

ICPROX

Complete manual — all components in one document

Document rev. **1.0** Date **2026-08**

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Each component keeps its own chapter numbering in this manual; it matches the individual manual on wiki.in-circuit.de/icprox/.

ICPROX

System Manual — Collision protection for industrial trucks based on ultra-wideband locating

Document rev. **1.0**

Date **2026-08**

Sets **902.225 · 902.228 · 902.229**

1 System overview

ICPROX protects people where vehicles and pedestrians share the same space. The system continuously measures the distance between vehicle and person by ultra-wideband radio and reacts in stages, long before things get tight: warn first, then slow down, and stop if necessary. It works without a camera, without line of sight, and in places where racking, walls, dust or steam block the view.

- Distance measurement to ± 10 cm, range up to 30 m
- Three adjustable reduction levels — warning, speed limitation, stop
- Retrofittable to the 24 V electrical system, without interfering with the vehicle electronics beyond the intended interfaces
- Stationary danger points and gates can be added without any cable to the vehicle
- No camera and no recording of personal data
- Expandable step by step, from a single vehicle to a whole building



Left, the vehicle equipment (control unit, display, three antennas); right, the infrastructure module for danger points and gates.

1.1 Two parts, each useful on its own

Subsystem	Task
On the vehicle	Control unit, display and one to three antennas detect people and other vehicles nearby and trigger the reduction
In the building	Infrastructure modules at junctions, gates and hazardous locations work autonomously — they need neither a cable to the vehicle nor a central system

The two parts can be joined: an additional fourth antenna on the control unit makes the vehicle a participant in the building network, so that it also responds to danger points and gates.

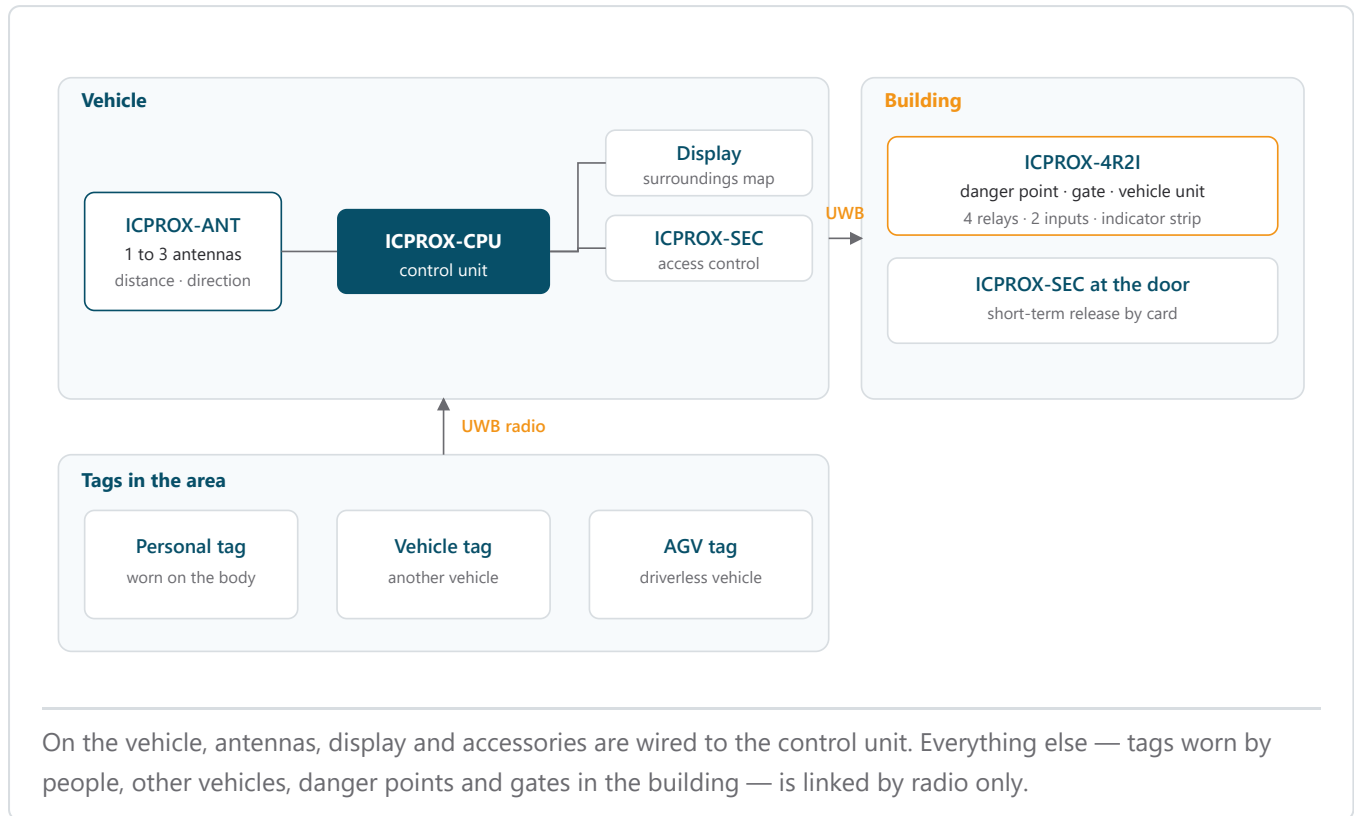
1.2 Which vehicle equipment is needed?

Choosing the vehicle equipment comes down to a single question: **what should the vehicle detect?**

The vehicle should detect ...	Equipment on the vehicle
the infrastructure only — danger points, gates, zones	1 × ICPROX-4R2I as a vehicle unit. It responds to every spot and gate in the building and switches the vehicle relays — control unit, display and antennas are not required for this
additionally people, AGVs or other vehicles	Control unit + display + 1 to 3 antennas (sets in chapter 4); the link to the infrastructure is handled by an optional fourth antenna

Make this decision deliberately: The two approaches do not extend equally well. The full system can later join the infrastructure system simply by adding one more antenna to the device line. Starting with a 4R2I on the vehicle, however, means that on a later upgrade to the full system the 4R2I cannot be reused there. This is why the configurator at www.in-circuit.de/icprox puts exactly this question first — whether people, AGVs or other vehicles are to be detected. The infrastructure in the building is unaffected by the choice and works with either approach.

2 How an installation is put together

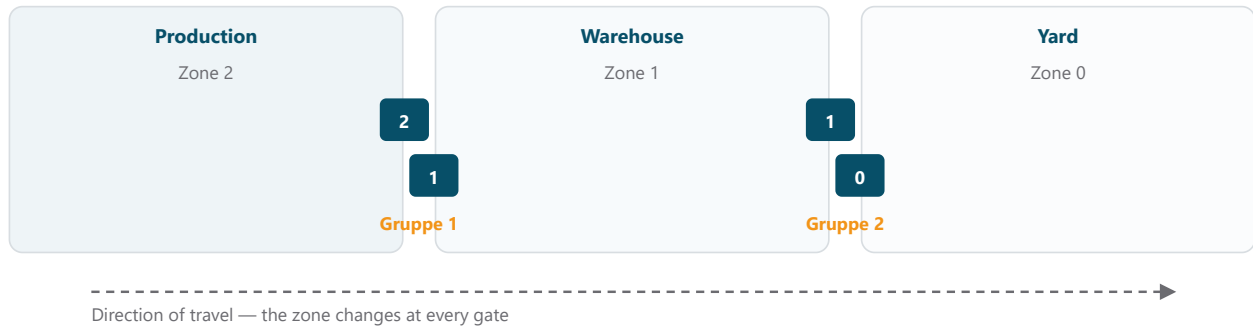


Tip: There is never a cable between vehicle and building. A danger point can therefore be retrofitted in a single morning without touching a vehicle at all.

2.1 Danger points, gates and zones

The infrastructure serves two purposes. A **danger point** acts locally: a vehicle entering its radius is slowed down and is free again once it leaves. A **gate** acts permanently — it hands the vehicle a **zone**, and the vehicle keeps it until the next gate changes it. That way the production hall can have a different speed limit than the warehouse without a single further unit being installed there.

Every gate consists of two units carrying the zone number of their side



Two gates, three zones. Every gate consists of two units — one per side, carrying the zone number of that side. The device group tells the vehicle which two belong together, which is why every gate gets its own.

The vehicle compares the distances to both units of a gate and adopts the zone of the nearer one. The direction of travel follows from that by itself — a gate needs no light barrier and knows nothing about directions. A **single** gate therefore does not trigger a zone change.

