is not a toy. Keep it out of the reach of children.
- Do not modify the board in ways not described in this manual or in the manufacturer's documentation. Neither the manufacturer nor the seller is liable for damage caused by improper installation or incorrect wiring.

1.2 Electrical Safety and Soldering

- Before soldering or making any change to the wiring, **disconnect the battery** and the USB cable.
- Observe the **power polarity** (BAT+ / GND). Reverse polarity or a short circuit will destroy the board and may cause a fire.
- Solder only to the designated solder pads, quickly and with a sufficiently powerful soldering iron – overheating may damage the board.
- After soldering, check that there are no solder bridges between adjacent pads and that no wire can come into contact with the carbon frame, a propeller or a sharp edge.
- Do not exceed the permitted supply voltage or the ESC current load specified in chapter 2.3.

1.3 Li-Po and LiHV Batteries

- Use only Li-Po or LiHV batteries with **3S to 4S** cells.
- Charge the battery only with a charger designed for the given cell type, on a non-flammable surface and under supervision.
- Do not continue to use a mechanically damaged, swollen or overheated battery; dispose of it in accordance with local regulations.
- Transport and store batteries in a fireproof bag, at room temperature and at storage voltage (see chapter 7.2).

1.4 Rotating Propellers

- **Always remove the propellers when setting up and testing the motors on the bench.**
- The motors may spin up unexpectedly. Connect the battery only with the radio transmitter switched on and the Arm switch in the Disarm position; keep your hands and other people away from the propellers.

2. Product Description

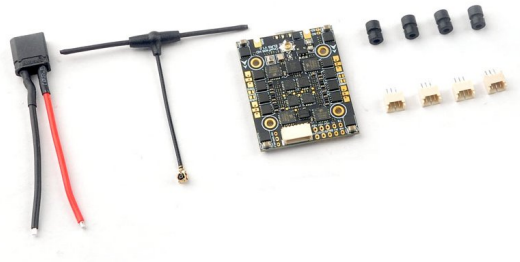
2.1 Intended Use

CruxF405HD ELRS is an AIO (all-in-one) board that combines a **flight controller (FC)** with an STM32F405 processor, a 20 A 4-in-1 **ESC (electronic speed controller)** with Bluejay firmware and an **ExpressLRS 2.4 GHz receiver** connected via a UART serial port. The board also carries a BMP280 barometer, 8 MB of blackbox memory and voltage and current sensors.

The board has a 20 × 20 mm mounting pattern and is intended for lightweight toothpick and long-range quads running 3S–4S batteries. The 6-pin connector on the board allows direct connection of a DJI (HD) digital video transmitter.

2.2 Package Contents

Item	Qty
CruxF405HD ELRS AIO board (FC + ESC + ELRS receiver)	1×
ELRS 2.4 GHz T-type antenna with IPEX connector	1×
XT30 power connector with cable	1×
Accessory kit (rubber damping grommets, connectors)	1×



Package Contents

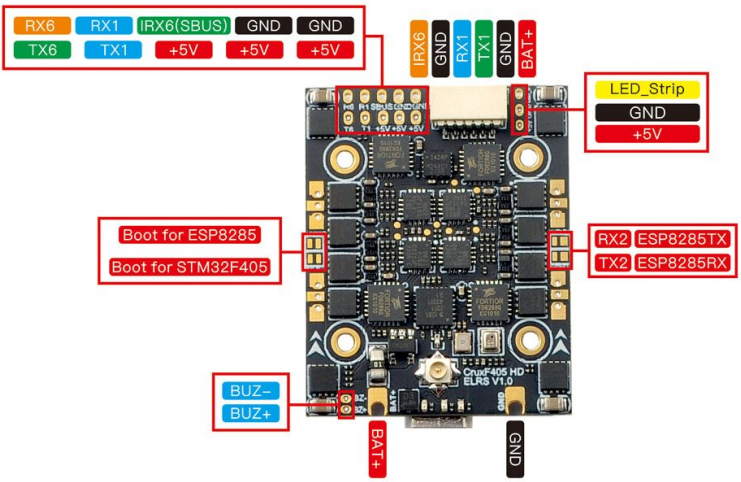
Not included: motors, frame, propellers, video transmitter, camera, battery, radio transmitter, USB cable or charger.

2.3 Specifications

Data provided by the manufacturer Happymodel.

