WENC2

Datasheet



Document Version: 2.1 — November 2026

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1. Product Description

WENC2 is a wireless transmitter-receiver system that carries motor encoder signals in industrial environments. The TX (transmitter) reads encoder inputs, and the RX (receiver) reproduces the signals as a quadrature output for the drive.

It replaces the encoder cable in applications where pulling cable is difficult or impossible (rotating bobbin, rotary table, slip-ring systems, multi-axis machines).

Models

Model	Encoder Channels	Description
WENC2-MONO	1	Single encoder channel
WENC2-DUO	2	Dual encoder channels
WENC2-TRI	3	Three encoder channels

2. Key Specifications

Parameter	Value
Communication	5 GHz robust protocol compliant with Wi-Fi 6ax licensing
Link security	Paired MAC verification + CCMP encryption framework
Topology	Point-to-point (peer-to-peer), automatic channel hopping
Supply voltage	RX: 15–30 V DC • TX: 15–30 V DC (see §3.1)
Encoder type	Incremental quadrature (A/B/~A/~B)
Encoder connection	4-wire (differential) or 2-wire (single-ended)
Encoder supply output (TX)	+23.5 V filtered
RX output level	HTL (24 V), over-current and short-circuit protected
Encoder input isolation	Optically isolated
Drive interface	HTL / push-pull, A/B (Z / index not used)
Motor RPM range (1024 ppr)	0–6000 RPM @ 1024 ppr (102.4 kHz); theoretical ≈ 8800
Operating distance (line of sight)	> 100 m LOS (open area); actual range depends on environment
RF output power	≤ 17 dBm (5 GHz, declared)
Antenna gain	1.1 dBi (2 × external antenna in package)
Operating temperature	−20 °C … +70 °C

3. Electrical Parameters

3.1 Supply

TX and RX have different supply ranges. **The TX lower limit is set by the DI logic threshold** (see §3.2, Note). **On the RX side, the HTL output level tracks the supply voltage** (V_out ≈ V_supply − 1 V).

3.1.1 TX Supply

Parameter	Value
Supply voltage	**15 – 30 V DC** (nominal 24 V)
Minimum supply	15 V (due to DI logic threshold)
Absolute Max (short-duration peak)	42 V
Typical current @ 24 V (normal mode, excl. encoder current)	28 mA
Average / peak current @ 24 V	29 mA avg / 32 mA peak
Average / peak current @ 15 V	42 mA avg / 59 mA peak
Reverse polarity protection	Withstands down to −32 V
Over-voltage protection	35 V varistor + fuse (Abs Max peak: 42 V)

3.1.2 RX Supply

Parameter	Value
Supply voltage	**15 – 30 V DC** (nominal 24 V)
Absolute Max (short-duration peak)	35 V
Typical / peak current @ 24 V (no load)	50 mA avg / 57 mA peak
Typical / peak current @ 15 V (no load)	55 mA avg / 64 mA peak
Typical / peak current @ 10 V (no load)	66 mA avg / 85 mA peak
HTL output level (supply-tracking)	V_out ≈ V_supply − 1 V (typical)
Reverse polarity protection	Withstands down to −32 V
Over-voltage protection	35 V varistor + fuse

> **RX supply-output relation:** The RX HTL output voltage tracks the supply voltage. For the drive's HTL 24 V thresholds to be met, **RX supply should be nominal 24 V**. Below 15 V supply the output level may fall below standard HTL thresholds.

3.2 Encoder Input (TX)

Parameter	Value
Input signal	A, /A, B, /B (incremental quadrature)
Level	HTL (24 V tolerant)
DI logic LOW threshold	V_in < 13.8 V
DI logic HIGH threshold	V_in > 14.0 V
A/B input current	Sink / source @ 24 V, ±2 mA (typical)
Connection types	4-wire differential or 2-wire single-ended
Isolation	Optically isolated
Encoder supply output (Terminal 3)	V_supply − 0.5 V (nominal +23.5 V @ 24 V supply)
Encoder supply current limit (Terminal 3)	500 mA continuous; protection triggers above 1000 mA

> **Note — TX minimum supply:** Since the DI HIGH threshold is 14 V, the TX supply voltage cannot fall below this level. For this reason **TX minimum supply is set to 15 V** (with a practical safety margin). The same threshold explains why the encoder supply output is tied to V_supply.