Important with several gates: The **device group** (switch block S3) identifies which two units form the same gate. Every gate gets its own group, both units of one gate share it. Otherwise the vehicle compares units belonging to different gates and adopts a zone that does not match its position. The vehicles stay set to "all groups" so that they see every gate.

3 Components

Component	Part no.	Task
ICPROX-CPU	902.220	Control unit on the vehicle: evaluates the measurements, switches four relays, provides the web interface
ICPROX-Display	902.217	Touch display with surroundings map and proximity tone
ICPROX-ANT	902.218	UWB antenna: one for distance, three for distance and direction, optionally one for the link to the building
ICPROX-4R2I	902.199B	Infrastructure module for danger points, gates and vehicles — four relays, two inputs, indicator strip
ICPROX-SEC	902.206	Access control with RFID cards, on a vehicle or at a door
ICPROX-KEY	902.230	Configuration key that enables the web interface of the control unit
ICPROX-Tag	902.214	Wearable transmitter by which the antennas detect people and vehicles — as a personal, vehicle or AGV tag
ICPROX charging cradle	902.237	Charges four tags side by side, powered over USB

Each component has its own manual; the links are listed in section 7.

4 Sets

Set	Part no.	Contents	Application
ICPROX-SET	902.225	Control unit, display, 1 antenna	Entry level: detection in the main direction of travel
ICPROX-SET-360	902.228	Control unit, display, 3 antennas	All-round detection including direction
ICPROX-SET-360+N	902.229	Control unit, display, 3 antennas + 1 antenna for the building	All-round detection plus the link to danger points and gates



The three sets: entry level, all-round detection, and all-round detection with the building link.

5 Planning and setting up an installation

1. **Identify the hazards:** Where do vehicles and people meet? Start with junctions, gates, racking aisles and exits.
2. **Equip the vehicles:** Choose a set — one antenna where the direction of travel matters, three antennas where approaches from the side must be detected too.
3. **Hand out the tags:** Issue personal tags to the staff; vehicles without their own system receive a vehicle tag so that they are detected.
4. **Add danger points:** Mount infrastructure modules at junctions and gates and set their detection radius on the device. A gate that switches the zone consists of **two modules** — one per side, both in the same device group; every further gate gets its own group.
5. **Set up the zones:** On every vehicle, adapt the three reduction levels to its size, speed and braking distance.

6. **Accept and instruct:** Verify the switching points with a personal tag, check the vehicle's behaviour at every level and instruct the drivers.

Caution: ICPROX assists the driver but does not relieve them of their duty of care. People without a tag are not detected by the radio locating. Site traffic rules and the risk assessment remain fully in force.

6 Technical data

Property	Value
Locating method	ultra-wideband (UWB), 6.5 GHz
Measuring accuracy	±10 cm
Range	up to 30 m with clear line of sight, typ. 10–20 m in a built-up environment
Reduction levels	3, configurable separately per vehicle
Antennas per vehicle	1 to 3 for locating, optionally 1 for the link to the building
Detection radius of danger points	1.5 m – 19 m
Connections on the vehicle	RS485, twisted pair, shielded
Link to the building	by radio only
Power supply	24 V DC
Set-up	Wi-Fi web interface of the control unit; danger points via slide switches
Data protection	no camera, no recording of personal data

7 Manuals and support

- ICPROX-CPU — vehicle control unit
- ICPROX-Display — touch display
- ICPROX-ANT — UWB antenna
- ICPROX-Tag — personal, vehicle and AGV tag
- ICPROX-P — system description of the vehicle equipment (detecting people, AGVs and vehicles)
- ICPROX-N — system description of the infrastructure (danger points, gates, zones)

- ICPROX-4R2I — infrastructure module · configuration aid
- ICPROX-SEC — access control
- ICPROX-KEY — configuration key

For further questions our support team will be glad to help: **In-Circuit Solutions GmbH** ·
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ICPROX-CPU

User Manual — Vehicle control unit of the ICPROX collision protection system

Document rev. **1.0** Date **2026-08** Part no. **902.220**

1 Product overview

The ICPROX-CPU is the control unit on the vehicle. It evaluates the distance measurements of the connected UWB antennas, decides on the reaction according to the configured zones and switches four volt-free relay contacts accordingly — from a warning light through to shutting the vehicle down. At the same time it powers the display and accessories and provides the web interface used for setting the system up.

- Up to three UWB antennas at the same time — distance only, or distance with direction (360°)
- Four volt-free relay outputs for a graded reaction: warn, slow down, stop
- Two digital inputs (24 V) for external signals such as a door contact or push-button
- Set-up through its own Wi-Fi web interface — no router, no software installation
- Display, RFID access control and reversing sensors connect through one shared cable
- Firmware update over the air or via USB; event logging to SD card



ICPROX-CPU (902.220) — angled and side view. All cables enter the housing through cable glands and are wired to terminals inside.

1.1 Role within the system

The CPU is the single point where all information comes together: it knows the distances to every person and vehicle tag, the state of the stationary danger points in the building and — where fitted — the driver authorisation from the access control unit. From all of this it derives one single reduction level and applies it through the relays.

2 Connections and controls

All connections are made to terminals inside the housing. Use twisted-pair shielded cable for the data lines — it is far more robust near drives and battery chargers.

Connection	Function
Supply 24 V DC	Fed from the vehicle electrical system; also powers display, antennas and accessories
Antenna line (P bus)	Connects 1 to 3 ICPROX-ANT units, data and power on one cable
Device line (N bus)	Connects display, ICPROX-SEC access control, reversing sensors and an optional fourth antenna for the infrastructure link
Relay R1	Reduction level 1 — typically a visual warning (beacon)
Relay R2	Reduction level 2 — typically an audible warning and speed limitation
Relay R3	Reduction level 3 — typically stopping the vehicle
Relay R4	Special function: normally-closed contact for the safety circuit, or remote-controlled output — configurable
Input IN1	24 V input, e.g. door contact or light barrier; can be set to trigger the highest reduction level
Input IN2	24 V input, e.g. push-button for opening a gate or switching a danger point
USB	Firmware update and diagnostics from a service laptop
SD card	Slot for the optional event log
LED row	Eight multi-colour indicators, see section 5.1 for their meaning

Caution: The ICPROX-CPU is an extra-low-voltage device (24 V DC, SELV/PELV). Its four relay contacts must only switch extra-low-voltage loads. Mains-powered equipment such as beacons, horns or gate drives must be driven through an interposing relay or contactor. Only work on the vehicle with the power switched off.

3 Commissioning in six steps

1. **Mount the control unit:** Fit the CPU in a protected position on the vehicle, ideally not immediately next to the drive or the battery charger. Do not cover the housing.
2. **Connect the antennas:** Wire one to three ICPROX-ANT units to the antenna line. One antenna measures distance ahead; three antennas provide all-round detection including direction.
3. **Connect display and accessories:** Wire the display, the optional access control unit and any reversing sensors to the device line. All of them are powered through that same cable.
4. **Wire the relays:** Route R1 to R3 to the desired vehicle reactions and, if required, loop R4 into the safety circuit. Mains loads only through an interposing relay.
5. **Switch the power on:** After a few seconds the first indicator starts pulsing green and the display shows the overview map. All devices are now talking to each other.
6. **Set up the zones:** Open the web interface (section 4) and adapt reduction zones, relay behaviour and antenna positions to the vehicle. Then carry out a test drive with a personal tag and check the switching points.

Tip: Enter the antenna positions exactly as installed — only then will the direction and distance shown on the display match reality.

