



## BL-M8812EU2

5 GHz Wi-Fi module with RTL8812EU chip  
LB-LINK · for OpenIPC digital FPV video



**Never transmit without antennas connected and without a heat sink.  
Power only with 5 V (4.75-5.25 V).**

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# 1. Safety instructions

## 1.1 Before you start

The BL-M8812EU2 is a populated electronic board – a radio module without an enclosure, power supply, antennas or cooling. It is intended to be built into your own setup by a technically skilled user who can solder, work with Linux and is familiar with the regulations for operating radio equipment. Read the entire manual before connecting the module.

- ① The module is sensitive to electrostatic discharge. Work on an antistatic mat with a grounding wrist strap and do not touch the board on its pads or components.
- ② Connect the module only to a 5 V supply within 4.75–5.25 V. Never connect it directly to a Li-Po battery or any other higher-voltage source – the module will be destroyed instantly and irreversibly.
- ③ Do all soldering and wiring with the power disconnected.
- ④ This product is not a toy and must be kept away from children. Small parts may be swallowed.

## 1.2 Antennas and transmission

**Never start transmitting without antennas connected. The module has no protection against operation without a load and the power amplifier can be damaged permanently.**

- Connect and disconnect the antennas only with the power off. Always connect a 5 GHz antenna to both connectors J0 and J1.
- The module is a radio transmitter. The user is responsible for the selected channel, bandwidth and transmit power – see chapter 3.
- Do not stay permanently in the immediate vicinity of the antennas while transmitting and do not point the antennas at people at close range.

## 1.3 Heat

- The module's power amplifiers generate a lot of heat. For reliable operation the manufacturer **requires an additional heat sink** with a thermal pad (chapter 4.2). Do not power the module without a heat sink.
- At higher power levels and during bench tests with no airflow over the module, use a heat sink with a fan.
- The heat sink and the board get hot during operation. Do not touch them and let them cool down after switching off.
- Do not place the module near flammable materials and do not cover the heat sink.

## 1.4 Operating environment

- Ambient operating temperature:  $-20\text{ }^{\circ}\text{C}$  to  $+70\text{ }^{\circ}\text{C}$ , relative humidity 10-95 % non-condensing.
- The module has no protection against water or dust. Protect it from moisture, rain, salt spray and conductive contamination (metal filings, carbon dust).
- Do not use the module near medical devices, in crewed aircraft or in places where the operation of radio equipment is prohibited.

## 2. Product description

### 2.1 What the module is for

The LB-LINK BL-M8812EU2 is a single-band, high-power 5 GHz Wi-Fi module with the Realtek RTL8812EU chip. It supports the IEEE 802.11a/n/ac standards, works in a 2T2R configuration (two antennas for both transmitting and receiving) and connects to the host device via a USB 2.0 interface. Each antenna path has its own power amplifier (FEM) and the module supports a narrow 10 MHz channel, which extends the link range.

In FPV, the module is used as the radio part of a digital video link in the **OpenIPC** project (WFB-ng, APFPV): on the aircraft it is connected to an IP camera and works as the video transmitter; on the ground it is connected to the single-board computer of the ground station and works as the receiver.

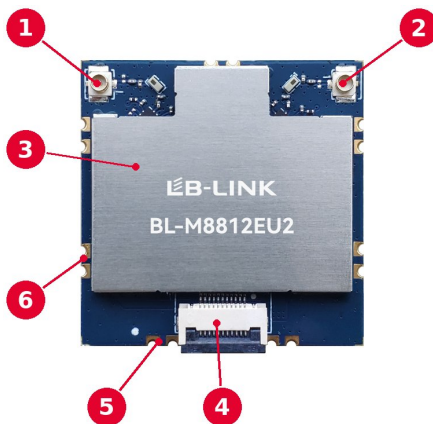
❖ **A Wi-Fi video link is suitable mainly for FPV wings and GPS-stabilised drones. Because of its higher latency it is not suitable for acrobatic freestyle or racing drones.**

### 2.2 Package contents

| Item                     | Qty | Note            |
|--------------------------|-----|-----------------|
| Wi-Fi module BL-M8812EU2 | 1   | populated board |

Antennas, heat sink, thermal pad, power supply and connecting cables are **not** included.