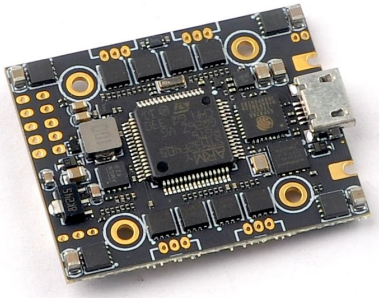
Parameter	Value
Flight controller (FC)	
Processor	STM32F405RGT6 (168 MHz, 1 MB flash)
Gyroscope	ICM42688 (SPI connection)
Barometer	BMP280
Blackbox memory	8 MB
Voltage / current sensor	yes / yes; voltage scale 110, current scale 470
Firmware, target	Betaflight, BETAFLIGHTF4
Mounting pattern	20 × 20 mm
Power Supply	3S–4S Li-Po / LiHV (DC 11–17.4 V)
ESC (4-in-1)	
Current	20 A continuous per channel, 25 A peak (5 s)
ESC processor	EFM8BB21
ESC firmware	Bluejay (BLHeli_S), factory installed
Protocol	DShot150 / DShot300 / DShot600
Programming	BLHeliSuite
ExpressLRS receiver	
Frequency band	2.4 GHz
Packet rate	25 / 50 / 150 / 250 / 500 Hz
Telemetry output power	< 12 dBm
Protocol to FC	CRSF, connected to UART2
Antenna connector	IPEX

2.4 Pinout



Layout of solder pads and connectors (side with the DJI connector)

Label	Function
BAT+ / GND	main power from a 3S–4S battery (large solder pads at the bottom edge)
6-pin connector	for a DJI digital video transmitter: IRX6, GND, RX1, TX1, GND, BAT+
RX1 / TX1	UART1 – typically MSP OSD for a digital video transmitter
RX6 / TX6	UART6 – GPS or another serial device
IRX6 (SBUS)	inverted RX6 input for an SBUS receiver
+5V / GND	5 V supply for peripherals
LED_Strip / GND / +5V	addressable LED strip
BUZ+ / BUZ−	buzzer
RX2 – ESP8285TX TX2 – ESP8285RX	connection of the onboard ELRS receiver to UART2
Boot for STM32F405	puts the flight controller into DFU mode (bootloader)
Boot for ESP8285	firmware flashing mode for the onboard receiver
IPEX	ELRS receiver antenna connector
Micro USB	connection to a computer (Betaflight Configurator)



Other side of the board with the STM32F405 processor

2.5 Serial Ports (UART)

Port	Factory state	Typical use
UART1	available on the RX1/TX1 solder pads and in the 6-pin connector; factory set for MSP/VTX	MSP OSD (DisplayPort) for a digital video transmitter
UART2	**used** by the onboard ELRS receiver	ExpressLRS receiver (CRSF)
UART6	available on the RX6/TX6 and IRX6 solder pads	GPS, another serial device, or SBUS input via IRX6

- **IRX6 and TX6/RX6 cannot be used at the same time.**
- UART1 or UART6 can usually be used for MSP OSD with a digital video transmitter.

※ UART2 is not freely available. Separating the RX2/TX2 solder pads disconnects the onboard receiver so that UART2 can be used for another device – but the onboard ELRS receiver will then stop working. Any modification of the board is at your own risk and is not a product defect.

3. Legal Requirements for Operation

3.1 The Law of the Country of Operation Is Decisive

Regulations (EU) 2019/947 and 2019/945 apply in all Member States of the European Union, but national implementing rules differ from country to country – registration portals, minimum pilot age, geographical zones, mandatory insurance, permitted frequency bands and maximum transmit power. The information in this chapter describes the situation in the Czech Republic. If you operate the model in another country, you must follow the regulations of the country in which you fly.

3.2 Radio Frequencies and Transmit Power

The board contains radio equipment – an ExpressLRS receiver that transmits telemetry back. According to the manufacturer, it operates in the **2.4 GHz** band with a telemetry output power of **< 12 dBm**.

Band	Limit in the Czech Republic	Regulation
2400–2483.5 MHz	25 mW e.i.r.p.	ČTÚ general authorisation VO-R/10, Art. 3(j)

- The user is responsible for setting the transmit power of the radio transmitter and module.
- Outside the Czech Republic, the frequency bands and limits of the respective country apply.

3.3 Operating the Assembled Drone

The board itself is not an unmanned aircraft. However, a drone you build with it is an unmanned aircraft system under Regulation (EU) 2019/947 and is subject to its rules. In the Czech Republic, the supervisory authority is the Civil Aviation Authority (ÚCL).

