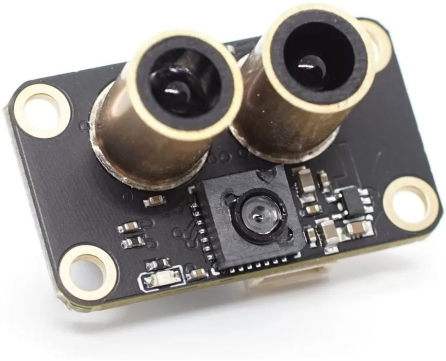
MTF-01

Optical flow and 8 m laser rangefinder
User manual



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

Rotorama, s.r.o. · www.rotorama.com

Contents

1. Safety instructions

1.1 Before you start

1.2 Electrical connection

1.3 Laser rangefinder

1.4 Drone operation

2. Product description

2.1 What it is for

2.2 Package contents

2.3 Parts

2.4 Specifications

3. Installation and wiring

3.1 Position on the drone

3.2 Sensor orientation

3.3 Connecting to the flight controller

3.4 Operating conditions

4. Configuring the sensor in MicoAssistant

4.1 Output protocols

4.2 MicoAssistant software

4.3 Changing the protocol via a USB-TTL adapter

4.4 Configuration without an adapter (ArduPilot)

5. Flight controller setup

5.1 ArduPilot

5.2 PX4

5.3 INAV

5.4 Micolink and custom software

6. Flying with optical flow

6.1 Pre-flight check

6.2 First flight

7. Maintenance and troubleshooting

7.1 Maintenance and storage

7.2 Troubleshooting

8. Information for the EU and Czech Market

8.1 Importer and responsible person in the EU

8.2 Product conformity

8.3 Disposal of electrical equipment

9. Warranty and rights arising from defective performance

1. Safety instructions

1.1 Before you start

- Read the entire manual before installation and setup. Keep the manual and hand it over to the next user together with the product.
- The MTF-01 is a component to be built into a drone or another model with a flight controller (FC). We **recommend installation and setup for experienced users**.
- This product is not a toy. Keep it out of the reach of children – small parts and cables can be swallowed.
- The sensor only supports the stabilisation of the drone. The pilot must be able to take over manual control at any time during the flight.

1.2 Electrical connection

- Power the sensor with **5 V** only. A higher voltage (e.g. directly from the battery) will permanently damage the sensor.
- The data lines use a **3.3 V (LVTTL)** logic level. Connect them only to a serial port (UART) of the flight controller or to a USB-TTL adapter.
- Always do the wiring with the battery disconnected and without USB power. Before powering up for the first time, check that the GND and 5 V wires are not swapped.
- Protect the sensor from static electricity, moisture and dirt.

1.3 Laser rangefinder

- The rangefinder (ToF) emits **invisible infrared radiation** with a wavelength of 850 nm.
- Do not look directly into the optics of a powered sensor at close range and do not view them through optical instruments (magnifier, binoculars, camera lens).
- Do not disassemble the sensor or remove the metal optics tubes.

1.4 Drone operation

Drone operation in the EU is governed by Regulations (EU) 2019/947 and 2019/945, but national implementing rules differ from country to country. The law of the country in which you operate the drone always applies.

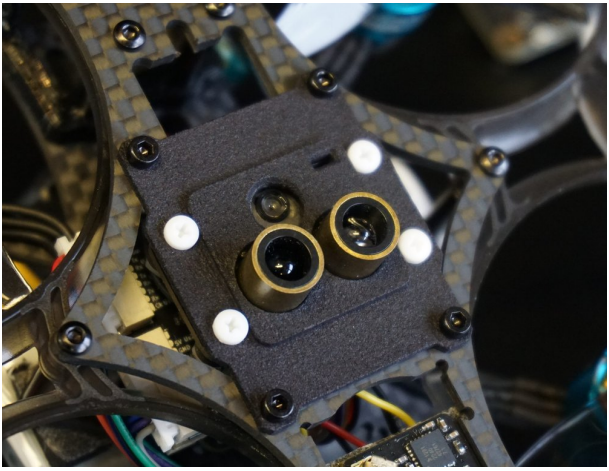
- Perform the first flights after installation in a safe area with no people nearby, ready to switch to manual control or Disarm (stop the motors) at once.
- Always remove the propellers when working on the drone with the battery connected.