### 2.3 Parts overview



BL-M8812EU2 module – top side with shielding cover

|   | Part             | Description                                                                                                                                           |
|---|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| ① | Connector J0     | IPEX antenna connector (MHF-1, u.FL) – antenna WLAN_ANT0                                                                                              |
| ② | Connector J1     | IPEX antenna connector (MHF-1, u.FL) – antenna WLAN_ANT1                                                                                              |
| ③ | Shielding cover  | covers the RTL8812EU chip and the power amplifiers; carries the type designation                                                                      |
| ④ | FPC connector J3 | 11-pin connector for a flat cable – power, USB and RESET (chapter 2.5)                                                                                |
| ⑤ | Pads 1–8         | solder pads on the board edge – power, USB and RESET; the pads continue to the right of the FPC connector; pad 1 is on the left next to the white dot |
| ⑥ | Side pads 9–18   | solder pads around the board edge, all connected to ground (GND)                                                                                      |

The underside of the board has copper pads for heat transfer to the heat sink and for grounding.

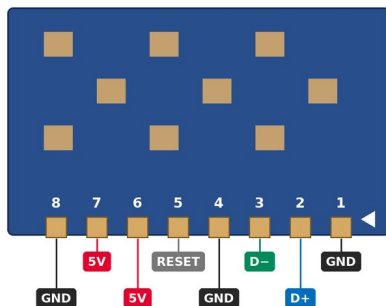
## 2.4 Technical data

| Parameter             | Value                                                                                                 |
|-----------------------|-------------------------------------------------------------------------------------------------------|
| Chipset               | Realtek RTL8812EU-CG                                                                                  |
| Standards             | IEEE 802.11a/n/ac, single-band 5 GHz                                                                  |
| Frequency ranges      | 5.15–5.25 GHz; 5.25–5.35 GHz; 5.47–5.73 GHz; 5.735–5.835 GHz                                          |
| Channels (20 MHz)     | 36–48; 52–64; 100–140; 149–165                                                                        |
| Antenna configuration | 2T2R (MIMO)                                                                                           |
| Channel bandwidth     | 10/20/40/80 MHz (manufacturer's data); for FPV video in OpenIPC 5, 10 and 20 MHz, 40 MHz receive only |
| Max. data rate        | 866.7 Mbit/s (802.11ac, VHT80, 2×2)                                                                   |
| Max. transmit power   | 29 dBm ±2 dB (802.11a, 6 Mbit/s, at the module output, manufacturer's recommended maximum)            |
| Receive sensitivity   | –96 dBm (802.11a, 6 Mbit/s); –65 dBm (VHT80, MCS9)                                                    |
| Interface             | USB 2.0 (solder pads or FPC connector J3)                                                             |
| Antenna connectors    | 2× IPEX (MHF-1, u.FL)                                                                                 |
| Power supply          | 5.0 V ±0.25 V (4.75–5.25 V), max. 1800 mA                                                             |
| Supply ripple         | less than 200 mV                                                                                      |
| Operating temperature | –20 °C to +70 °C                                                                                      |
| Operating humidity    | 10–95 % RH non-condensing                                                                             |
| Dimensions            | 32.0 × 32.0 × 3.4 mm                                                                                  |
| ESD rating            | 2 kV (HBM)                                                                                            |

❖ **The transmit power depends on the modulation: the manufacturer states a recommended maximum of 28 dBm (HT20 and HT40 MCS0) and 27 dBm (VHT80 MCS0); the calibrated values for the highest data rates are 21.5–23 dBm. All values apply at the module output, without antenna gain.**

## 2.5 Pad and FPC connector pinout

Power, USB and RESET are brought out twice – to solder pads 1-8 and to the FPC connector J3. Pads and pins with the same name are connected. Always use only one of the two options.