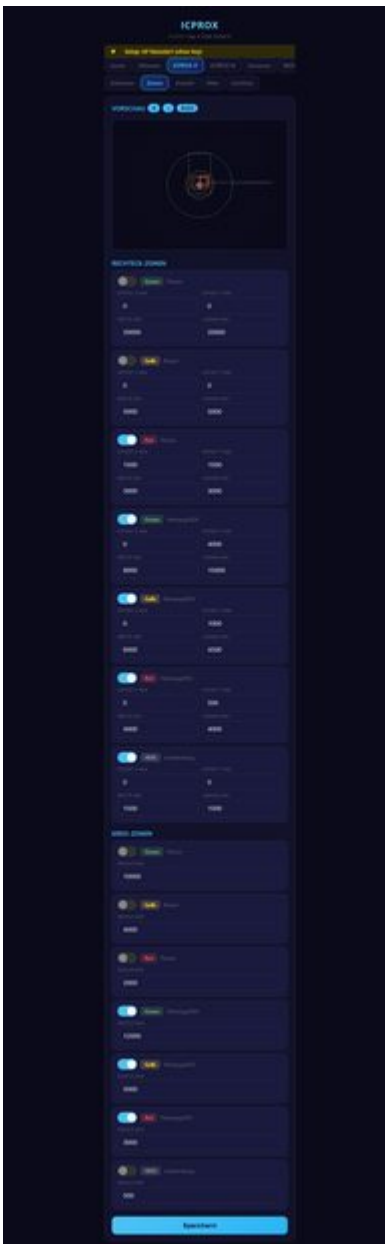
4 Configuration (web interface)

4.1 Access to the web interface

For set-up the CPU opens its own Wi-Fi network named **ICPROX-Setup**. Connect a smartphone or laptop to it and open the browser — the interface appears automatically. No router, no internet connection and no installed software are required.

So that the vehicle does not broadcast an open network during normal operation, access is only enabled while the **ICPROX-KEY** configuration key is nearby. The key simply needs a power source (power bank, laptop) and is detected by the CPU automatically.

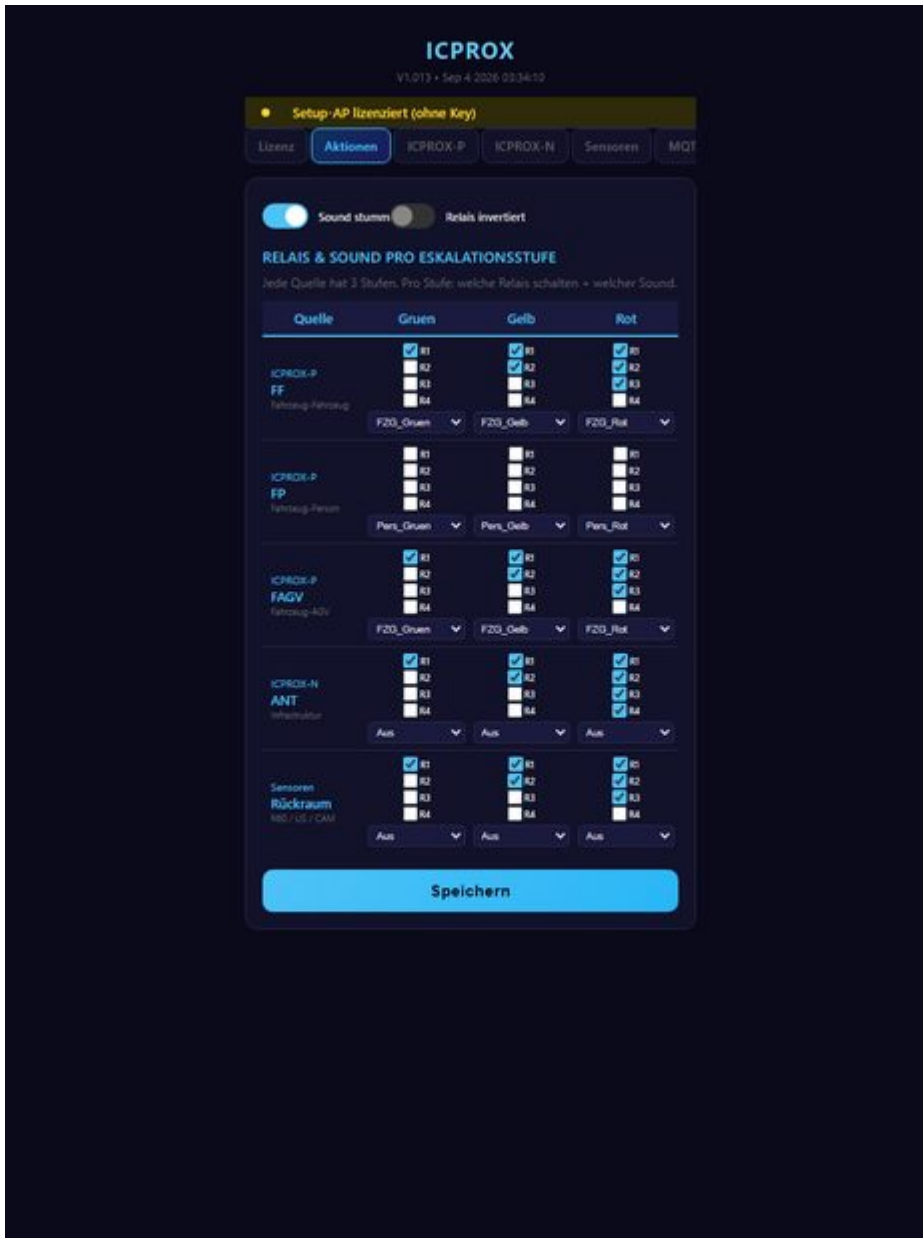
4.2 Reduction zones



Setting	Meaning
Zone shape	Circle around the vehicle or rectangle; the rectangle follows forks and vehicle outline more closely
Zone size per level	The distance at which each reduction level takes effect — level 1 outermost, level 3 innermost
Direction-dependent sizes	Separate dimensions to the front, rear and sides (only useful with three antennas)
Graphical preview	The configured zones are drawn to scale around the vehicle

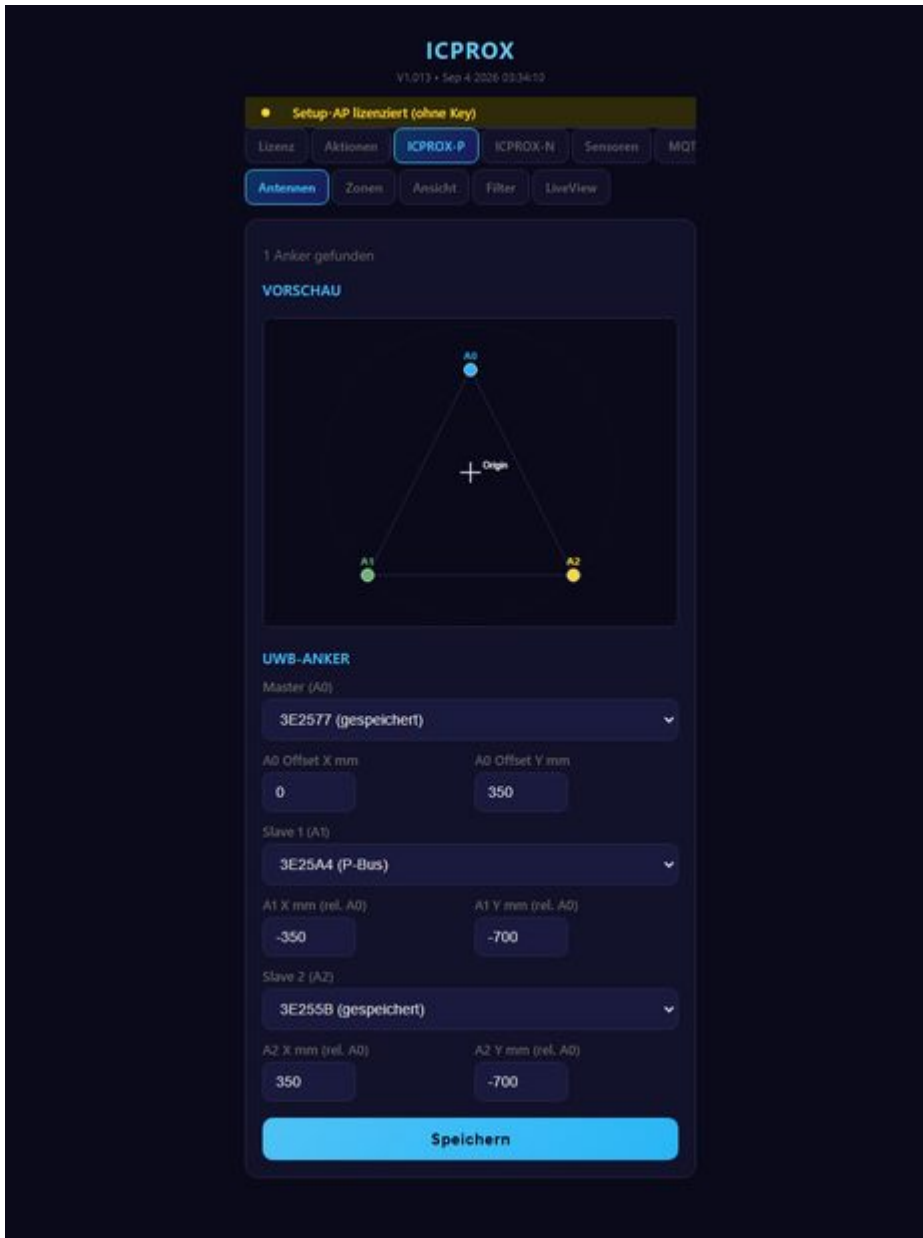
4.3 Relays and inputs

Setting	Meaning
Assignment R1–R3	Which reduction level operates which relay
Contact type	Normally open or normally closed. As a normally-closed contact the relay also drops out on a broken wire, which makes the circuit tamper-proof
Hold time	How long a reduction remains active after leaving the zone — prevents chattering at the zone boundary
Function of R4	Normally-closed contact for the safety circuit, or remote-controlled output
Function of IN1 / IN2	External triggering of the highest reduction level, or push-button for gates and danger points