2. Product description

2.1 What it is for

The MicoAir MTF-01 combines two sensors in one housing: an **optical flow** sensor and a **laser rangefinder** (ToF, lidar) with a range of up to 8 m. Using a downward-facing camera, the optical flow sensor tracks the movement of the surface below the drone and derives the horizontal velocity from it; the rangefinder measures the height above the ground.

This allows a flight controller running **ArduPilot, PX4, INAV** or FMT to hold position and altitude even without a GPS signal, for example indoors. The sensor connects to a serial port (UART) and communicates via the Mavlink, MSP or Micolink protocol. The protocol is set in the MicoAssistant software.



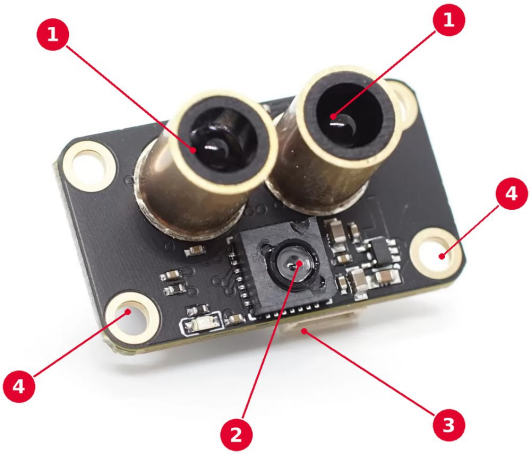
MTF-01 mounted on the underside of a drone (photo: MicoAir)

2.2 Package contents

Qty	Item
1	MicoAir MTF-01 sensor (optical flow + laser rangefinder)
1	Cable set

※ The package does **not** include a USB-TTL adapter (needed to configure the sensor from a computer), a sensor mount, screws or a flight controller.

2.3 Parts



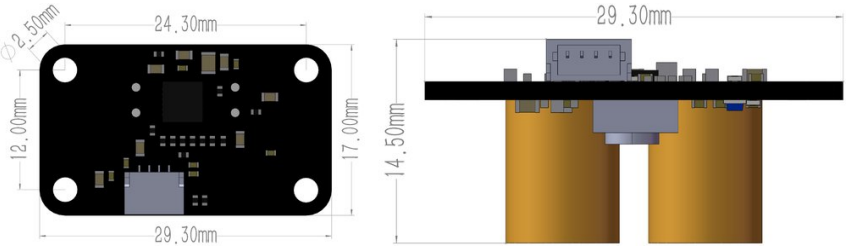
View of the bottom (sensing) side of the sensor

① Laser rangefinder (ToF) optics – emitter and receiver in metal tubes

② Optical flow camera

③ Cable connector (GND, 5 V, RX, TX)

④ Mounting holes Ø 2.5 mm (spacing 24.3 × 12 mm)



Sensor dimensions in mm – top and side view (drawing: MicoAir)

2.4 Specifications

Parameter	Value
Supply voltage	5 V
Power consumption	500 mW
Output	UART, 115200 Bd
Output logic level	LVTTL (3.3 V)
Protocols	Micolink / Mavlink / MSP
Output rate	100 Hz
Supported FC firmware	ArduPilot / PX4 / INAV / FMT
Laser rangefinder (ToF)	
Range	8 m (90% reflectance, 600 lx); 5 m (90% reflectance, 60 klx)
Dead zone	2 cm
Ranging accuracy	4 cm (below 2 m, 90% reflectance); 2% (above 2 m, 90% reflectance)
Centre wavelength	850 nm
Emitting half angle	3°
Optical flow	
Field of view (FOV)	42°
Max. measured speed	7 m/s at 1 m height
Required surface illumination	more than 60 lx
Working distance	more than 8 cm
Light source	LED
Mechanical data	
Dimensions	29.3 × 17 × 14.5 mm
Mounting hole spacing	24.3 × 12 mm, holes Ø 2.5 mm
Weight	4.5 g

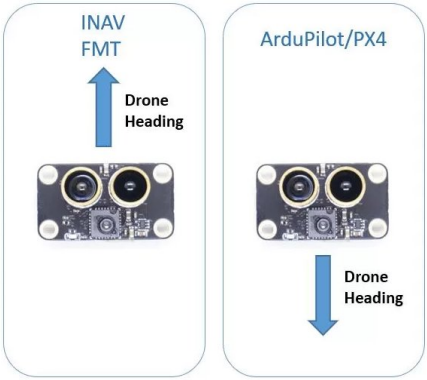
3. Installation and wiring

3.1 Position on the drone

- Mount the sensor on the underside of the drone so that the optics and the camera **point straight down** and have a clear view of the ground. No landing gear, cables, antenna or duct may be in the field of view.
- Fix the sensor firmly, without play, using the four Ø 2.5 mm mounting holes (spacing 24.3 × 12 mm). The manufacturer provides a 3D model of a sensor case for download on its product page.
- Protect the optics from dirt and flying debris; covered or dirty optics will spoil the measurements.