*Pads 1-8 – bottom view (side with copper pads), ◀ mark next to pad 1; drawing not to scale*

| Pad  | Signal    | Description                                                                                |
|------|-----------|--------------------------------------------------------------------------------------------|
| 1    | GND       | ground                                                                                     |
| 2    | USB2.0+DP | USB data D+                                                                                |
| 3    | USB2.0-DM | USB data D–                                                                                |
| 4    | GND       | ground                                                                                     |
| 5    | RESET     | reset / shutdown of the module, active low (3.3 V level), internally pulled high via 47 kΩ |
| 6    | VDD5.0    | 5 V power supply                                                                           |
| 7    | VDD5.0    | 5 V power supply                                                                           |
| 8    | GND       | ground                                                                                     |
| 9-18 | GND       | ground (side pads)                                                                         |

► **FPC connector J3 (11 pins, 0.5 mm pitch)**

| Pin    | Signal    | Description       |
|--------|-----------|-------------------|
| A1, A2 | GND       | ground            |
| A3     | USB2.0+DP | USB data D+       |
| A4     | USB2.0-DM | USB data D–       |
| A5, A6 | GND       | ground            |
| A7-A10 | VDD5.0    | 5 V power supply  |
| A11    | RESET     | reset, active low |

*Viewed from the top side of the module, pin A1 is on the left and A11 on the right.*

## 3. Radio operation and legal conditions

### 3.1 The law of the country of operation applies

Directive 2014/53/EU (RED) applies in all Member States of the European Union, but the conditions for using radio frequencies – permitted bands, maximum transmit power and restrictions on outdoor or on-board aircraft use – are set by each country individually and differ. The information in this chapter describes the situation in the Czech Republic. If you operate the module in another country, you must comply with the regulations of the country in which you operate it.

### 3.2 Frequencies and transmit power in the Czech Republic

The module operates in the frequency ranges 5150–5350 MHz, 5470–5730 MHz and 5735–5835 MHz. The conditions for their use in the Czech Republic are set by the general authorisations of the Czech Telecommunication Office (ČTÚ) **VO-R/12/11.2021-11** (wideband data networks) and **VO-R/10/05.2025-5** (short-range devices):

| Band          | Limit in CZ                                                        | On a drone (UAS)                                                                                         | Regulation                                 |
|---------------|--------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|--------------------------------------------|
| 5150–5250 MHz | 200 mW e.i.r.p., 10 mW/MHz                                         | 5150–5170 MHz prohibited; 5170–5250 MHz only with spectrum access and interference mitigation techniques | VO-R/12, Art. 2(1)(b) band b1, (f) and (g) |
| 5250–5350 MHz | 200 mW e.i.r.p., 10 mW/MHz; indoor use only, TPC and DFS mandatory | no                                                                                                       | VO-R/12, band b2                           |
| 5470–5725 MHz | 1 W e.i.r.p., 50 mW/MHz; TPC and DFS mandatory                     | no – prohibited under EU law                                                                             | VO-R/12, band b3; Decision (EU) 2022/179   |
| 5725–5850 MHz | 1 W e.i.r.p.; outdoors only fixed installations                    | no                                                                                                       | VO-R/12, band b4                           |
| 5725–5875 MHz | <b>25 mW e.i.r.p.</b>                                              | <b>yes</b>                                                                                               | VO-R/10, Art. 3(2)(k)                      |

**For an outdoor video link from a drone in the Czech Republic, use the 5725–5875 MHz range (channels 149–165) with a radiated power of no more than 25 mW e.i.r.p. The manufacturer's recommended maximum of 29 dBm (approx. 800 mW) exceeds this limit more than 30 times – even before antenna gain is added.**

- The e.i.r.p. limit applies to the **combination** of transmitter power and antenna gain. If the module transmits through both antennas simultaneously, the total radiated power of both paths counts. See chapter 5.3 for the calculation.

- The module must not be operated with additional amplifiers and must not be modified electrically or mechanically.
- The operator is responsible for the choice of channel, bandwidth and transmit power and for complying with the conditions of the general authorisations. Breaching them is an offence under Czech Act No. 127/2005 Coll., on electronic communications.
- Operation is not protected against interference and must not cause harmful interference to other services.