4.4 Vehicle and antennas

- **Number of antennas** and where they are fitted on the vehicle (longitudinal and lateral offset)
- **Vehicle dimensions** for the to-scale representation on the display
- **Display and sound:** brightness and volume of the proximity warning
- **Connected devices** can be listed and their firmware updated



Tip: After every change to the zones, run a short check: have a colleague walk slowly towards the stationary vehicle carrying a personal tag while you read off the display at which distance each level responds.

4.5 Demo switch-over: 1 antenna / 3 antennas

For demonstrations the system can be toggled between two operating modes to show the difference directly: with **one antenna** the system only knows the distance — it warns in circular zones around the vehicle. With **three antennas** direction is added and the warning zones follow the vehicle outline as rectangles.

The switch-over button is enabled on the filter page of the web interface ("enable switch-over button on the display"). It then appears at the bottom right of the display (labelled **1A ✓** or **3A ✓** for the active mode) and next to the slider on the web interface (labelled as the action, e.g. **3A→1A**). The live view always shows the zones in effect — in single-antenna mode the circular zones, with tags drawn as distance circles without direction.

Switching takes effect immediately and is never stored: after a restart an enabled demonstration unit starts in single-antenna mode. For the comparison both rectangular and circular zones must be configured.

5 Operating behaviour

5.1 Status indication

The eight indicators inside the unit show the operating state without a display or laptop:

Indication	Meaning
Green pulse	Normal operation. The pulse becomes faster as soon as tags are detected or a reduction is active
Blue	A stationary danger point is within range
Fast red flashing	Fallback mode — evaluation is disturbed and the vehicle is reduced for safety. Check wiring and antennas
Red flashing once per second (second indicator)	No SD card detected. Only logging is affected; the protective function is unchanged
Yellow (second indicator)	Vehicle released — only with access control fitted
Inputs (two indicators)	Green = input open, magenta = input active
Relays (four indicators)	Green = idle, magenta = operated

5.2 Graded reduction

Level	Trigger	Typical reaction
1	A person or vehicle reaches the outer zone	Visual warning, notice on the display
2	Middle zone reached	Audible warning, speed limitation
3	Inner zone reached	Vehicle is stopped

The relays operate cumulatively: at level 2, R1 and R2 are engaged; at level 3, R1 through R3. The highest level that currently applies always wins. Stationary danger points in the building can request the same levels; here too the stronger reaction is the one that takes effect.

5.3 Driver authorisation and logging

If the ICPROX-SEC access control unit is connected, the safety circuit stays open until a valid card has been presented. Without a card the vehicle will not move off. With an SD card

inserted, approaches and switching events are logged continuously and can be evaluated later.

6 Technical data

Property	Value
Part number	902.220
Supply voltage	24 V DC (vehicle electrical system)
Relay outputs	4 × volt-free (R1–R3 reduction, R4 safety/special function)
Relay switching load	extra-low voltage only (SELV/PELV)
Digital inputs	2 × 24 V (IN1, IN2)
UWB antennas	up to 3 × ICPROX-ANT for 360° detection, optionally 1 × for the infrastructure link
Further devices	display, ICPROX-SEC, reversing sensors (shared device line)
Data lines	RS485, twisted pair, shielded
Status indication	8 × multi-colour LED
Set-up	Wi-Fi web interface <code>ICPROX-Setup</code> , enabled by ICPROX-KEY
Firmware update	over the air or via USB
Logging	SD card (optional)
Housing	industrial design, IP65

7 Troubleshooting

Symptom	Possible cause / remedy
No display, no indicators	Check the supply (24 V, fuse, terminals). Starting up takes a few seconds after power-on
Display stays dark, CPU pulses green	Check the device line: wires of the pair swapped, shield not connected, or a loose terminal
Fast red flashing	Fallback mode: antenna line interrupted or an antenna not working. Check the wiring, then briefly switch the power off
People are not detected	Is the tag charged? Are the number and mounting positions of the antennas entered correctly in the web interface? Are the antennas obstructed by metal?
Reduction happens too early or too late	Adjust the zone sizes; with only one antenna the zones act equally in all directions
Relay operates but the load stays off	The contacts are volt-free and do not switch mains voltage — fit an interposing relay or contactor
Vehicle will not move off	With access control fitted: present a valid card. Otherwise check the wiring of R4 and of the safety circuit
Wi-Fi ICPROX-Setup not visible	Power the ICPROX-KEY and bring it close to the vehicle, then refresh the Wi-Fi list on your device
Second indicator flashes red	SD card missing or unreadable. Re-insert or replace the card — the protective function is not affected

For further questions our support team will be glad to help: **In-Circuit Solutions GmbH** ·
Boltenhagener Str. 124, 01109 Dresden, Germany · www.in-circuit.de

7.1 Related manuals

- ICPROX system overview
- ICPROX-ANT — UWB antenna
- ICPROX-Display — touch display
- ICPROX-SEC — access control
- ICPROX-KEY — configuration key

ICPROX-Display

User Manual — Touch display with a real-time map of the vehicle surroundings

Document rev. **1.0**

Date **2026-08**

Part no. **902.217**

1 Product overview

The ICPROX-Display shows the driver what the protection system currently sees: people and vehicles nearby appear as dots on a to-scale map, with the configured warning zones drawn around them as coloured areas. It connects to the control unit through a single cable, which also supplies its power.

- Square colour display, 720 × 720 pixels, with capacitive touch
- Real-time map showing distance and direction of every detected tag
- The screen colour follows the reduction level — recognisable from the corner of the eye
- Built-in loudspeaker: a proximity tone whose rate changes with distance
- Shows stationary danger points and gates within range
- Connection and power through one single cable to the control unit



ICPROX-Display (902.217) — angled and front view.

1.1 Role within the system

The display is purely an indication and operating unit. All measurement and all decisions are made in the ICPROX-CPU control unit; the display only presents them. Should it fail, protection remains fully effective — only the picture and the sound are missing.

2 Connections and controls

Item	Function
Device line	Connection to the ICPROX-CPU — data and power in one cable (twisted pair, shielded)
Touch surface	The entire display area; operation is described in section 4
Loudspeaker	Proximity tone, volume adjustable from the control unit's web interface

Caution: The display must not restrict the driver's field of view. Choose a mounting position within the normal viewing area that obscures neither the load nor the path ahead. Only work on the vehicle with the power switched off.

3 Commissioning

1. **Choose the mounting position:** Within the driver's field of view, without obscuring it, and preferably out of direct sunlight.
2. **Fix the display:** Bolt the bracket firmly to the dashboard, pillar or console; the unit must stay in place even under vibration.
3. **Route the cable:** Run the device line to the control unit, not parallel to drive or charging cables, and connect the shield as specified.
4. **Connect:** Wire the cable to the device terminals of the control unit — no separate power supply is needed.
5. **Switch on and check:** The surroundings map appears after power-up. If a waiting notice is shown permanently instead, there is no connection to the control unit.
6. **Adapt the presentation:** Set brightness, volume and vehicle dimensions in the control unit's web interface so that the picture matches the vehicle.

4 Display and operation

4.1 Surroundings map

Element	Meaning
Vehicle in the centre	Your own vehicle, drawn to scale from the configured dimensions
Dots	Detected person and vehicle tags, placed by measured distance and direction
Coloured areas	The configured reduction zones — level 1 outermost, level 3 innermost
Symbols at the edge	Stationary danger points and gates currently within range
Status bar	Operating state, number of detected tags, current reduction level



Left: normal three-antenna operation (rectangular zones, direction sectors); right: single-antenna mode (circular zones, tags as distance circles). The switch-over button at the bottom right only appears when the demo switch-over is enabled — see CPU manual, section 4.5.