3.3 Encoder Output (RX)

Parameter	Value
Output signal	A, /A, B, /B (quadrature)
Level	HTL / push-pull (supply-tracking, see §3.1.2)
Continuous current per channel	100 mA sink / 100 mA source
Absolute Max per channel	1000 mA (PTC protected)
Short-circuit protection	PTC based; response ≈ 300 ms, auto-recovery
Index (Z) signal	**Not used** (WENC2 transmits A/B only)

> **Quadrature integrity is required.** A and B signals must be read together for the built-in error recovery, correct counting and noise rejection hardware/algorithms to function. **A-only or B-only pulses cannot be used or transmitted on their own.**

3.4 Protection and Connection Safety

Parameter	Value
TX input — optical isolation	Galvanic isolation between terminals and internal electronics
RX output — over-current protection	Yes, auto-recovery
RX output — short-circuit protection	Yes
ESD rating (terminal)	±4 kV contact / ±8 kV air (IEC 61000-4-2 Level 2 target) (all I/O: 40 V varistor + 10 kΩ GND pulldown)

4. Performance / Timing

Parameter	Value
Boot time — unpaired device (power → service AP up)	≈ 5 s
Boot time — paired device (power → normal mode active)	≈ 12 s
Max encoder pulse frequency	0–102 kHz per channel (theoretical ceiling ≈ 150 kHz)
Service mode status update interval	≈ 100 ms (status update)

> **Service mode output:** The full RX encoder output is produced only in **normal operation mode**. In service mode the output runs at ~100 ms intervals (status update) — **it is not suitable for closed-loop operation**.

5. Mechanical Specifications

TX and RX use the same enclosure. Mechanical dimensions are identical; the difference is only the terminal print / labeling.

5.1 TX Mechanical

Parameter	Value
Enclosure dimensions (W × D × H, antenna excluded)	70 × 103 × 60 mm
Weight (with antenna, excl. terminal)	120 g
IP rating	IP20 (open housing with ventilation holes)
Mounting	TS35 (35 mm) DIN rail clip + cross-head screw holes
Terminal type	Screw terminal (pluggable), 2 × 8 pin
Terminal pitch	3.81 mm
Screwdriver tip	2.5 mm flat
Conductor cross-section	0.22 – 0.75 mm² (AWG 24 – 18)
Antenna type	External, screw-type connector
Antenna band	5 GHz
Antenna gain	1.1 dBi

5.2 RX Mechanical

Parameter	Value
Enclosure dimensions (W × D × H, antenna excluded)	70 × 103 × 60 mm
Weight (with antenna, excl. terminal)	120 g
IP rating	IP20 (open housing with ventilation holes)
Mounting	TS35 (35 mm) DIN rail clip + cross-head screw holes
Terminal type	Screw terminal (pluggable), 2 × 8 pin
Terminal pitch	3.81 mm
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Antenna band	5 GHz
Antenna gain	1.1 dBi

> **High-IP applications:** For installations that require dust, moisture or wash-down compliance, WENC2 can be supplied in a custom sealed enclosure on request.

6. Environmental Conditions

Parameter	Value
Operating temperature	−20 °C … +70 °C (industrial-grade components)
Storage temperature	−40 °C … +85 °C
Operating humidity	10 – 95 % RH (non-condensing)
Operating altitude	≤ 2000 m

7. Operating Modes

7.1 Normal Mode

Paired devices start in normal mode automatically when powered.

- TX and RX connect automatically (using the stored peer MAC address)
- Encoder data is transmitted in real time
- RX reproduces an identical quadrature signal to the drive
- WiFi access point is **off** (Web UI unreachable)
- LEDs show the signal strength

7.2 Service Mode

Used for pairing, monitoring, settings and OTA updates.

- RX opens a WiFi access point → Web UI access from tablet/phone
- Encoder values can be monitored live in the Web UI
- A/B signal diagnostics detect cable faults
- Device settings (name, password) can be changed
- OTA firmware update can be performed
- **RX encoder output runs as ≈100 ms status update** — not suitable for closed-loop

7.3 Output Modes (Position Tracking)

The RX output mode is selected **per encoder channel** in the RX Web UI under **Output Mode**; **Save** takes effect during normal operation.

