WOLF GATEWAY · LINUX EDGE CONTROLLER

Wolf-3Oi3Ro

3 Relays · 3 Isolated Inputs · RS-485 Modbus RTU

I/O	3 relays (5 A @ 230 V AC) · 3 opto-isolated inputs
FIELD BUS	RS-485 Modbus RTU
NETWORK	10/100 Ethernet · optional 4G/LTE
SOFTWARE	Wolf-OS platform · Wolf-App automation
POWER	9–30 V DC · 0.6–1.2 W
INSTALLATION	DIN-rail · –40 to +55 °C

1 Introduction

The **FoxIoT Wolf-3Oi3Ro** is a Linux-based industrial edge controller in the Wolf Gateway family. It pairs the Wolf motherboard with a 3Oi3Ro expansion card that adds **three Omron relays**, **three opto-isolated digital inputs**, and an **RS-485 Modbus RTU** port. Three relays send control signals or switch equipment, three opto-isolated inputs read states from other systems, and the gateway forwards their data to your cloud, SCADA, or VPP platform — via MQTT, REST, or Modbus TCP over Ethernet or 4G/LTE.

The hardware runs **Wolf-OS** (the Linux platform) and **Wolf-App** (drop-in automation software). Expansion cards are detected automatically at boot, so the platform configures its drivers without manual setup.

1.1 Key features

- 3 × Omron relays (5 A @ 230 V AC) — control signals, contactors, or direct loads.
- 3 × opto-isolated inputs (5–30 V DC, polarity-insensitive) for ground-isolated signal bridging.
- RS-485 Modbus RTU field bus, MQTT / REST / Modbus TCP on the network side.
- 10/100 Ethernet, optional 4G/LTE (mini-PCIe modem + SIM).
- Runs Wolf-OS and Wolf-App, automatic expansion-card detection.
- DIN-rail, 9–30 V DC, –40 to +55 °C.

1.2 Typical applications

- **VPP / curtailment** — receive setpoints over MQTT or Modbus TCP, command inverters and batteries over Modbus, switch grid equipment via the relays.
- **Bridge signals between systems** — read an on/off signal from a BMS or PLC on an opto-isolated input and pass it on through a relay. Isolation protects both sides.
- **Modbus TCP ↔ RTU gateway** — a TCP-capable PLC or SCADA polls the RTU devices directly. Wolf-App translates each Modbus TCP request to RTU on the bus and returns the response — transparent, no register mapping.
- **Remote equipment control** — connect over Ethernet or 4G/LTE. Automation runs locally through network outages and syncs status when the link returns.

> **About this manual.** This manual covers the **hardware** of the Wolf-3Oi3Ro — installation, wiring, power, and the on-board I/O. Software (operating system, networking, automation, cloud) is documented separately: see the **Wolf-OS** and **Wolf-App** manuals listed below.

Related documents

Document	Link
Datasheet / product overview	foxiot.eu/products/wolf-gateway/wolf-3oi3ro
Wolf-OS (platform)	foxiot.eu/products/wolf-gateway/wolf-os
Wolf-App (automation)	foxiot.eu/products/wolf-gateway/wolf-app
First-time setup guide	foxiot.eu/wolf-setup
Firmware releases	foxiot.eu/firmware/wolf-gateway

2 Safety

Read and understand this manual before installation or maintenance. The following guidance protects personnel and equipment.

2.1 General safety guidelines

- Only qualified personnel should install, wire, or service the device.
- Use appropriate personal protective equipment when working with electrical components.
- Do not operate the device if it appears damaged or has been exposed to moisture.
- Ensure all wiring and connections comply with local regulations and standards.
- Keep the working area clean and free of conductive materials.

2.2 Electrical installation safety

Electrical hazard — risk of severe injury or death. Relay outputs may switch mains voltage (e.g. 230 V AC). A lethal shock is possible if terminals are touched during operation. **Always disconnect power before any installation or maintenance.** Mains wiring must be performed only by qualified personnel in accordance with local electrical regulations.

- **DIN-rail mounting** — mount on a 35 mm DIN rail inside an electrical cabinet, secured so the unit cannot shift or fall.
- **Low-voltage wiring** — power the unit from an isolated (SELV) supply. Use appropriate low-voltage wire for power and inputs. Do not route low- and high-voltage wiring together (may be prohibited locally).
- **Modbus data line** — use 120 Ω twisted-pair cable on the RS-485 lines. The card already includes an on-board 120 Ω terminator, so add a terminator only at the end of the line.
- **Relay wiring** — use properly rated wiring and protect each load circuit with an appropriate fuse. The 5 A rating is resistive only. Derate for inductive and capacitive loads (see Specifications).