- A drone without a class label (C0–C4) can be operated in the open category as **privately built** – in subcategory A1 with a take-off mass below 250 g and a speed of up to 19 m/s, otherwise in subcategory A3. Subcategory A2 is not available.
- If the drone has a camera, its operator must **register** regardless of the drone's mass; the registration number must be displayed on the drone.
- Fly up to a height of 120 m, within visual line of sight (VLOS) and never over assemblies of people. In subcategory A3, keep a distance of 150 m from residential, commercial, industrial and recreational areas.
- When flying with FPV goggles, an **observer** who keeps the drone in direct sight must be next to the pilot.
- We recommend liability insurance even where it is not mandatory.

4. Installation and Wiring

4.1 What Else You Need

- a frame with a 20 × 20 mm mounting pattern, four motors and propellers suitable for 3S–4S batteries,
- a 3S–4S Li-Po or LiHV battery with an XT30 connector and a suitable charger,
- a radio transmitter with an ExpressLRS 2.4 GHz module,
- a video transmitter and camera (e.g. a DJI digital system),
- a soldering iron, solder, flux and a Micro USB data cable,
- a computer with Betaflight Configurator.

4.2 Mounting in the Frame

- Mount the board in the frame using the included rubber damping grommets – they dampen vibrations transmitted from the motors to the gyroscope.
- The arrows on the board indicate the direction of flight. If you mount the board rotated, set the orientation in Betaflight Configurator (*Configuration* tab, *Board and Sensor Alignment*).
- Do not overtighten the screws; the grommets must remain flexible. The board must not touch the frame or other parts.

4.3 Connecting the Motors

Solder the motor wires to the solder pads on the sides of the board. Then check the motor order and direction of rotation and adjust them if necessary in Betaflight Configurator (chapter 5.6). Shorten the wires to the required length so that they cannot come into contact with a propeller.

4.4 Power Supply

- Solder the included power cable with the XT30 connector to the **BAT+** and **GND** solder pads. Observe the polarity – red wire to BAT+, black wire to GND.
- The board is designed for **3S–4S** Li-Po / LiHV batteries. Do not connect a higher voltage.
- To suppress voltage spikes from the ESCs, we recommend soldering a low-ESR electrolytic capacitor with a sufficient voltage margin to the power solder pads.

4.5 Receiver Antenna

- Connect the ELRS antenna to the IPEX connector on the board. Press the connector straight down until it clicks, without levering.
- Route the active part of the antenna away from the carbon frame and metal parts and as far as possible from the video transmitter.

- **Do not operate the receiver without the antenna connected** – there is a risk of signal loss.

4.6 Digital Video Transmitter

The 6-pin connector on the board is ready for direct connection of a DJI digital video transmitter. It carries the IRX6, GND, RX1, TX1, GND and BAT+ signals.

- The BAT+ pin of the connector carries **full battery voltage**. Check the video transmitter documentation to make sure it can handle 3S–4S voltage.
- MSP DisplayPort is set on UART1 to display the OSD in the goggles (chapter 5.4).
- Never power the video transmitter without an antenna connected.

4.7 Buzzer, LEDs and Other Peripherals

- **Buzzer:** BUZ+ and BUZ− solder pads. A buzzer makes it easier to find the model after a crash.
- **LED strip:** LED_Strip, GND and +5V solder pads.
- **GPS and other serial devices:** UART6 (RX6/TX6), powered from the +5V and GND solder pads. Note: the device's TX connects to the board's RX and vice versa.
- **External SBUS receiver:** signal to IRX6 – RX6/TX6 cannot then be used at the same time.

5. Setup

5.1 Connecting to Betaflight Configurator

① Connect the board to the computer with a Micro USB data cable (the battery does not need to be connected).

② Launch Betaflight Configurator, select the board's serial port, then click *Connect*.

③ The board's firmware target is **BETAFLIGHTF4**.

If the board is still not recognised by the computer after replacing the cable and installing drivers, you can put it into DFU mode by bridging the *Boot for STM32F405* solder pads while plugging in the USB cable, and then flash the firmware again.

5.2 Binding the ExpressLRS Receiver

The receiver is factory-connected to UART2 and configured in Betaflight as a serial receiver with the CRSF protocol. The transmitter module must run ExpressLRS firmware with the **same major version** as the receiver.