3.2 Sensor orientation

The default orientation of the sensor relative to the direction of flight (*Drone Heading*) depends on the flight controller firmware. For INAV and FMT the direction of flight is on the side of the rangefinder optics, for ArduPilot and PX4 on the opposite side (at the connector). If you mount the sensor differently, the rotation must be set in the flight controller firmware.

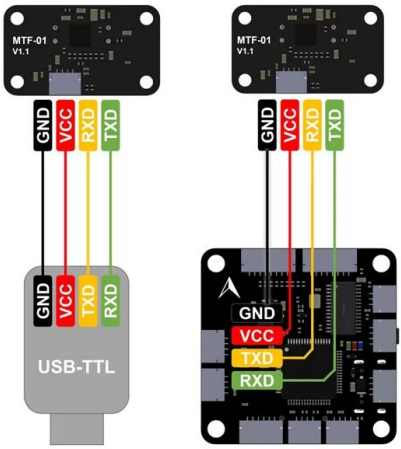


Default sensor orientation (view from below onto the sensing side); arrow = direction of flight (image: MicoAir)

3.3 Connecting to the flight controller

The sensor is connected with four wires to a free serial port (UART) of the flight controller. The data lines are **crossed**: sensor TX to port RX, sensor RX to port TX.

Sensor	Flight controller (FC) / USB-TTL adapter
GND	GND (ground)
5 V (VCC)	5 V
RX	TX
TX	RX



Wiring to a USB-TTL adapter (left) and to a flight controller (right) (image: MicoAir)

3.4 Operating conditions

- **Optical flow** requires surface illumination of more than 60 lx and a surface with visible texture (carpet, grass, paving). Over plain-coloured, glossy or transparent surfaces and over water the measurement is unreliable.
- Optical flow works from a height of 8 cm. The maximum measured speed is 7 m/s at a height of 1 m.
- The **rangefinder** measures from 2 cm. The 8 m range is achieved at 90% surface reflectance and 600 lx illumination; in direct sunlight (60 klx) the range drops to 5 m. Dark or poorly reflective surfaces shorten the range further.

4. Configuring the sensor in MicoAssistant

4.1 Output protocols

The protocol used by the sensor to send data must match the flight controller firmware. Set it in the MicoAssistant software before installation.

Protocol	Use
Mav_APM	Mavlink for ArduPilot
Mav_PX4	Mavlink for PX4
MSP	INAV
Micolink	MicoAir's own protocol – FMT and custom software

4.2 MicoAssistant software

MicoAssistant is the manufacturer's software for configuring MicoAir sensors. It is available as an online tool (Windows, macOS, Linux) at micoair.com/assistant and as an older Windows version for download in the *Downloads* section at micoair.com. The Windows version needs no installation – just unzip and run it; it requires .NET Framework 4.7.2.

※ The Windows version may crash on some language versions of the operating system. In that case use the *no_chart* version.

4.3 Changing the protocol via a USB-TTL adapter

① Connect the sensor to the computer via a USB-TTL adapter according to the table in section 3.3.

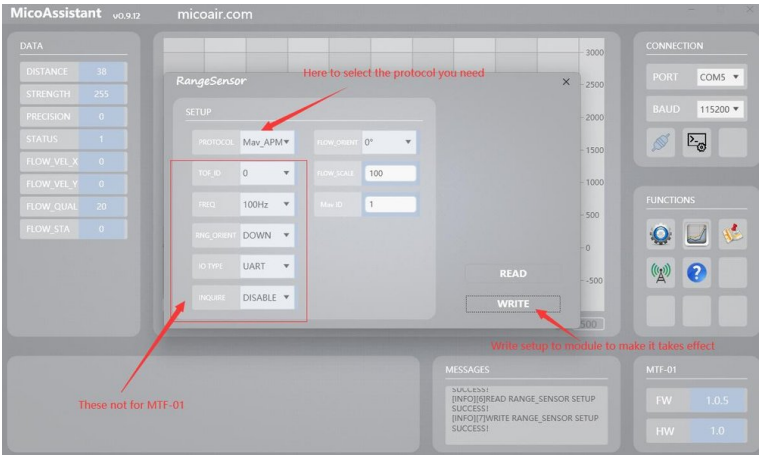
② In the Windows Device Manager, check that the adapter is recognised and which COM port it uses.