2.3 Handling, storage & environment

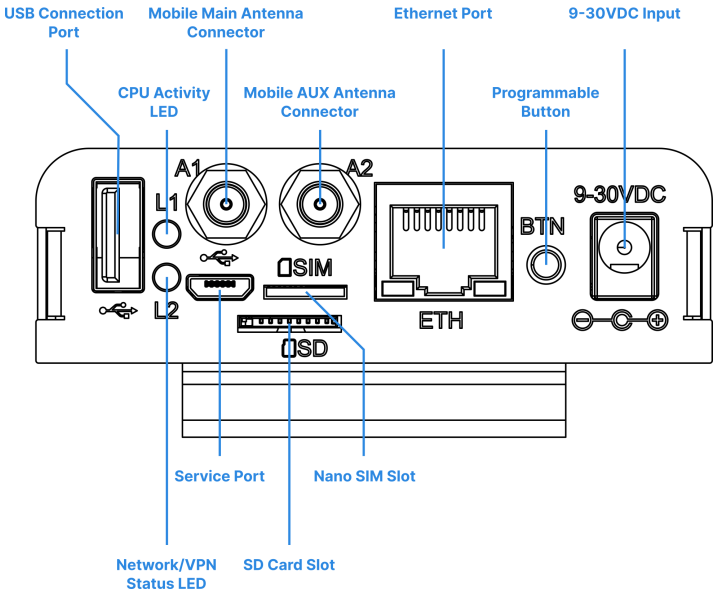
Handle with care to avoid mechanical shock. Store in the original packaging in a clean, dry place within the rated temperature range. The device is for indoor cabinet use. Outdoor installation is possible only inside a suitably rated weatherproof enclosure (IP65 or higher). Avoid excessive humidity/condensation, direct sunlight or radiant heat, and corrosive gases, dust, or vibration.

3 Specifications

3.1 Connectors and ports

The unit has two connection sides. The motherboard carries the network, power, and storage ports. The expansion card carries the field I/O — the relays, isolated inputs, and RS-485 port.

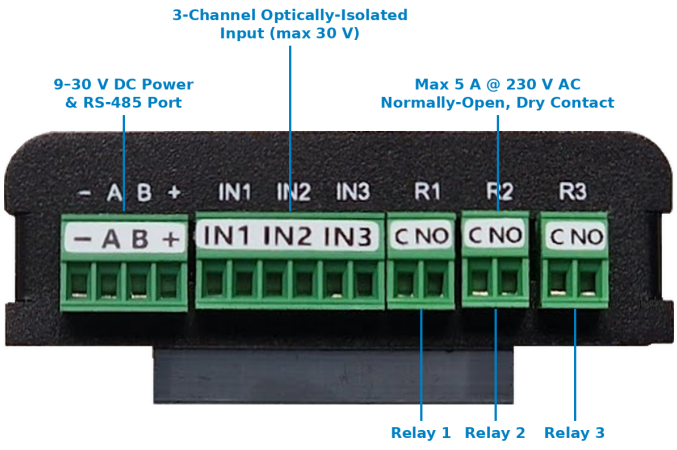
Network, power, and storage connect on the motherboard front:



Wolf-3Oi3Ro front ports

Front Port	Function
USB	USB 2.0 host, software-switchable power, over-current protection
Service Port	Micro USB 2.0 — console and firmware upgrade
ETH	10/100 Mbps Ethernet (RJ45)
A1 / A2	4G/LTE antenna connectors — A1 main, A2 Rx-diversity (optional)
Nano SIM	SIM slot for the LTE modem
SD	Micro-SD card slot, software-switchable power
BTN	User-programmable button
L1 / L2	Programmable status LEDs — L1 heartbeat, L2 user
9–30 VDC	DC jack (2.1 / 5.5 mm) power input

Field wiring connects on the expansion card:



Wolf-3Oi3Ro expansion-card connectors

Connector	Function
– A B +	Power (–, +) 9–30 V DC · RS-485 A (+) / B (–)
IN1 / IN2 / IN3	3 opto-isolated inputs · 5–30 V DC, polarity-insensitive
R1 / R2 / R3 (C, NO)	3 relays (common + normally-open) · 5 A @ 230 V AC, resistive

> **RS-485 polarity.** On this connector A is positive (non-inverting) and B is negative — the common industry convention. The RS-485 standard's A/B lettering is a well-known source of confusion (often cited as the opposite), so if a device won't communicate, try swapping A and B.