① Power the board by connecting the USB cable and wait until the red LED on the board goes out. Disconnect the power immediately.

② Repeat step ①. On the **third** power-up, the red LED starts double-blinking – the receiver is in bind mode.

③ On the radio, open the *ExpressLRS.lua* script in the *TOOLS* menu and select *[Bind]*.

④ The LED first blinks slowly and then lights up solid – binding was successful.

If the LED triple-blinks after binding, change *Model Match* on the radio from "off" to "on", or vice versa.

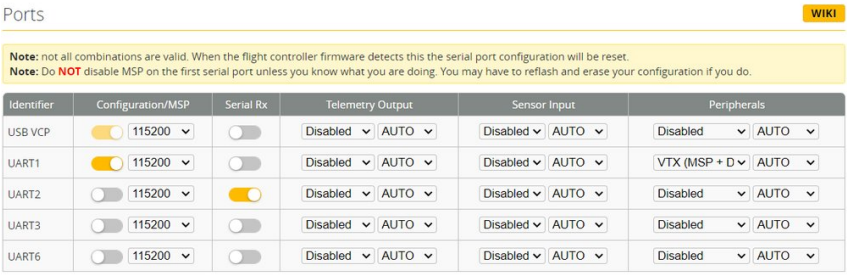
※ The receiver can also be bound by using the same binding phrase in the transmitter and the receiver; the procedure is described in the ExpressLRS documentation (chapter 5.9).

5.3 Receiver LED Status

Red LED	Meaning
solid	bound, radio link established
double blink	bind mode
slow blinking	no signal from the transmitter module
fast continuous blinking	ExpressLRS receiver Wi-Fi enabled
triple blink	Model Match mismatch – change the Model Match setting

5.4 Port and Receiver Setup

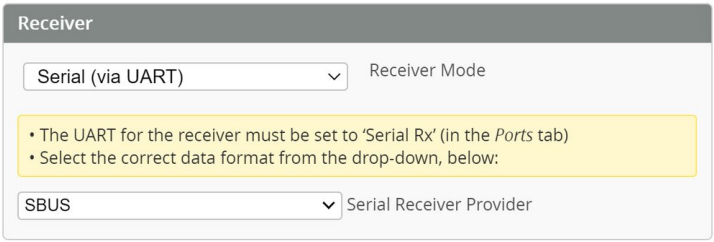
Default settings of the *Ports* tab: UART1 – MSP and VTX peripheral (MSP + DisplayPort), UART2 – *Serial Rx* for the onboard ELRS receiver.



Default settings of the Ports tab (Betaflight Configurator)

▶ Control with a DJI radio via SBUS

To fly the drone with a DJI radio, whose signal comes from the DJI video transmitter as SBUS on IRX6, set *Serial (via UART)* mode and the *SBUS* protocol on the *Receiver* tab. On the *Ports* tab, enable *Serial Rx* on UART6, to which the IRX6 input belongs, and disable it on UART2.



Receiver setup for a DJI radio (Receiver tab)

5.5 Voltage and Current Sensors

Check the sensor settings on the *Power & Battery* tab. The manufacturer specifies a **voltage scale of 110** and a **current scale of 470**. Enter them again after a firmware update or settings reset.

5.6 Motor Check

Remove the propellers before checking the motors!

① Connect the battery and confirm on the *Motors* tab that the propellers are removed.

② Spin up the motors one by one and check that the order matches the diagram shown in the program.

③ Check the direction of rotation. A reversed direction can be corrected in Betaflight Configurator (*Motor direction*) or in the ESC configurator (BLHeliSuite).

④ Set the ESC protocol on the *Configuration* tab to DShot (DShot150, DShot300 or DShot600).

5.7 Arm, Disarm and Failsafe

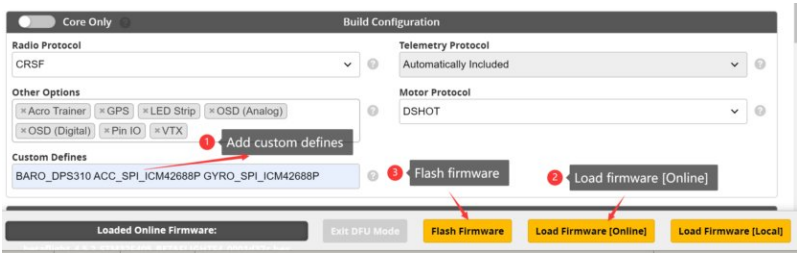
- On the *Modes* tab, assign the **ARM** function to a switch on the radio. Always use only this switch to **Arm** (enable the motors) and **Disarm** (disable the motors).
- On the *Failsafe* tab, set the response to signal loss. Test it without propellers: the motors must stop when the radio is switched off.
- We also recommend assigning a switch for the buzzer to help locate the model.