③ In MicoAssistant, select the correct COM port and the baud rate **115200** in the upper right corner and click the connect icon.

④ Once connected, the software recognises the sensor, displays the measured data and shows the firmware version in the lower right corner. If nothing is displayed, check the wiring and the port.

⑤ Click the setup icon (gear). If the setup window does not open, the connection to the sensor is not working – go back to step ①.

⑥ Select the required protocol and click *WRITE*. The software confirms the successful setting with a message in the message box.



MicoAssistant setup window – protocol selection and WRITE button (screenshot: MicoAir)

4.4 Configuration without an adapter (ArduPilot)

If you do not have a USB-TTL adapter, a flight controller running ArduPilot can use the *Serial Passthrough* function, which routes the sensor port to the USB port of the flight controller. Manufacturer's procedure (example for port Telem1/SERIAL1):

① Connect the sensor to the Telem1 (SERIAL1) port of the flight controller.

② In Mission Planner, set in the *Full Parameter List*: SERIAL1_BAUD = 115, SERIAL1_PROTOCOL = 1, SERIAL1_OPTIONS = 1024. Click *Write Params* and reboot the flight controller.

③ After reconnecting, set SERIAL_PASS2 = 1 (passthrough on SERIAL1) and SERIAL_PASSTIMO = 30 and click *Write Params*. After a few seconds the flight controller enters passthrough mode. **Do not reboot it now** – a reboot ends the passthrough mode.

④ Click *Disconnect* in Mission Planner but leave the USB cable connected.

⑤ In MicoAssistant, select the COM port of the flight controller and the baud rate 115200 and connect. Then continue with section 4.3, steps ⑤ and ⑥ (for ArduPilot select *Mav_APM*).

5. Flight controller setup

Replace the letter **n** in the parameter name with the number of the serial port the sensor is connected to (e.g. n = 2 for Telem2 / SERIAL2).

5.1 ArduPilot

① In MicoAssistant, set the protocol to **Mav_APM**.

② Connect the sensor to a serial port of the flight controller (e.g. Telem2).

③ Set the parameters according to the table (step ③), reboot the flight controller or refresh the parameters, and set the rangefinder parameters (step ④).

Parameter	Value	Step
SERIALn_BAUD	115	③
SERIALn_OPTIONS	1024	③ (don't forward)
SERIALn_PROTOCOL	1	③
FLOW_TYPE	5	③
RNGFND1_TYPE	10	③
RNGFND1_MAX_CM	800	④
RNGFND1_MIN_CM	1	④
RNGFND1_ORIENT	25	④

After setup, the *opt_qua* and *rangefinder1* values should be visible on the *Status* tab in Mission Planner.

▶ EKF3 sensor fusion

For the flight controller to use the sensor data, the EKF3 sources must be configured. For indoor flight only, without GPS, it is sufficient to set the **EK3_SRC1** set. To switch between GPS (outdoors) and optical flow (indoors), keep EK3_SRC1 at default, enter the values below into the **EK3_SRC2** set and set RC6_OPTION = 90. The switch on channel 6 then selects SRC1 (GPS) in the low position and SRC2 (optical flow) in the middle position.

Parameter	Value
AHRS_EKF_TYPE	3
EK3_SRC_OPTIONS	0
EK3_SRCx_POSXY	0
EK3_SRCx_POSZ	2
EK3_SRCx_VELXY	5
EK3_SRCx_VELZ	0
EK3_SRCx_YAW	1

※ x = 1 for the EK3_SRC1 set, x = 2 for the EK3_SRC2 set.