3.2 Motherboard

Parameter	Value
CPU	NUC980 ARM926EJ-S @ 300 MHz
Memory	128 MB DDR II
Storage	128 MB NAND Flash
Ethernet	10/100 Mbps RJ45
USB	Micro USB 2.0 (FW upgrade) + USB 2.0 host (software-switchable power, over-current protection, 1 A)
SD Card	Micro-SD slot with detection, software-switchable power
SIM	Nano SIM (for LTE modem)
Mini PCIe	USB 2.0 + GPIOs, software-switchable power (4G/LTE/NB-IoT/WiFi modules)
Crypto	Hardware acceleration — AES-256, RSA-2048, SHA-512, ECC-256, HMAC, RNG (Linux software is not limited to these)
RTC	Real-time clock (battery backup optional)
Sensors	Onboard PCB temperature, input voltage monitoring
Status LEDs	2× programmable (heartbeat + user by default)

3.3 Expansion card (3Oi3Ro)

Parameter	Value
Relay outputs	3 × Omron G6DN-1A-L DC5 (SPST-NO), 5 A @ 230 V AC / 30 V DC resistive, >100,000 operations (derate for inductive/capacitive loads)
Digital inputs	3 × opto-isolated, polarity-insensitive · activation ≥5 V, max 30 V DC · ~2 mA @12 V / ~4.2 mA @24 V · 3750 Vrms isolation · 50 ms debounce

Parameter	Value
RS-485	±15 kV HBM ESD, ±30 V bus protection (on-board TVS), 120 Ω termination, on-board fail-safe bias
Card detection	On-board EEPROM (auto-detected by the platform at boot)

3.4 Communication & network

Parameter	Value
Field bus	RS-485 Modbus RTU, 300–115200 bps (standard rates)
Ethernet	10/100 Mbps RJ45
Cellular	Optional 4G/LTE — Quectel EC25-EUX (mini-PCIe) + nano-SIM
Network protocols	MQTT, REST, Modbus TCP — client, server, and transparent RTU↔TCP gateway (Wolf-App)
Remote access	VPN — WireGuard (built-in) · OpenVPN (Wolf-OS package)

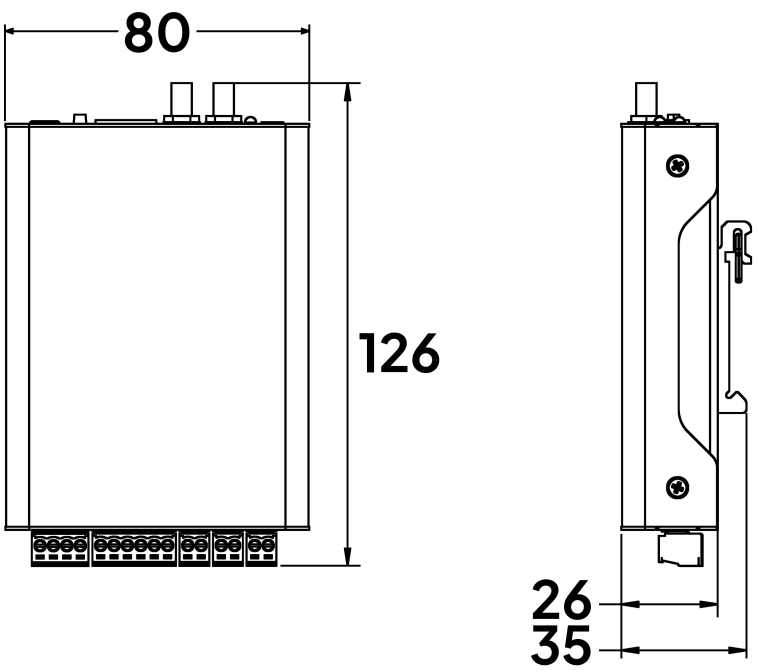
3.5 Power

Parameter	Value
Input range	9–30 V DC — DC jack (2.1 / 5.5 mm) or – / + terminals (one source only)
Average power	0.6 W @ 12 V DC · add ~0.18 W per energized relay (~1.15 W max)
Reverse-voltage protection	Yes

Figures are for the base unit. The optional 4G/LTE modem draws additional power depending on network state and signal quality.