4.2 Touch operation

- **Tap the status bar:** Opens the list of all detected tags with their number, distance and requested reduction level. Tapping again returns to the map.
- **Tap the map:** Changes the scale of the view.

All settings are made in the control unit's web interface, not on the display itself. To make access easier, the display can show a QR code that connects a smartphone directly to the

set-up Wi-Fi.

If the WiFi connection doesn't work, there is an alternative setup tool via USB cable: wiki.in-circuit.de/icprox/icprox_setup_tool_en.html.

Tip: Enter the true vehicle dimensions — the map is drawn to scale, and a vehicle entered too small makes distances look larger than they really are.

5 Operating behaviour

5.1 Colours and sound

State	Display	Sound
No approach	Map in its idle colour, tags shown as neutral dots	silent
Reduction level 1	Warning colour, the tag concerned highlighted	slow beeping
Reduction level 2	Stronger warning colour	faster beeping
Reduction level 3	Alarm colour, notice that the vehicle is being stopped	continuous tone

The proximity tone follows the distance: the closer the person, the denser the beeping. This lets the driver tell whether someone is approaching or moving away without looking at the display.

5.2 Firmware update

The display is updated through the control unit; there is no need to remove it. During the process it shows a progress bar and restarts automatically afterwards. The power supply must not be interrupted while the update is running.

6 Technical data

Property	Value
Part number	902.217
Screen	720 × 720 pixels, IPS, colour
Operation	capacitive touch
Sound	built-in loudspeaker, adjustable volume
Connection	one cable to the ICPROX-CPU (RS485, twisted pair, shielded)
Power supply	through the device line from the control unit
Mounting	dashboard, pillar or console
Housing	compact housing, suitable for industrial use
Firmware update	through the control unit, without removal



Side and rear view showing the cable outlet.

7 Troubleshooting

Symptom	Possible cause / remedy
Display stays dark	Check the power supply of the control unit; check that the device line is firmly seated at both ends
Permanent waiting notice	No connection to the control unit: wires of the pair swapped, shield not connected, or cable interrupted
No tags on the map	No tag is within range, or the antennas are not connected — check the indication on the control unit
Distances look wrong	Check vehicle dimensions and antenna positions in the web interface
No sound	Increase the volume in the web interface; the tone only starts at reduction level 1
Hard to read in sunlight	Increase the brightness and choose a position with less direct sunlight
Touch does not respond	Clean the screen; operation with thick gloves may be limited

For further questions our support team will be glad to help: **In-Circuit Solutions GmbH** · Boltenhagener Str. 124, 01109 Dresden, Germany · **www.in-circuit.de**

7.1 Related manuals

- ICPROX system overview
- ICPROX-CPU — vehicle control unit
- ICPROX-ANT — UWB antenna

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ICPROX-ANT

User Manual — UWB antenna module for distance and direction

Document rev. **1.0** Date **2026-08** Part no. **902.218**

1 Product overview

The ICPROX-ANT is the radio module through which the vehicle perceives its surroundings. Using ultra-wideband radio it measures the signal travel time to every tag within range and derives the distance from it — accurate to roughly ten centimetres, without a camera and without requiring a clear line of sight. Up to three modules on one vehicle additionally provide the direction.

- Distance measurement to ± 10 cm at ranges of up to 30 m
- Works through racking and walls, and in dust, steam and darkness
- Recognises automatically whether it serves as a locating antenna or as the link to the building infrastructure
- Connection and power through one single cable to the control unit
- Compact industrial housing, protection class IP65
- No camera, no recording of personal data



ICPROX-ANT (902.218) — angled view and bottom with the cable outlet.

2 Connections and controls

Item	Function
Connecting cable	The only connection to the control unit: data and power in one twisted-pair shielded cable
Antenna area	Integrated in the housing; it must be able to radiate freely to the outside
Status indicator	Multi-colour LED inside the unit, visible with the housing opened

Caution: Do not mount the module behind metal, metal mesh or metallised glass — this attenuates the radio link severely, so people are detected late or not at all. Keep a distance of about 10 cm from large metal surfaces.

3 Commissioning

1. **Decide on the number:** One module detects distance in the main viewing direction. Three modules, spread as widely as possible over the vehicle, additionally provide the direction.
2. **Choose the position:** High up, with a clear view outwards, not obscured by roof, mast or load. Keep the distance from large metal surfaces.
3. **Mount the modules:** Bolt the housings firmly in place and note their orientation — it is entered in the web interface later.
4. **Connect:** Wire all modules to the antenna line of the control unit. No separate power supply is required.
5. **Switch on:** The control unit detects the connected modules automatically; their number appears in the web interface.
6. **Enter the positions:** Record the mounting position of each module (longitudinal and lateral offset from the vehicle centre) and verify it with a personal tag.

Tip: With three modules the direction becomes more accurate the further apart they sit. Two antennas mounted close together add hardly any directional information.

4 Operating modes

The module adapts itself to the line it is connected to. There are no switches and no software settings on the device itself.

Connected to	Task
Antenna line	Locating antenna. Measures the distance to every tag within range and reports it to the control unit. One module provides distance, three modules additionally provide direction.
Device line	Infrastructure link. Connects the vehicle by radio to the stationary danger points and gates in the building and passes their requests on to the control unit.

4.1 All-round detection with three modules

With three locating antennas each one measures its own distance to the same tag. From these three values the control unit calculates the direction the person is approaching from. Only this makes it possible to set direction-dependent warning zones — narrower ahead than to the side, for example — and lets the display place people at the right spot on the map.

5 Operating behaviour

5.1 Range and environment

With a clear line of sight, ranges of up to 30 m are achievable. With racking, walls or vehicles in between, the range typically drops to 10 to 20 m; the measurement itself stays reliable, only the covered area becomes smaller. Dust, steam, moisture and darkness have practically no effect.

5.2 Behaviour in case of a fault

If a module fails or its cable is interrupted, the control unit reports this and enters its safety-oriented fallback mode. With three modules the directional information is the first thing to be lost; plain distance monitoring continues as long as the leading antenna is working.

6 Technical data

Property	Value
Part number	902.218
Locating method	ultra-wideband (UWB), 6.5 GHz
Measuring accuracy	± 10 cm
Range	up to 30 m with clear line of sight, typ. 10–20 m in a built-up environment
Modules per vehicle	1 to 3 for locating, optionally 1 for the infrastructure link
Connection	RS485, twisted pair, shielded
Operating mode	selected automatically from the connected line
Power supply	through the connecting cable from the control unit
Housing	compact housing, IP65

7 Troubleshooting

Symptom	Possible cause / remedy
Module is not detected	Check the connecting cable: wires of the pair swapped, loose terminal, or shield not connected
Range clearly too short	Mounting position obstructed (metal, load, driver's roof) — mount the module higher or more freely
Direction on the display is wrong	Check the mounting positions in the web interface; are longitudinal and lateral offset swapped?
Distances fluctuate strongly	Strong reflections in narrow metal aisles. Move the module slightly or adapt the zone sizes
Distance only, no direction	Fewer than three locating antennas are working — check the number in the web interface
Control unit reports fallback mode	A module is not working or its cable is interrupted. Check the wiring, then briefly switch the power off

For further questions our support team will be glad to help: **In-Circuit Solutions GmbH** ·
Boltenhagener Str. 124, 01109 Dresden, Germany · **www.in-circuit.de**

7.1 Related manuals

- ICPROX system overview
- ICPROX-CPU — vehicle control unit
- ICPROX-4R2I — infrastructure module

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ICPROX-CAM

User Manual — rear-area sensor with camera and time-of-flight validation

Document rev. **1.0** Date **2026-09** Part no. **902.238**

1 Product overview

The ICPROX-CAM covers the area behind the vehicle. It detects what radio positioning cannot: positioning recognises people and vehicles by their tag — fixed and uninvolved objects such as pallets, walls and parked trailers carry none.

To do so the camera evaluates two methods together: image processing finds edges, a built-in time-of-flight sensor measures the distance and confirms them. Only what both methods agree on is registered as an obstacle.