5.2 PX4

In MicoAssistant, set the protocol to **Mav_PX4** and connect the sensor to port TELEMn. The parameter names depend on the PX4 version:

Parameter	Value
PX4 1.11–1.13	
MAV_1_CONFIG	TELEMn – then reboot the FC
MAV_1_MODE	Normal
SER_TELn_BAUD	115200 8N1
SENS_FLOW_ROT	No rotation
EKF2_AID_MASK	use optical flow
EKF2_RNG_AID	Range aid enable
EKF2_HGT_MODE	Range sensor
PX4 1.14 and newer	
MAV_1_CONFIG	TELEMn – then reboot the FC
MAV_1_MODE	Normal
SER_TELn_BAUD	115200 8N1
EKF2_OF_CTRL	Enabled
EKF2_RNG_CTRL	Enabled
EKF2_HGT_REF	Range sensor – then reboot the FC
SENS_FLOW_ROT	No rotation
PX4 1.17 and newer – additionally	
MAV_PROTO_VER	1

5.3 INAV

① In MicoAssistant, set the protocol to **MSP**.

② Connect the sensor to a free serial port (UART) of the flight controller.

③ In INAV Configurator, enable **MSP** at 115200 for that UART on the *Ports* tab.

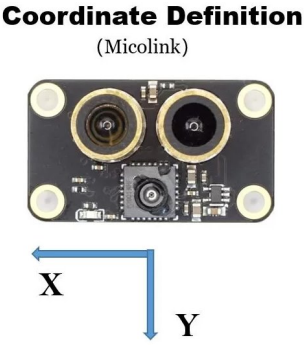
④ On the *Configuration* tab, select **MSP** as both the *Rangefinder* and the *Optical flow* type. The same can be set in the CLI: *set rangefinder_hardware = MSP* and *set opflow_hardware = MSP*, then *save*.

⑤ On the *Calibration* tab, perform the optical flow calibration (*Calibrate Optic Flow*) following the on-screen instructions.

A detailed INAV tutorial and video tutorials are available on the manufacturer's page micoair.com/optical_range_sensor_mtf-01.

5.4 Micolink and custom software

Micolink is a lightweight protocol by the manufacturer intended for FMT and for developers who want to read the sensor data with their own code. The message description, coordinate definition and sample C code can be found in the manufacturer's documentation Decoding Micolink Messages from MTF-01. According to it, the distance is given in millimetres, a value of 0 means an invalid measurement, and the optical flow velocity is converted to cm/s by multiplying it by the height in metres.



Definition of the X and Y coordinates in the Micolink protocol (image: MicoAir)

6. Flying with optical flow

6.1 Pre-flight check

- The sensor optics and camera are clean and nothing obstructs their field of view.
- The sensor is firmly attached, the cable is secured and cannot get into the propellers.
- In the configuration software or in the flight controller telemetry, check that the sensor is sending data: the measured height changes when you lift the drone, and the optical flow values change when you move it over the surface.
- Lighting and surface meet the conditions in section 3.4.
- Always insert a **fully charged battery** into the drone.

6.2 First flight

- Take off in a mode with manual control of altitude and position, and only switch to a mode that uses the sensor once airborne (*Loiter* in ArduPilot, altitude and position hold modes in INAV).
- With ArduPilot, the flight controller may refuse to Arm (start the motors) in *Loiter* mode if the sensor is too close to the ground. Arm in *AltHold* mode and switch to *Loiter* after take-off.
- If the drone drifts or oscillates in position hold, switch back to manual control immediately, land and check the sensor orientation (section 3.2) and the settings.

7. Maintenance and troubleshooting

7.1 Maintenance and storage

- Clean the optics carefully with a dry soft brush or an air blower. Do not use solvents.
- After a crash, check the optics tubes, camera, connector and cable for damage.
- Store the sensor in a dry place, out of direct sunlight, protected from dust and mechanical damage.

7.2 Troubleshooting

Problem	Possible cause and solution
MicoAssistant does not recognise the sensor	Check the wiring (TX and RX crossed), the COM port and the adapter driver. If the connection does not work at 115200 Bd, try 57600 Bd.
Setup window does not open	The connection to the sensor is not working – see the previous row. On Windows try the *no_chart* version.
Flight controller does not detect the sensor	Wrong protocol set in the sensor (section 4.1), wrong port or baud rate, RX and TX wires swapped.
Height not measured or unstable	Dirty optics, low-reflectance surface, strong sunlight, obstruction in the field of view.
Drone drifts in position hold	Insufficient lighting or surface without texture, wrong sensor orientation (section 3.2), incorrect EKF source settings (ArduPilot).
Cannot Arm in Loiter mode	The sensor is too close to the ground – Arm in AltHold mode (section 6.2).

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@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 (MTF-01) is marked on the printed circuit board of the sensor; the firmware version is shown by the MicoAssistant software after connecting the sensor.

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.