#### ► **Restrictions in EU countries**

Under Commission Implementing Decision (EU) 2022/179 as amended by (EU) 2022/2307, the following restrictions apply in all EU Member States: the 5250–5350 MHz band is for indoor use only (not in road vehicles, trains or aircraft); the 5470–5725 MHz band must not be used by unmanned aircraft systems (UAS); in the 5150–5250 MHz band, UAS may use only the 5170–5250 MHz range. Maximum power levels and further conditions are set by each country.

### **3.3 Use on a drone**

Operating a drone with a camera and video link is further governed by Regulations (EU) 2019/947 and 2019/945 and by the national regulations of the country of operation – operator registration, pilot competency, operational category and geographical zones. When flying with FPV goggles in the open category, an observer who watches the drone directly must stand next to the pilot. In the Czech Republic, information is provided by the Civil Aviation Authority ([www.caa.gov.cz](http://www.caa.gov.cz)).

## 4. Installation and wiring

### 4.1 What else you need

- **Two 5 GHz antennas** with an IPEX (u.FL) connector, directly or via a pigtail. The antenna VSWR should be no more than 2.
- **Heat sink** of at least 32 × 32 mm and a **thermal pad** with a thermal conductivity of 4 W/mK and a thickness of up to 1.5 mm; for higher power and bench operation a heat sink with a fan.
- **5 V power supply** (4.75–5.25 V) with ripple below 200 mV, able to deliver a peak current of at least 1800 mA. The manufacturer recommends a current-mode buck DC/DC converter for its fast response to load changes.
- **Host device with USB host** – an IP camera with OpenIPC firmware (on the aircraft) or a single-board computer or PC running Linux (ground station).
- Twisted wire pair for USB, power wires, a fine-tip soldering iron and an antistatic workplace.

✱ **The OpenIPC documentation states that at high power settings the module's current draw can exceed 2 A and recommends a 5 V supply rated for more than 3 A. Choose a power supply with sufficient headroom.**

### 4.2 Mounting the heat sink

- ① The heat sink goes on the **underside** of the module – the side with the copper pads, directly below the module.
- ② Place the thermal pad between the heat sink and the underside of the module so that it covers the whole board area and heat is dissipated over the entire surface.
- ③ Fix the heat sink so that it presses evenly on the module and the board does not bend. Make sure the heat sink does not touch the solder pads on the board edges – it would short them.
- ④ Do not replace the thermal pad with conductive paste or a metal pad.

### 4.3 Soldering the wires

- ① Route the D+ (pad 2) and D– (pad 3) wires as a **twisted pair** by the shortest possible path to the USB of the host device, away from the power wires. Connect D+ to D+ and D– to D–.
- ② Connect the module ground (pad 1 or 4) to the ground of the host device. USB does not work without a common ground.
- ③ Connect 5 V to pads 6 and 7 and ground to pad 8. Size the power wires for a current of at least 2 A.
- ④ The RESET pad (5) does not have to be connected – it is pulled high inside the module. If you connect it, it must not receive more than a 3.3 V level; a logic low resets or shuts down the module.

**The module is not suitable for reflow soldering. High temperatures would damage the thermal silicone pad between the chip and the shielding cover. Solder by hand with a fine-tip iron, briefly and without overheating.**

If you design your own carrier board for the module, the manufacturer recommends routing USB as a differential pair with an impedance of  $90 \pm 5 \Omega$  surrounded by ground and adding ESD protection to the USB data lines (TVS diodes with a capacitance below 1 pF).

## 4.4 Connecting the antennas and first power-up

- ① With the power off, place the antenna plugs squarely onto connectors J0 and J1 and press them gently until they click. IPEX connectors are fragile – do not pull on the cable and do not lever them sideways.
- ② Check that the heat sink is mounted and the wiring matches chapter 2.5.
- ③ Only then connect the 5 V power supply.

## 5. Setting up with OpenIPC

The module has no firmware or settings of its own – it is controlled by the driver of the host device. Procedures change as OpenIPC evolves; up-to-date guides are in the documentation at [docs.openipc.org](https://docs.openipc.org) (page dedicated to the RTL8812EU chip: [docs.openipc.org > net-cards > rtl8812eu](https://docs.openipc.org/net-cards/rtl8812eu)).