Mode	Missed-pulse compensation	Reverse step	Delay	On link loss	Suitable use
0 — Speed transfer (default)	None	None	As long as the speed filter	Output stops, error remains	Constant high speed, speed feedback
1 — Position, safe	Yes (limited rate)	None	Slightly behind	Falls behind, then catches up	Length measurement, counting
2 — Position, predictive	Yes (limited rate)	None	Almost none	Falls behind, then catches up	Low speed, ramps, position following
3 — Position, servo	Yes	Possible	Almost none	Catches up, overshoots slightly and returns	Tight position match; position follower (drive in position/slave mode)

In position modes (1–3) **no pulse is lost**: after a short link interruption the missing pulses are completed when the link returns. In speed mode the last speed is held during short gaps (smooth transition).

Mode descriptions

- **0 — Speed transfer:** reproduces the transmitter speed as is; pulses missed in a link loss are not made up.
- **1 — Position, safe:** follows pulse by pulse and never steps backwards; completes missing pulses after a loss; lags slightly.
- **2 — Position, predictive:** safe mode plus look-ahead; practically no delay, no backward steps.
- **3 — Position, servo:** predictive mode plus back-correction; holds position tightest but may step backwards.

Advanced Settings

Parameter	Range	Default	Description
`kp`	1–500 1/s	200	Position gain: how fast the output closes the position error
`catch_hz`	—	2000 Hz	Catch-up limit: maximum extra pulse rate while catching up
`resync`	—	10000 pulses	Re-alignment threshold: when exceeded, the output is re-aligned and an alarm is raised
`lead_us`	0–5000 µs	1250	Look-ahead time (modes 2 and 3)
`acc`	on / off	on	Acceleration estimation (modes 2 and 3)

Application Recommendation

- Speed feedback to the drive → **mode 0**.
- Drive position follower (electronic gear / master-slave position) → **mode 3**.
- Counting / length measurement where no pulse loss is acceptable → **mode 1** (do not choose mode 3 if reverse steps are unwanted).

8. Terminal Assignments

8.1 TX (Transmitter — Motor Side)

Terminal	Function	Model
1	+24 V supply input	All
2	GND	All
3	+23.5 V encoder supply output	All
4	GND (encoder)	All
5	**ENC0.A**	All
6	ENC0./A	All
7	**ENC0.B**	All
8	ENC0./B	All
9	**ENC1.A**	DUO, TRI
10	ENC1./A	DUO, TRI
11	**ENC1.B**	DUO, TRI
12	ENC1./B	DUO, TRI
13	**ENC2.A**	TRI
14	ENC2./A	TRI
15	**ENC2.B**	TRI
16	ENC2./B	TRI

2-wire encoder: Only A and B are connected. On the TX side, /A and /B terminals are **bridged to GND**. On the RX side no bridging is done.

8.2 RX (Receiver — Drive Side)

Terminal	Function	Model
1	+24 V supply input	All
2	GND	All
3	GND	—
4	**ENC0.A**	All
5	ENC0./A	All
6	**ENC0.B**	All
7	ENC0./B	All
8	GND	—
9	**ENC1.A**	DUO, TRI
10	ENC1./A	DUO, TRI
11	**ENC1.B**	DUO, TRI
12	ENC1./B	DUO, TRI
13	**ENC2.A**	TRI
14	ENC2./A	TRI
15	**ENC2.B**	TRI
16	ENC2./B	TRI

> RX outputs are **HTL level (24 V)** and connect directly to the drive's encoder input.

9. PPR / RPM Coverage

WENC2 operates **transparently** with the drive — it forwards what comes from the encoder unchanged. Per channel, the pulse frequency (A signal) operating range is **0–102 kHz**; the theoretical ceiling is **≈ 150 kHz**. Reference: **6000 RPM @ 1024 ppr** (= 102.4 kHz).

The speed limit scales inversely with the encoder PPR: `RPM = f × 60 / PPR`

Encoder PPR	Operating upper limit	Theoretical ceiling
512	12000 RPM	17500 RPM
1024	6000 RPM	8800 RPM
2048	3000 RPM	4400 RPM
4096	1500 RPM	2200 RPM

The mechanical limits of the encoder and motor apply in addition. When the encoder is changed, only the **PPR / pulse-count parameter in the drive** is updated; no setting is needed on WENC2. Output frequency resolution is ≈ 2.4 Hz.

10. LED Indicators and Boot Modes

10.1 LED Bar (D1–D4)

4 signal LEDs + 1 power LED (always on).