3.6 Mechanical & environmental

Parameter	Value
Mounting	DIN-rail
Dimensions	126 × 80 × 35 mm
Weight	~350 g
Operating temperature	–40 to +55 °C
Storage temperature	–40 to +75 °C
Humidity	5–90 % (non-condensing)



Wolf-3Oi3Ro mechanical dimensions (mm)

4 How It Works

4.1 Platform & expansion card

The Wolf motherboard runs Wolf-OS (the Linux platform) and Wolf-App (the ready automation software), while the 3Oi3Ro expansion card provides the field I/O. Wolf-OS identifies the card at boot via an on-board EEPROM and loads the right drivers automatically — no manual configuration of the I/O. Two programmable status LEDs (L1 heartbeat, L2 user) indicate operation.

4.2 Relays & isolated inputs

Three Omron relays send control signals or switch loads up to 5 A at 230 V AC (resistive rating). Three opto-isolated inputs read 5–30 V DC signals and are polarity-insensitive, so they safely bridge digital signals between systems that must not share a ground.

4.3 Startup & power-loss behavior

The relays are non-latching (SPST-NO), so all contacts are open whenever the controller is unpowered, booting, or rebooting. Relay state does not survive a reboot. The opto-isolated inputs have no default state — they are level-read. At startup the software reads each input's current level, so an active input reads as active. Inputs are not monitored during boot, so a pulse or toggle that arrives while the controller is starting is not captured.

4.4 Communication

The RS-485 port runs Modbus RTU to field devices — the primary field protocol. The same port also connects other RS-485 devices, and M-Bus meters through an M-Bus gateway. On the network side, Wolf-App forwards data over MQTT, REST, or Modbus TCP via Ethernet or an optional 4G/LTE modem.

5 Installation

Read the Safety section before installing.

> Disconnect all power before wiring. Do not route low- and high-voltage wiring together. Double-check polarity and that every connection is secure before powering on.

1. **Unpack and inspect** the device for transport damage, and check the model and ratings.

2. **Mount** — first hook the top edge of the clip over the top of the 35 mm DIN rail, then press the unit down to compress the top spring and push the bottom in against the rail. The spring then presses the unit firmly against the rail.

3. **Wire** the relays, opto-isolated inputs, and RS-485 to the pluggable terminals — see Connectors and ports under Specifications.

4. **Network** — connect Ethernet, or fit the nano-SIM and connect the antenna to A1 for 4G/LTE. A second antenna on A2 (Rx-diversity) is recommended for better reception.

5. **Power** — apply 9–30 V DC, via the DC jack or the – / + terminals on the expansion card. Use only one source — do not connect both at the same time.

6. **Configure** — set up connectivity and automation in **Wolf-App**. See Software & Configuration and the first-time setup guide.

See the full **connection diagram** (power, RS-485 Modbus bus, opto-isolated inputs, relay outputs) in the Connection Diagram appendix (landscape page) at the end of this manual.

> **Controller removal.** To remove the unit, push it down to compress the top spring clip, then pull the bottom edge toward you and lift it off the rail — no tool needed.

6 Software & Configuration

The Wolf-3Oi3Ro has no display — apart from the programmable button, all setup and operation happen in software. This hardware manual does not duplicate the software documentation. For networking, secure updates, automation, and cloud connectivity, use the dedicated manuals:

> • **Wolf-OS** — the Linux platform: networking, secure updates, system services. See foxiot.eu/products/wolf-gateway/wolf-os.
>
> • **Wolf-App** — drop-in automation: cloud/VPP connectivity, MQTT / REST / Modbus TCP, I/O mapping, and rules. See foxiot.eu/products/wolf-gateway/wolf-app.
>
> • **First-time setup** — step-by-step at foxiot.eu/wolf-setup.
>
> • **Firmware releases** — bundles and changelogs at foxiot.eu/firmware/wolf-gateway.

7 Maintenance

The device is designed for indoor cabinet use and needs minimal maintenance.