### 5.1 Driver

- **On the aircraft (IP camera):** you need OpenIPC firmware with the RTL8812EU driver (package *rtl88x2eu-openipc*). For some cameras a separate firmware variant for RTL8812EU modules is available – follow the OpenIPC documentation for your camera.
- **On the ground (ground station):** install an RTL8812EU driver on the Linux computer. For WFB-ng, the OpenIPC documentation recommends the *rtl8812eu* driver from the *svpcom* repository for its better performance.

### 5.2 Channel bandwidth

The RTL8812EU driver in monitor mode with packet injection, which the FPV link uses, supports transmitting with a channel bandwidth of **5, 10 and 20 MHz**. The 40 MHz bandwidth works for receiving only.

**Do not enable 40 MHz mode on the module in the air unit. The receiver will then get no image. If this happens, follow the OpenIPC article “How to fix glitch on EU and BU-based VTXes” ([docs.openipc.org > wfb-ng > unbrick-eu-bu](https://docs.openipc.org/wfb-ng/unbrick-eu-bu)).**

### 5.3 Setting the transmit power

In OpenIPC the power is set in one of two ways:

- with the *driver\_txpower\_override* parameter in */etc/wfb.conf* – range 0–63; the value is an internal driver step, **not the power in dBm**,
- with the command *iw dev <interface> set txpower fixed <mBm>* – power in mBm (100 mBm = 1 dBm), range 0–3150; can also be changed while running.
- The set power must not exceed the manufacturer's recommended maximum (chapter 2.4). Higher steps overdrive the amplifier – the signal distorts and range does not improve. Current draw and heat rise with power.
- The radiated power (e.i.r.p.) is the module output power in dBm plus the antenna gain in dBi. Set the power to no more than the limit in dBm minus the antenna gain (25 mW = 14 dBm). When transmitting through both antennas, the total power of both paths counts.
- **The power and channel settings must comply with the conditions in chapter 3.** Default or recommended values from OpenIPC guides usually exceed the limits applicable in the Czech Republic many times over.

## 6. Operation, storage and troubleshooting

### 6.1 Before every power-up

- Both antennas are connected and undamaged, the IPEX connectors hold firmly.
- The heat sink is in place; for bench operation the fan is running.
- The supply voltage is within 4.75–5.25 V and the wires are neither damaged nor shorted.
- Channel, bandwidth and transmit power comply with the regulations of the country of operation.

### 6.2 Storage and maintenance

- Store in an antistatic bag in a dry place at 5 °C to 40 °C and 20–90 % relative humidity. The limit storage temperatures are –40 °C to +85 °C at 10–95 % humidity, non-condensing.
- Do not clean the module with water or solvents. Remove dust with a dry soft brush or compressed air.
- Do not remove the shielding cover – the chip's thermal pad is underneath.

### 6.3 Troubleshooting

| Problem                                           | Possible cause and solution                                                                                                                                   |
|---------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Host device does not detect the module            | RTL8812EU driver missing; D+/D– wires swapped or not twisted; no common ground; check the wiring according to chapter 2.5                                     |
| Module disconnects or restarts while transmitting | insufficient power supply or thin power wires – at peak current the voltage drops below 4.75 V; use a stronger supply and shorter, thicker wires              |
| No image at the receiver after enabling 40 MHz    | the module cannot transmit in 40 MHz mode; follow chapter 5.2                                                                                                 |
| Module overheats, link drops out                  | heat sink or thermal pad missing, heat sink without airflow; reduce power, add a fan                                                                          |
| Short range, weak signal                          | antenna not connected or damaged, unsuitable antenna for 5 GHz, wrong antenna orientation, overdriven amplifier; check the antennas and reduce the power step |

## 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 (BL-M8812EU2) is given on the shielding cover of the module.

## 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](http://www.asekol.cz), [www.ecobat.cz](http://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](http://www.coi.cz).