10.2 Normal Mode — Signal Strength

LEDs	Signal strength (RSSI)	Meaning
4 (D1–D4)	> −57 dBm	Excellent (devices side by side)
3	> −67 dBm	Strong
2	> −75 dBm	Moderate
1	> −85 dBm	Weak
0	—	No link / very weak

The value is filtered (±3 dB hysteresis). Both TX and RX show the bar.

10.3 LED Animation Table

Pattern	Appearance	Meaning
Fast sweeping light	75 ms step, back and forth	Power-up
Medium sweeping light	150 ms step	Normal mode, searching for peer (also on RX while there is no link)
Slow sweeping light	300 ms step	Service mode, **not** paired
Inner pair / outer pair alternating	D2+D3 ↔ D1+D4, 400 ms	Service mode, paired
All blink	200 ms on/off	Pairing window open / pairing in progress
Fill from bottom + 3 blinks + steady	~1.6 s, then the service-paired pattern	Pairing complete
Fill from bottom → signal bar	1–4 LEDs steady	Normal mode, linked; bar = signal strength
All on, then turn off one by one	1 s cycle	TX: link lost, reconnecting
Fast flash	~5 s	“Find” command received
Short flash, long dark	100 ms / 1 s	Error: device not configured (no model record) — contact service
Rotating pair, one direction	120 ms	Update mode: waiting for the package
Quarters fill + next LED blinks	progress	Update in progress (each LED = 25 %)
All four steady	—	Update finished, restarting
Fast diagonal flicker	D1+D3 ↔ D2+D4, 60 ms	Update error / cancelled (the old software keeps running)
All off	—	No power

10.4 Single-Button Operation

Each device has a **single button**. Operation depends on the current state:

State	Action	Result
Normal operation	Hold 5 s	Switches to service mode as soon as the 5 s threshold is reached (no need to release); the paired device is also called into service mode. A short press is ignored in normal operation (prevents accidental switching).
Service mode	Short press	**Find:** the LEDs of the paired device flash for ~5 s.
Service mode	Double short press (within 0.8 s)	**Button pairing window, 60 s.** Double-press on both devices; two devices with an open window (TX + RX, strongest signal) pair automatically. No Web UI needed. Physical access = authorization (both devices must be touched).
Service mode	Hold 3 s	**Exit service mode**, return to normal operation.
At power-up	Hold ≥ 0.1 s	Starts in service mode (2 short flashes).
At power-up	Hold 10 s	**Factory reset** (progress LED lights at ≈ 3.3 s and ≈ 6.7 s). WiFi name/password (12345678), device name, pairing and settings return to defaults; serial number and model are kept.

An unpaired device always starts in service mode. A paired device starts directly in normal mode and looks for its peer (there is no start-up waiting window).

11. Web UI Features (Service Mode)

WiFi Connection Info

Parameter	Value
SSID	`WENC_RX_xxxxxx / WENC_TX_xxxxxx`
Default password	`12345678`
IP	`192.168.10.1`
Browser URL	`http://192.168.10.1`

11.1 Main Screen

- **Encoder rotation animation:** Live rotation visual per encoder
- **RPM / Hz / Direction:** Instant speed and direction (CW/CCW/Stop)
- **RSSI indicator:** Signal strength bar + dBm value + quality
- **Link status:** Channel, packet loss rate

11.2 A/B Signal Diagnostics

For each encoder channel, A and B signal levels are shown with colored indicators:

- **Green** = signal present (HIGH)
- **Red** = signal absent (LOW)

When the encoder rotates, the indicators are expected to change. This feature is used to detect cable faults (visible only in service mode).

11.3 System Information

Info	Description
Device temperature	TX and RX device temperature
Restart counter	TX and RX total restart count
Reset reason	Reason of the last restart
Firmware	TX and RX firmware version and date
MAC	TX and RX MAC addresses

Restart Counter — Slip-Ring Maintenance Tracking

The restart counter was added for detection of momentary power interruptions. On systems powered through a slip-ring, brush–ring contact loss causes short power drops that restart the device.