- Camera with edge detection, validated by a built-in time-of-flight sensor
- Field of view 100° × 60°, range up to 6 m
- Detects objects without a tag — pallets, walls, parked trailers
- Shown as a semicircle in four sectors on the touch display
- Connection and power over the N-bus — one cable for data and supply
- Set up through the built-in web interface
- Works with the vehicle control unit and with the infrastructure module as a vehicle module
- Can be armed for reversing only
- Protection class IP54, PA12 enclosure



The ICPROX-CAM (902.238), angled view and from above.

2 Connections and controls

Item	Function
Camera aperture	The sensor's line of sight; must stay clear and be cleaned regularly
TOF window	Distance measurement confirming the detected edges
Device line	Connection to the system N-bus: 24 V, A, B, GND — data and power in one cable

Caution: Rear-area sensing assists the driver; it does not relieve them of their duty of care. It can only detect what lies within the camera's field of view; concealed, very low or reflective objects may go undetected. Responsibility for how the vehicle is driven remains with the driver.

3 Commissioning

1. **Choose the position:** High at the rear of the roof if one camera is to cover the whole rear area — or left and right on the counterweight if the view from the roof is not enough or the vehicle is wide.
2. **Align it:** The field of view is $100^\circ \times 60^\circ$. Tilt the camera so that the area immediately behind the vehicle is in the picture, not the floor far away.
3. **Connect:** Wire the device line to the N-bus (24 V, A, B, GND). No separate power supply is needed.

4. **Enable it:** Activate rear-area sensing in the control unit. There you can also specify that it acts only when reversing.
5. **Set it up:** Define sectors, thresholds and sensitivity through the built-in web interface (section 4).
6. **Check:** Place an obstacle behind the vehicle and reverse towards it. The sector concerned must appear on the display in the colour of the reduction level that applies.

4 Configuration

The camera has its own web interface. The sectors, the trigger thresholds and the sensitivity of the detection are set there. No additional program is required.

What a detected obstacle actually does on the vehicle is set in the control unit instead: the action matrix holds, under the source **rear area**, which relay is pulled at which reduction level.

Note: Arming for reversing only is evaluated through a logic input — both the vehicle control unit and the infrastructure module used as a vehicle module can read this input. The system then evaluates the camera only once reverse gear is engaged.

5 Behaviour in operation

5.1 What the driver sees

The touch display shows the rear area as a **semicircle in four sectors**. Each sector carries the colour of the reduction level currently applying to it. That shows at a glance **where** something is behind the vehicle, not merely that something is.

5.2 State of the camera

Field R	Meaning
Green	The camera is working
Yellow or red	Fault or error
Grey	No camera installed

Field **R** is part of the three-part status display N · P · R on the screen.

6 Technical data

Feature	Value
Part number	902.238
Method	camera with edge detection, validated by time-of-flight ranging
Field of view	100° × 60°
Range	up to 6 m
Indication	semicircle in four sectors on the touch display
Setup	built-in web interface
Connection	N-bus (24 V, A, B, GND)
Power supply	8–24 V DC
Power consumption	approx. 1.5 W
Dimensions (L × W × H)	60 × 50 × 30 mm
Weight	45 g
Material	PA12
Colour	black
Protection class	IP54
Operating temperature	0 ... 70 °C
Conformity	CE to RED 2014/53/EU, RoHS

7 Troubleshooting

Symptom	Possible cause / remedy
Field R stays grey	Rear-area sensing is not enabled in the control unit, or the camera is not connected to the N-bus
Field R yellow or red	Fault: check the N-bus wiring and terminals (24 V, A, B, GND)
No sector changes colour	The obstacle is outside the field of view or the range, or sensing is restricted to reversing and reverse gear is not engaged
Sectors colour with no obstacle	The camera points at the floor far away or at a solid wall — correct the tilt; adjust the sensitivity in the web interface
Detection is getting worse	Camera aperture and TOF window are dirty — clean them
No relay switches	No action is assigned in the action matrix under the source rear area

For further questions our support team will be glad to help: **In-Circuit Solutions GmbH** ·
Boltenhagener Str. 124, 01109 Dresden, Germany · **www.in-circuit.de**

7.1 Related manuals

- ICPROX system overview
- ICPROX-CPU — vehicle control unit
- ICPROX-Display — touch display
- ICPROX-4R2I — infrastructure module

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ICPROX-Tag

User Manual — The wearable transmitter by which the system detects people and vehicles

Document rev. **1.1** Date **2026-09** Part no. **902.214 · 902.214B**

1 Product overview

The ICPROX tag is the counterpart to the vehicle equipment: it makes whoever carries it visible to the system. Vehicles fitted with ICPROX-P continuously measure the distance to every tag within range and derive their reaction from it — warning, speed limitation or stop. The tag itself has neither buttons nor a display in the usual sense; it is charged, handed out and worn.

- Ultra-wideband radio (6.5 GHz) — measures distances to about 10 cm
- Works through racking, walls, dust and steam; no line of sight required
- Warns the wearer as well — by vibration and an audible signal
- More than 48 hours of continuous operation on one charge
- No controls, nothing to set, nothing to mix up
- Records no position data and no personal data

1.1 Two sizes

The tag comes in two sizes. Both measure by the same method and to the same accuracy; they differ in size and battery capacity. The smaller **Tag S** is meant for the wrist, the larger tag for a vest, belt or lanyard.

Feature	ICPROX tag	ICPROX Tag S
Part number	902.214	902.214B
Dimensions (L × W × H)	46 × 43 × 16 mm	40 × 35 × 13 mm
Weight	33 g	28 g
Battery	LiPo 1000 mAh	LiPo 450 mAh
Runtime	over 48 h continuous	shorter, in line with the smaller cell
Charging	cradle 902.237	cradle 902.237A001
Worn	vest, belt, lanyard	wrist



Left, the ICPROX Tag S (902.214B); right, the charging cradle from above — four places side by side.



ICPROX tag (902.214) — sealed housing without controls. The indicator strip on the front shows the operating state; the label carries the device number.

Important: The system only detects people who are carrying a switched-on tag. Anyone without a tag is not picked up by the radio locating. The ICPROX tag assists the driver but replaces neither care nor the site's traffic rules.

2 Indicators and signals

The tag has no buttons and no switch. Everything it communicates goes through the indicator strip on the front and through vibration and an audible signal:

Signal	Meaning
Green, short pulse	Normal operation — the tag is awake and seen by the system
Red, slowly brightening	The tag is in the charging cradle and charging
Red, permanently on	Charging complete — the tag can be removed
Red, short flashes during operation	Battery low, charge the tag soon
Vibration and audible signal	A vehicle has come within the warning distance — pay attention
No indication at all	Battery empty or tag switched off — place it in the charging cradle

Note: On the vehicle and AGV tag the vibration is switched off — there is nobody there to feel it (chapter 4).

3 Commissioning

1. **Charge:** Place the tags in the charging cradle and connect its USB socket to a power supply. The red indicator slowly brightens — the tag is charging. When it stays lit permanently, the tag is full.
2. **Hand out:** Every tag carries a printed device number. Assign that number to a person or a vehicle and record the assignment — it appears later in the device list on the vehicle display.
3. **Wear it:** Carry the tag visibly and unobstructed on the body, on the high-visibility vest or on the belt. Not in a trouser pocket and not under metal — both weaken the radio signal.
4. **Verify:** Start a vehicle equipped with ICPROX-P and approach it. The tag must appear in the device list on the display, and vibration and the audible signal must start when the warning distance is undercut.
5. **Return it:** At the end of the shift the tag goes back into the charging cradle. There it does not measure, it charges.

Charging cradle: Four tags stand side by side in the base, powered through a USB-C socket on its side. An ordinary USB power supply is enough; no computer is required. Each size has its own cradle: **902.237** for the ICPROX tag, **902.237A001** for the Tag S. The cradles are identical apart from the recesses; the tags do not fit the other cradle.

4 Roles

All tags are identical in construction. What an individual tag represents is defined by its **role**, which is stated when ordering and set at the factory. On the vehicle display every role appears with its own symbol, so the driver sees at a glance whether a person or another vehicle is approaching.

Role	Carried by	Particularity
Personal tag	Employees, visitors, contractors	Warns the wearer as well, by vibration and audible signal
Vehicle tag	Vehicles without ICPROX equipment of their own	Makes the vehicle visible to equipped vehicles; no vibration
AGV tag	Automated guided vehicles	Like the vehicle tag, with its own symbol on the display

Vehicle tag or vehicle unit? A vehicle tag only makes a vehicle *visible* — it does not react itself. If the vehicle is also to respond to danger points and gates, it needs an ICPROX-4R2I as its vehicle unit or a complete ICPROX-P system. The comparison is given in the ICPROX system overview.