- **Cleaning** — disconnect power, then wipe the enclosure with a dry or slightly damp lint-free cloth, no solvents or abrasives.
- **Connectors** — periodically inspect the power, I/O, and network connections, and clean oxidation or debris with electronics-approved contact cleaner or compressed air.
- **Periodic inspection (every 12 months)** — check for mechanical damage, secure mounting, and loose cables, and confirm the recommended firmware version.
- **Firmware** — Wolf-OS and Wolf-App update in-field as signed bundles. Do not remove power during an update. Releases and changelogs: foxiot.eu/firmware/wolf-gateway.

Do not open the enclosure. There are no user-serviceable parts inside, and mains-voltage parts may be exposed. Opening it voids the warranty — see Warranty limitations.

8 Troubleshooting

Hardware-side checks for common field issues. Software diagnostics — networking, automation, and logs — are covered in the Wolf-OS and Wolf-App manuals.

Symptom	Check
L1 green LED not blinking	By default L1 (green) blinks as a heartbeat. At boot it stays solid, then begins blinking after ~30 s. If it never starts, measure the – / + terminals: confirm 9–30 V DC, correct polarity, and that voltage stays within limits (over-voltage can cause permanent damage).
No Modbus RTU comms	Wire A (+) to every device's A (+) and B (–) to B (–), polarity consistent along the whole chain. Use twisted-pair cable of the correct impedance, with A/B on the same pair. The card has an on-board 120 Ω terminator at its end — check that the far end of the line is terminated too. The "–" terminal also serves as the RS-485 signal ground — as good practice, run a signal-ground wire linking "–" between devices so they share a common reference. Once wiring is confirmed correct, check baud rate, stop bits, and parity — parity is the most common misconfiguration.
No Ethernet	Check the RJ45 cable and switch port. The RJ45 connector has built-in link/activity LEDs — confirm the link LED shows a connection. IP and DHCP configuration is covered in the Wolf-OS docs.
Can't reach the device / IP unknown	Boot into recovery mode for a fixed IP, or factory-reset to restore defaults (network reverts to DHCP). See the first-time setup guide.
No 4G/LTE	Confirm the SIM is seated and the antenna connected (main antenna on A1). Most LTE problems are not hardware: the SIM PIN must be removed before inserting the card, the operator must have activated the data service, and the APN must be correct. Wolf-App configures the modem automatically — see the setup guide.

Symptom	Check
Relay not switching	Disconnect the load and measure across the C–NO terminals. When the relay is commanded on, contact resistance should be low (near continuity). You may hear the relay click when it actuates, but a click alone does not confirm the contacts conduct. Overload — especially inductive or capacitive loads beyond the rating — can weld the contacts together, leaving the relay permanently faulty.
Input not read	Measure the input terminal voltage with a multimeter. The opto-isolated inputs are polarity-insensitive and activate at ≥5 V DC (30 V max) — below that the input may not register. A 50 ms debounce, plus the boot-time gap, means a very short pulse or one arriving during boot can be missed.

9 Ordering Information

Item	Order code	Description
Wolf-3Oi3Ro	GW-WOLF-OI-R1	3 relays, 3 isolated inputs, RS-485 Modbus RTU
Wolf-3Oi3Ro-LTE	GW-WOLF-OI-R1-LTE	As above, with 4G/LTE modem (Quectel EC25-EUX)
Plug-in power adapter	ACC-PSU-12P	12 V DC, 1.5 A (2.1 / 5.5 mm jack)
DIN-rail PSU	ACC-PSU-24D	24 V DC, 1.5 A
LTE antenna	ACC-ANT-M-LTE	Magnet-mount, for the -LTE variant

Order through hello@foxiot.eu or your distributor.

10 Warranty, Support & RMA

10.1 Warranty conditions

FoxIoT OÜ provides a limited warranty for **36 months from the date of purchase**, covering defects in materials and workmanship under normal use, in accordance with this manual and the product's environmental specifications. During the warranty period FoxIoT will repair or replace defective units at no charge, provided the product has not been modified, misused, or subjected to adverse conditions.

- Valid only for original products from FoxIoT OÜ.
- Proof of purchase may be required.
- Warranty service is limited to repair or replacement.
- The warranty does not cover associated costs such as removal, reinstallation, or transportation.

Independent of the warranty period, FoxIoT provides security updates for at least **5 years** from the product's release, as required by EU CRA 2024/2847.