- High restart count → poor contact → maintenance needed
- **High TX increment** → motor-side slip-ring contact poor
- **High RX increment** → drive-side supply problem (loose terminal, fuse, power source)
- Record the counters as a reference after commissioning; track the rate of increase with periodic checks
- Factory reset clears the counters

11.4 Pairing

- **Scan Devices:** Lists nearby TX units
- **Pair:** Creates a persistent pairing with the selected TX
- **Locate Me:** Flashes the TX/RX LEDs for ~5 s to find the physical unit
- **Unpair:** Clears pairing on both devices

11.5 Device Settings

Setting	Description	Default
Device Name	Name shown in the WiFi SSID	MAC address (last 3 bytes)
AP Password	WiFi access point password (min 8 characters)	`12345678`

11.6 OTA Update

- Wireless, **signed and encrypted** update package (`.ota`); each device is updated through its own WiFi network, no cable needed. Anti-rollback protection and automatic return to the previous software.
- If the upload does not start within 5 min, takes longer than 20 min in total, or shows no progress for 30 s, the device restarts and starts with its old software.
- If the new software does not confirm itself at its first start, the device automatically returns to the previous software.
- **Do not cut the power during an update.**

11.7 Other

- **Switch TX Peer to Service Mode:** Remotely puts the TX into service mode
- **Return to Normal Operation:** Both devices return to normal mode
- **Help:** Commissioning and troubleshooting guide

Service Web UI — What's New

- **Access:** default SSID `WENC_RX_<last 3 MAC bytes>` / `WENC_TX_<…>` (`WENC_RX_<name>` if a name is set), password `12345678` (changeable, 8–32 characters). Address `192.168.10.1` or `wenc-rx.local` / `wenc-tx.local` ; captive portal — the page opens automatically on connecting. There is no administrator password; protection is the WiFi password.
- **TX Web UI:** live measurement (rotation wheel, A/B LEDs, cable diagnostics: idle / check B / check A / phase / OK), cable check without pairing, “Max Hz” column, simulated speed-profile signal (up to 600 s).
- **System:** boot counter and last reset reason (TX and RX), download of the black-box record (last 64 events), factory reset (with confirmation).
- **Settings:** WiFi name, device name (1–20 characters: A-Z a-z 0-9 _ -), WiFi password; per-field instant validation.
- **Language:** Turkish / English selection.
- **“What are the modes?”** section: mode diagrams and comparison table.

12. Secure Update (Anti-Rollback)

After an OTA update the new firmware must validate itself within 60 seconds. If validation fails (crash, error etc.), the device automatically rolls back to the **previous working firmware**. This mechanism prevents broken updates from being installed in the field.

Parameter	Value
Rollback time	≤ 60 s

13. Wireless Interface

The wireless layer of WENC2 is based on Wi-Fi 6 (IEEE 802.11ax) and operates in the 5 GHz band only.

- IEEE 802.11ax (Wi-Fi 6), 5 GHz
- CCMP encryption framework defined in IEEE 802.11-2012

14. Ordering and Package Contents

14.1 Order Codes

Order Code	Encoder Channels	Contents
WENC2-MONO	1	1 × TX + 1 × RX
WENC2-DUO	2	1 × TX + 1 × RX
WENC2-TRI	3	1 × TX + 1 × RX

14.2 Standard Package Contents

- 1 × TX transmitter
- 1 × RX receiver
- 2 × 5 GHz 1.1 dBi external antenna
- 4 × 8-pin 3.81 mm pluggable screw terminal sockets
- Cardboard packaging