5 Operating behaviour

5.1 Battery life

One charge lasts for more than 48 hours of continuous operation. How long it actually lasts depends above all on **how much the tag has to do**: the dominant consumer is not transmitting but listening. A tag in dense traffic, constantly with several vehicles within range, uses noticeably more than one that spends most of its time alone in the warehouse. In practice this means a tag comfortably lasts a full shift, usually several.

It has proven best to return the tags to the charging cradle at the end of every shift — then the question of remaining charge never arises during operation.

5.2 In the charging cradle

A tag in the charging cradle **does not measure**. It withdraws from radio traffic so that it does not show up in the building as a supposed person, and devotes itself to charging. The cradle is therefore also the parking place: whoever is not carrying a tag is not in the system.

5.3 Range and environment

With a clear line of sight the tag reaches around 30 m, in a built-up environment typically 10 to 20 m. Racking, walls, dust and steam weaken the signal but do not interrupt it — unlike a camera or a light barrier, the measurement stays valid without any line of sight. What does have a noticeable effect is immediate shielding by metal or by the wearer's own body; hence the advice to carry the tag unobstructed.

5.4 Firmware updates in the field

The tag receives new firmware over the air, without a cable and without opening the housing: using the **ICPROX-OTABRIDGE** USB transmitter stick (902.081A001). The tag is briefly restarted for this (e.g. docked in and removed from its charging cradle) and accepts the update during its start-up window. Procedure and tool are described in the ICPROX-OTABRIDGE manual.

6 Technical data

Property	Value
Part number	902.214 (tag) · 902.214B (Tag S)
Locating method	Ultra-wideband (UWB), 6.5 GHz
Measuring accuracy	±10 cm
Range	up to 30 m line of sight, typ. 10–20 m in a built-up environment
Measurement rate	about 4 measurements per second
Battery	lithium polymer, permanently fitted — 1000 mAh (tag) · 450 mAh (Tag S)
Operating time	more than 48 h continuous for the tag, depending on load; shorter for the Tag S in line with its smaller cell
Charging	through cradle 902.237 (tag) or 902.237A001 (Tag S) — four bays, USB-C on the side, 220 mA charging current per bay
Dimensions (L × W × H)	46 × 43 × 16 mm (tag) · 40 × 35 × 13 mm (Tag S)
Weight	33 g (tag) · 28 g (Tag S)
Indication	indicator strip, red / green
Signalling	vibration and buzzer (depending on role)
Controls	none
Data protection	no camera, no recording of personal data

Battery: The lithium polymer battery is permanently fitted and is not user-replaceable. Do not open the tag, do not store it above 45 °C and do not continue using it with a damaged housing. Retired tags belong in electrical waste collection, not in general refuse.

7 Troubleshooting

Symptom	Possible cause / remedy
Tag does not appear in the vehicle's device list	Is the tag charged? Has it been taken out of the cradle? In the cradle it deliberately withdraws. Otherwise: reduce the distance and check whether the indicator pulses green
Tag is only detected intermittently	The tag is being shielded — do not carry it in a trouser pocket, under a jacket or behind metal. Unobstructed on a vest or belt is the most reliable
No vibration although the vehicle reacts	On vehicle and AGV tags the vibration is switched off at the factory. On a personal tag: check the battery level
Indicator stays dark in the charging cradle	Check that the tag is seated properly, keep the contacts dry and clean; test the USB power supply and cable
Operating time clearly below 48 h	Normal in very dense traffic — the tag then measures continuously against many vehicles. If it persists in quiet operation too, have the tag checked
Reaction starts too late	Not a tag issue: the switching points are set on the vehicle. See the control unit manual

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7.1 Related manuals

- ICPROX system overview
- ICPROX-CPU — vehicle control unit
- ICPROX-Display — touch display
- ICPROX-ANT — UWB antenna
- ICPROX-OTABRIDGE — radio update stick

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ICPROX-4R2I

User Manual — Infrastructure module for danger points, gates and vehicles

Document rev. **1.0** Date **2026-08** Part no. **902.199B**

1 Product overview

The ICPROX-4R2I makes any spot in a building capable of protecting itself: mounted at a junction, a gate or a danger point, it detects vehicles within an adjustable radius by ultra-wideband radio and reacts immediately — with a beacon, a horn, a barrier, or by slowing the vehicle down itself. The very same device can also be fitted to a vehicle, where it carries out the requests coming from the danger points.

- Four operating modes, set with slide switches alone — no PC, no software
- Detection radius adjustable in steps from 1.5 to 19 m
- Four volt-free relay outputs and two inputs for volt-free contacts
- Eight-way indicator strip with four selectable display styles
- Works autonomously by radio — no cable to the vehicle is needed
- Groups make sure that only the intended vehicles react



ICPROX-4R2I (902.199B) with its eight-way indicator strip — top and angled view.

1.1 The four operating modes

Mode	Application
SPOT — danger point	Stationary at a hazardous location. Detects vehicles within the set radius, switches the local relays and requests a reduction from the vehicle
GATE — zone transition	At gates and zone boundaries. Acts like a danger point and additionally hands the vehicle the zone it is entering beyond the gate
TAG — vehicle unit	Fitted to a vehicle. Receives the requests from the danger points and carries them out through its own relays — a self-contained vehicle solution, with no further devices on the vehicle
EXTRA — cable operation	Without radio locating: the inputs switch the relays, and every device connected by cable adopts the same state

The small vehicle system: If a vehicle only needs to respond to the infrastructure — danger points, gates, zones — a single 4R2I as its vehicle unit is all it takes. Towards spots and gates it does the same job as the full vehicle equipment of control unit, display and antennas; those are only needed once people, AGVs or other vehicles are to be detected as well. Make the decision deliberately: on a later upgrade to the full system, the 4R2I on the vehicle cannot be reused. The configurator at www.in-circuit.de/icprox puts exactly this question first.

2 Connections and controls

Item	Function
Supply 24 V DC	Its own supply; the device needs no connection to a vehicle
Relays R1–R4	Four volt-free contacts; their assignment depends on the operating mode (section 5.2)
Inputs IN1, IN2	Two inputs for volt-free contacts, switched to GND — e.g. a gate-open contact, a push-button, or the relay output of a light barrier or induction loop. Do not apply any voltage.
Indicator strip	Eight-way multi-colour indicator, connected with three wires; display style selectable (section 5.3)
Slide switches S1–S4	Four blocks of four switches carrying the entire configuration. Order on the board from left to right: S4 – S3 – S2 – S1
Device line	Links several modules to each other and connects an ICPROX-SEC access control unit

Caution: The ICPROX-4R2I is an extra-low-voltage device (24 V DC, SELV/PELV). Its four relay contacts must only switch extra-low-voltage loads. Mains-powered equipment such as beacons, horns, barriers or gate drives must be driven through an interposing relay or contactor. Only change the switch settings with the power switched off.

3 Commissioning in six steps

1. **Select the operating mode:** Set SPOT, GATE, TAG or EXTRA on switches S1.1 and S1.2 (section 4.1) — with the power switched off.
2. **Set the range:** Set the required detection radius on block S2 (section 4.2). When in doubt start small and extend it later.
3. **Build gates in pairs:** A gate consists of two units, one per side, each with the gate level of its side. Both get the **same device group**; every further gate a different one.
4. **Choose group and special functions:** On blocks S3 and S4 define the device group, the behaviour of relay R4, the spot function and the display style (sections 4.3 and 4.4).
5. **Mount the unit:** As high as possible with a clear view of the area to be monitored, and not directly behind metal or metal mesh.
6. **Wire it up:** Connect supply, relay outputs and inputs. Mains loads only through an interposing relay. IN1 and IN2 take volt-free contacts only — do not apply any voltage.
7. **Check:** Switch the power on and drive a vehicle through the area. The indicator strip shows at what distance the unit responds; adjust the radius afterwards if required.

Tip: The switch settings are read at power-up. After every change, briefly switch the power off — otherwise the unit keeps running with the previous setting.

4 Configuration with the slide switches

Four blocks of four switches define the entire behaviour. On the board they run from left to right in the order **S4 – S3 – S2 – S1**; within a block, switch 1 sits on the right and switch 4 on the left. An illustrated configuration aid showing every combination as a switch picture is available at wiki.in-circuit.de/icprox/dipsw_4r2i.html.