10.2 Warranty limitations

The warranty does **not** apply in the following cases:

- Physical damage from mishandling, impact, fire, or water exposure.
- Damage from improper installation, incorrect wiring, or operation outside the specified limits.
- Modifications or repairs by unauthorized personnel.
- Normal wear and tear.
- Software issues related to non-standard configurations.

> The warranty is void if the product has been opened or tampered with in any way not approved by FoxIoT OÜ.

10.3 Technical support

Contact our support team through:

Email	support@foxiot.eu
Support hours	Monday–Friday, 10:00–16:00 EET (Estonian time)
Languages	English, Estonian

Have your device's serial number, firmware version, and a clear description of the problem ready when contacting support.

10.4 RMA process (Return Material Authorization)

To return a product for repair or replacement you must obtain a valid **RMA number** from support — devices returned without one are not accepted.

1. Contact technical support to report the issue.
2. Provide the serial number, a clear description of the issue, and proof of purchase.
3. Receive an RMA number and return instructions.
4. Package the product carefully to prevent shipping damage and include the RMA number.
5. Send the unit to the return address provided by support.

Returns through an authorized reseller or distributor must still be submitted to FoxIoT support to obtain an RMA number. The reseller manages end-customer logistics and documentation. Direct end-customer returns are accepted after support verifies the purchase channel and warranty eligibility.

11 Compliance & Standards

The Wolf Gateway platform is designed and documented to EU industrial and cybersecurity requirements. Product security information is published per the EU Cyber Resilience Act (Regulation 2024/2847).

11.1 Product cybersecurity context

The Wolf platform applies a defense-in-depth strategy:

- **Signed firmware** — Wolf-OS and Wolf-App ship as digitally signed bundles. The updater verifies each bundle's signature before installing it.
- **Secure remote access** — use the built-in VPN (OpenVPN, WireGuard) for remote management. Do not expose management interfaces directly to the public internet.
- **Intended environment** — install inside a locked electrical cabinet, on a segmented automation network behind a firewall.
- **Security updates** — provided for at least 5 years, per EU CRA 2024/2847. Report vulnerabilities to security@foxiot.eu.

Topic	Detail
Directives	EMC 2014/30/EU · RoHS 2011/65/EU · WEEE 2012/19/EU
Cyber Resilience	EU CRA (Reg. 2024/2847) — product security information published
Secure boot & updates	Signed Wolf-OS / Wolf-App firmware bundles
Vulnerability reporting	security@foxiot.eu — coordinated disclosure

Product Security Information (CRA-UI-001) and signed firmware releases are published at foxiot.eu/legal/security. Report vulnerabilities to security@foxiot.eu.