5.8 Firmware Update and Barometer

When updating Betaflight firmware via *Firmware Flasher*, select the BETAFLIGHTF4 target and enter the following in the *Custom Defines* field:

BARO_DPS310 ACC_SPI_ICM42688P GYRO_SPI_ICM42688P

Without these defines, **the gyroscope will not work**. Then load the firmware (*Load Firmware [Online]*) and flash it (*Flash Firmware*).



Entering Custom Defines in Firmware Flasher

After the firmware has been flashed successfully, enable the barometer by entering these commands on the *CLI* tab:

```
resource I2C_SCL 2 B10
resource I2C_SDA 2 B11
set baro_bustype = I2C
set baro_i2c_device = 2
save
```

- Back up your settings before updating (*diff all* command on the CLI tab).
- The firmware of the onboard ExpressLRS receiver can be updated separately, for example via its Wi-Fi (see the ExpressLRS documentation).
- The ESC firmware is Bluejay; it can be configured and updated with BLHeliSuite.

5.9 Further Guides

Detailed documentation for ExpressLRS and EdgeTX radios is available on the official websites:

ExpressLRS – binding, Wi-Fi, firmware updates: www.expresslrs.org

EdgeTX – radio setup and running Lua scripts: edgetx.org

Betaflight documentation: betaflight.com

6. Before the First Flight

6.1 Pre-flight Check

- Install a **fully charged** 3S–4S battery in the model.
- Check that the board, wires, antennas and propellers are secured; wires must not reach into the propellers.
- Switch on the radio first, and only then connect the battery. Check that the receiver LED is solid and that all channels respond in the correct direction on the *Receiver* tab.
- Check that the Arm/Disarm switch and failsafe work.
- Make sure that the flying site and the operation comply with regulations (chapter 3).

6.2 Monitoring Battery Voltage

State	Per cell	3S	4S
fully charged – Li-Po	4.20 V	12.6 V	16.8 V
fully charged – LiHV	4.35 V	13.05 V	17.4 V
end flight	3.5 V	10.5 V	14.0 V
storage	3.8 V	11.4 V	15.2 V

Monitor the voltage in the OSD. As soon as it drops below the end-of-flight value, land and disconnect the battery.

7. Maintenance and Troubleshooting

7.1 After Every Flight

- Disconnect the battery and let the board and motors cool down.
- Check the solder joints, wire insulation and the antenna connector.
- Remove dirt with a dry brush. Do not use water or solvents.
- After a crash, check that no components on the board are damaged and that the board has not been hit by a propeller.

7.2 Storage

- Store the board in a dry place, in an antistatic bag and out of the reach of children.
- Store batteries disconnected, at a storage voltage of 3.8 V/cell (3S: 11.4 V, 4S: 15.2 V).

7.3 Troubleshooting

Problem	Cause and solution
Receiver LED triple-blinks	Model Match mismatch. On the radio, change Model Match from "off" to "on" or vice versa.
Receiver LED blinks slowly	No signal from the transmitter module. Switch on the radio, check the selected model and the binding.
Receiver will not bind	The transmitter module and receiver have a different ExpressLRS major version, or the receiver is not in bind mode (LED double blink). Repeat the procedure (chapter 5.2).
Gyroscope does not work after a firmware update	The custom defines were missing during flashing. Flash the firmware again with the defines from chapter 5.8.
Barometer does not work	Enter the CLI commands from chapter 5.8.
Board does not connect to the computer	Use a data cable (not a charge-only cable), install the drivers, or use DFU mode (chapter 5.1).
Motor spins the wrong way	Change the direction of rotation in Betaflight Configurator or in BLHeliSuite (chapter 5.6).
No OSD in the goggles	On the *Ports* tab, check the MSP and VTX (MSP + DisplayPort) settings on UART1 (chapter 5.4).
Model does not respond to the DJI radio	Check the SBUS setting on the *Receiver* tab and *Serial Rx* on UART6 (chapter 5.4).

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 (CruxF405 HD ELRS V1.0) is printed on the circuit board.

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.