15. Troubleshooting Reference

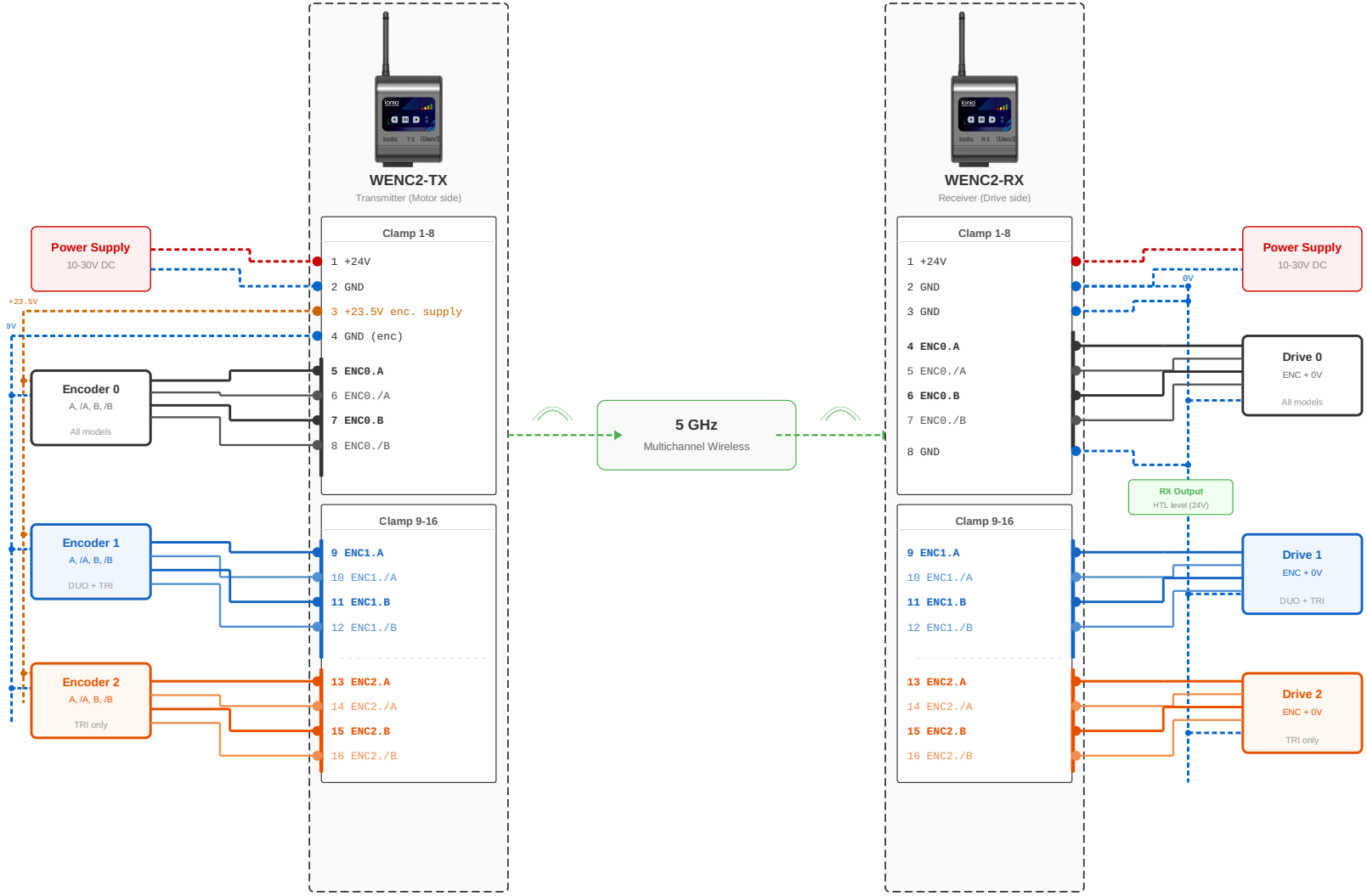
Symptom	Possible Cause	Solution
LEDs not lit	No power or no signal	Check supply (15–30 V). In normal mode LEDs are off when there is no signal
Pairing fails	Devices are not in service mode	Put both devices into service mode
Web UI does not open	Wrong WiFi or mobile data on	Connect to the SSID that starts with `WENC_` and turn off mobile data
Encoder turning but no count at drive	Cable fault or RX in service mode	Use A/B signal diagnostics in the Web UI. If RX is in service mode, return to normal operation
Direction inverted at drive	A/B order inverted	Invert via drive parameter; **or** on a 4-wire connection swap A with /A (most practical); **or** on a 2-wire connection swap ENC.A with ENC.B on the TX
All indicators red	Encoder has no power	Broken cable or, on 2-wire, the /A, /B → GND bridge is missing
Indicators do not change	Signal wire broken	Check the corresponding A or B line
Position oscillates between +1/−1	Wrong wiring	Check A/B/~A/~B connection order
Frequent restarts	Poor slip-ring contact or supply issue	Compare the restart counters — TX increment → slip-ring maintenance; RX increment → drive-side supply check
Not working after OTA	Broken firmware	Auto-rollback restores the previous version (within 60 s)

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Appendix A — Wiring Diagram

WENC2 System Wiring Diagram

All models (MONO / DUO / TRI) — Connect according to color code



Connection by Model:

- **MONO:** Black cables only (ENC0)
- **DUO:** Black + blue (ENC0 + ENC1)
- **TRI:** Black + blue + orange (ENC0 + ENC1 + ENC2)

+24V supply — 0V (GND) — +23.5V enc. supply

* 2-wire encoder: On TX side, bridge /A and /B clamps to GND (no bridging on RX side)

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