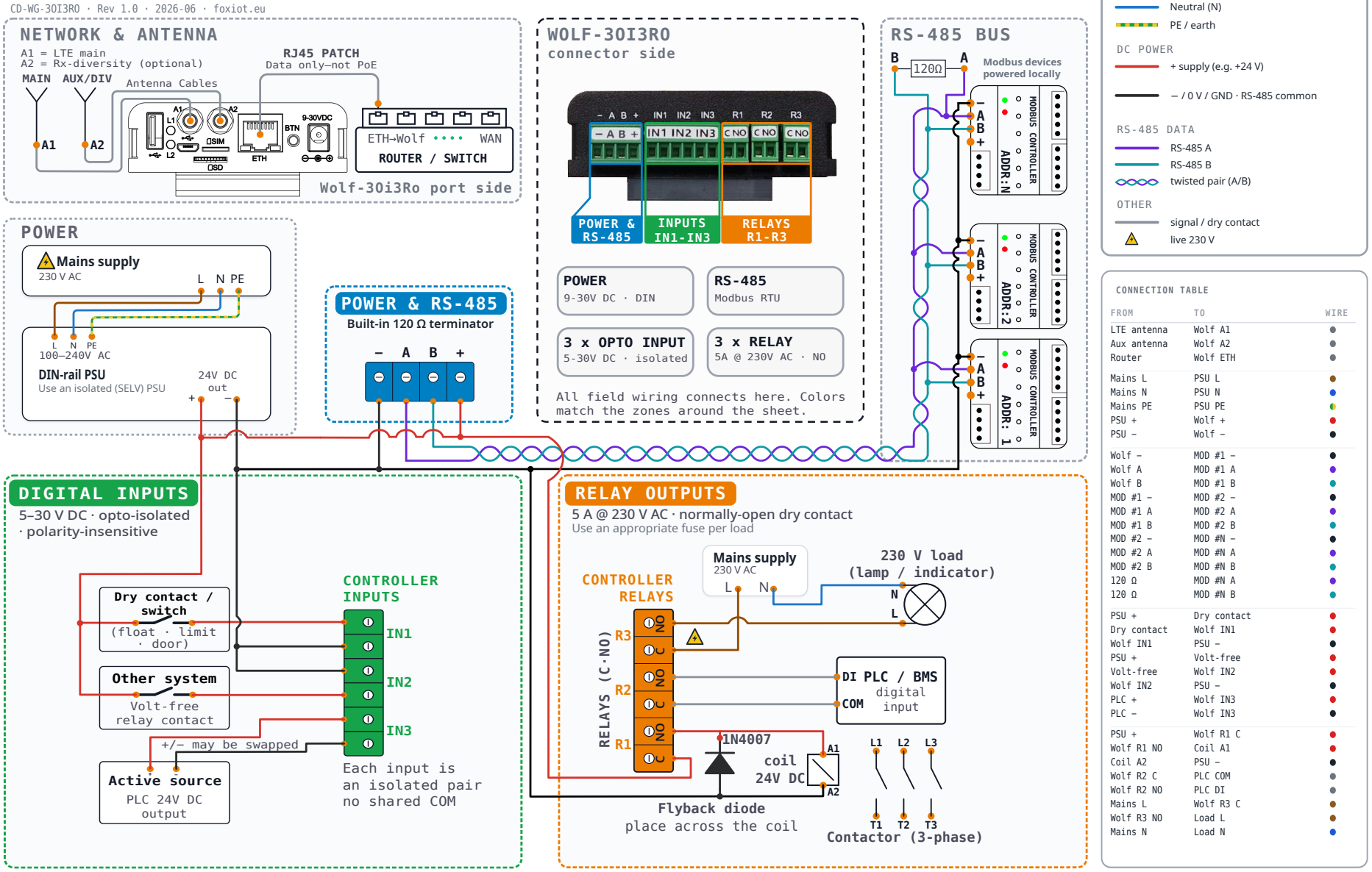
Disposal (WEEE). Do not dispose of this device with household waste. At end of life, return it to a designated WEEE collection point or to FoxIoT OÜ — see recycling & disposal.

12 Connection Diagram

Wolf-3Oi3Ro

CONNECTION DIAGRAM

CD-WG-3OI3RO · Rev 1.0 · 2026-06 · foxiot.eu



WIRE KEY

AC MAINS
- Phase / Line (L)
- Neutral (N)
- PE / earth

DC POWER
- + supply (e.g. +24 V)
- – / 0 V / GND · RS-485 common

RS-485 DATA
- RS-485 A
- RS-485 B
- twisted pair (A/B)

OTHER
- signal / dry contact
- live 230 V

CONNECTION TABLE

FROM	TO	WIRE
LTE antenna	Wolf A1	
Aux antenna	Wolf A2	
Router	Wolf ETH	
Mains L	PSU L	
Mains N	PSU N	
Mains PE	PSU PE	
PSU +	Wolf +	
PSU –	Wolf –	
Wolf –	MOD #1 –	
Wolf A	MOD #1 A	
Wolf B	MOD #1 B	
MOD #1 –	MOD #2 –	
MOD #1 A	MOD #2 A	
MOD #1 B	MOD #2 B	
MOD #2 –	MOD #N –	
MOD #2 A	MOD #N A	
MOD #2 B	MOD #N B	
120 Ω	MOD #N A	
120 Ω	MOD #N B	
PSU +	Dry contact	
Dry contact	Wolf IN1	
Wolf IN1	PSU –	
PSU +	Volt-free	
Volt-free	Wolf IN2	
Wolf IN2	PSU –	
PLC +	Wolf IN3	
PLC –	Wolf IN3	
PSU +	Wolf R1 C	
Wolf R1 NO	Coil A1	
Coil A2	PSU –	
Wolf R2 C	PLC COM	
Wolf R2 NO	PLC DI	
Mains L	Wolf R3 C	
Wolf R3 NO	Load L	
Mains N	Load N	

Wolf-3Oi3Ro connection diagram — power and RS-485 Modbus bus, opto-isolated inputs, and relay outputs

Revision History

Version	Date	Notes
1.0	2026-06-11	Initial release.