4.1 Operating mode and mode options (S1)

Switch	Setting
S1.1 / S1.2	Operating mode: both OFF = SPOT · S1.1 ON = TAG · S1.2 ON = GATE · both ON = EXTRA
S1.3 in SPOT	Inner reduction: below half the distance the vehicle is reduced by +2 instead of +1 — explained in detail in section 8
S1.4 in SPOT	Short range: base radius 1.5 m instead of 4 m for confined areas
S1.3 in TAG	Relays R1–R3 as normally-closed contacts — they also drop out on a broken wire (tamper-proof)
S1.4 in TAG	Enable the ICPROX-SEC access control on the vehicle
S1.3 / S1.4 in GATE	Gate level 0 to 3: the zone number the vehicle adopts when passing through. Gates with level 2 or 3 additionally reduce vehicles to level 2 or 3 below half the distance. A gate needs two units carrying the levels of both sides

4.2 Detection radius (S2)

The four switches of block S2 add up on top of the base radius of 4 m (or 1.5 m with short range selected):

Switch	Added range	Example
S2.1	+8 m	S2.2 and S2.3 switched on give +6 m, which together with the base radius makes a detection radius of 10 m
S2.2	+4 m	
S2.3	+2 m	
S2.4	+1 m	

In **EXTRA** mode block S2 has a different meaning: **only S2.1 alone** switched on selects

high-active cable operation, **only S2.2 alone** selects low-active. With **any other S2 position**

— all off, S2.3 or S2.4 on, or any combination — the unit performs a factory reset at power-up and discards all stored settings including the zone.

Caution: In EXTRA mode, every S2 position other than "S2.1 only" or "S2.2 only" triggers the factory reset at power-up and erases the stored settings irreversibly. Check the S2 position carefully before switching on.

4.3 Relay R4 and groups (S3)

Switch	Setting
S3.1 / S3.2 in SPOT and GATE	Behaviour of R4 — switched by the button on the vehicle (IN2) or on the access module: both OFF = unused · S3.1 ON = a button press switches R4 on, it stays on while the vehicle remains within range and releases automatically afterwards · S3.2 ON = R4 operates while the button is held
S3.3 / S3.4 in SPOT and GATE	Device group 0 to 3 — decides which vehicles respond to this danger point. In GATE mode it also identifies the gate: both units of one gate must carry the same group, different gates different ones
S3.1 – S3.4 in TAG	Group filter: one switch per group the vehicle responds to. All switches OFF means: respond to every group. With access control enabled (S1.4) the groups come from the access module — the filter then has no effect

Important with several gates: Each gate gets its own device group, both units of one gate share it. Otherwise the vehicle compares gates belonging to different gates and adopts a zone that does not match its position. Set the vehicles to "all groups" (filter S3.1–S3.4 all OFF) so they see every gate.

Tip: Groups separate types of traffic — forklifts from tow trains, for example. A danger point in group 1 lets vehicles whose filter only accepts group 2 pass without reacting.

4.4 Spot function and display style (S4)

Switch	Setting
S4.1 / S4.2	Spot function — relays R1–R3 and the indicator strip switch identically in all four settings; the only difference is whether and when vehicles are reduced: both OFF = normal operation (every vehicle within the radius is reduced) · S4.1 ON = no vehicle reduction (vehicles pass unaffected — for signalling only, or during commissioning) · S4.2 ON = SmartPass (early release as the vehicle moves away) · both ON = TwinProx (reduction only from two vehicles onwards) — details in section 5.1
S4.3 / S4.4	Display style of the indicator strip: both OFF = simple · S4.3 ON = graded · S4.4 ON = states · both ON = running light (section 5.3)

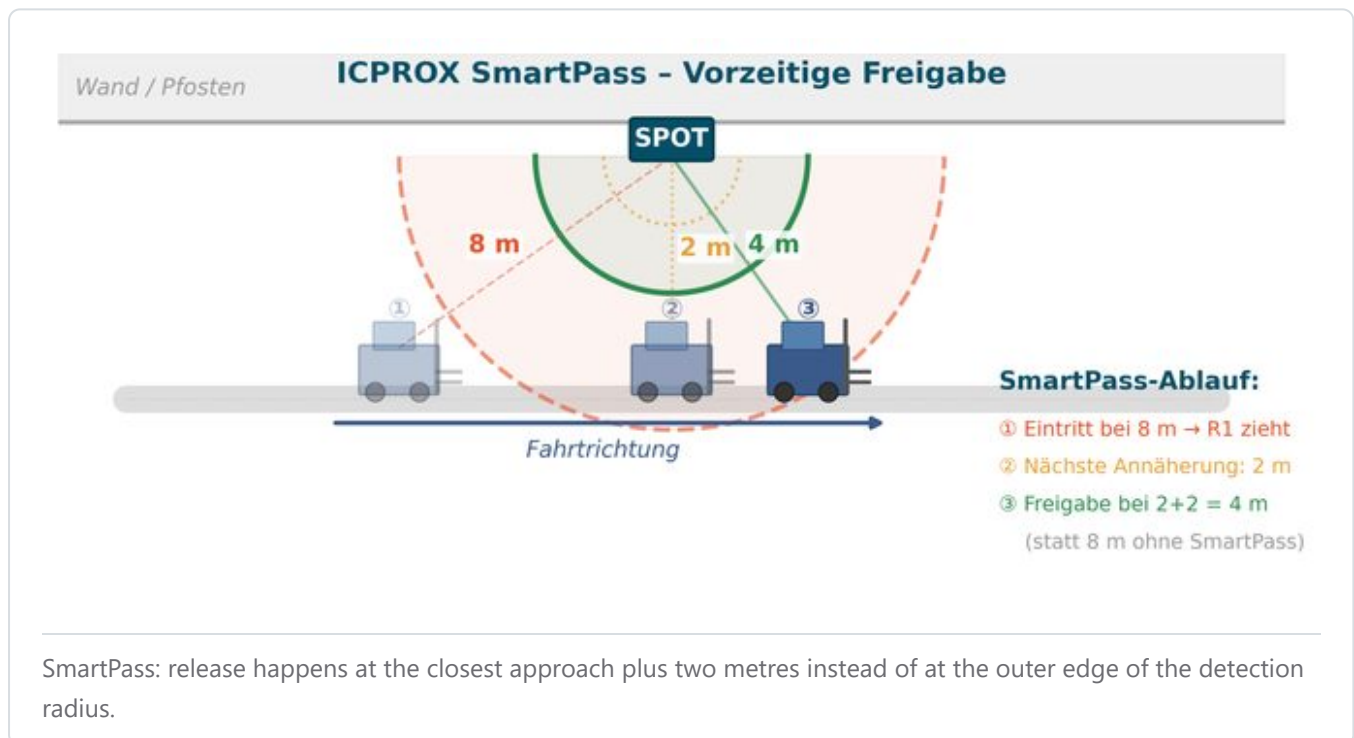
5 Operating behaviour

5.1 The spot function: SmartPass and TwinProx

The spot function (S4.1/S4.2) does not change the local behaviour of the unit: relays R1–R3 and the indicator strip switch in every setting exactly as described in section 5.2. It only determines **whether and when the vehicles themselves are reduced** — in normal operation every vehicle within the radius, with "no vehicle reduction" none of them, and with SmartPass and TwinProx according to the rules below.

SmartPass releases a vehicle as soon as it is clearly moving away — rather than only once it has left the full radius. The unit remembers how close the vehicle came and lifts the reduction as soon as it has moved two metres further away than that. With a radius of eight metres and a closest approach of two metres, the reduction therefore ends at four metres already. Vehicles can accelerate again much earlier past the danger point.

Two properties matter here: the early release affects **the vehicle only** — the local relays and the indicator strip of the danger point keep working unchanged. And if a released vehicle approaches again by one metre, the reduction resumes immediately.



TwinProx distinguishes how many vehicles are in the detection area at the same time: R1 operates on the first vehicle as an early warning, R2 only from the second one onwards — which is exactly the situation that makes a junction dangerous. As long as only one vehicle is present, no reduction is sent to it either — the single vehicle passes unhindered while the local early warning runs; only with two or more vehicles are they actually reduced.



Version in a mirror housing (902.200A001) with an all-round indicator: green with at most one vehicle, red as soon as two vehicles are at the junction together. The driver sees the mirror image and the signal in one glance.

5.2 Relays and inputs per operating mode

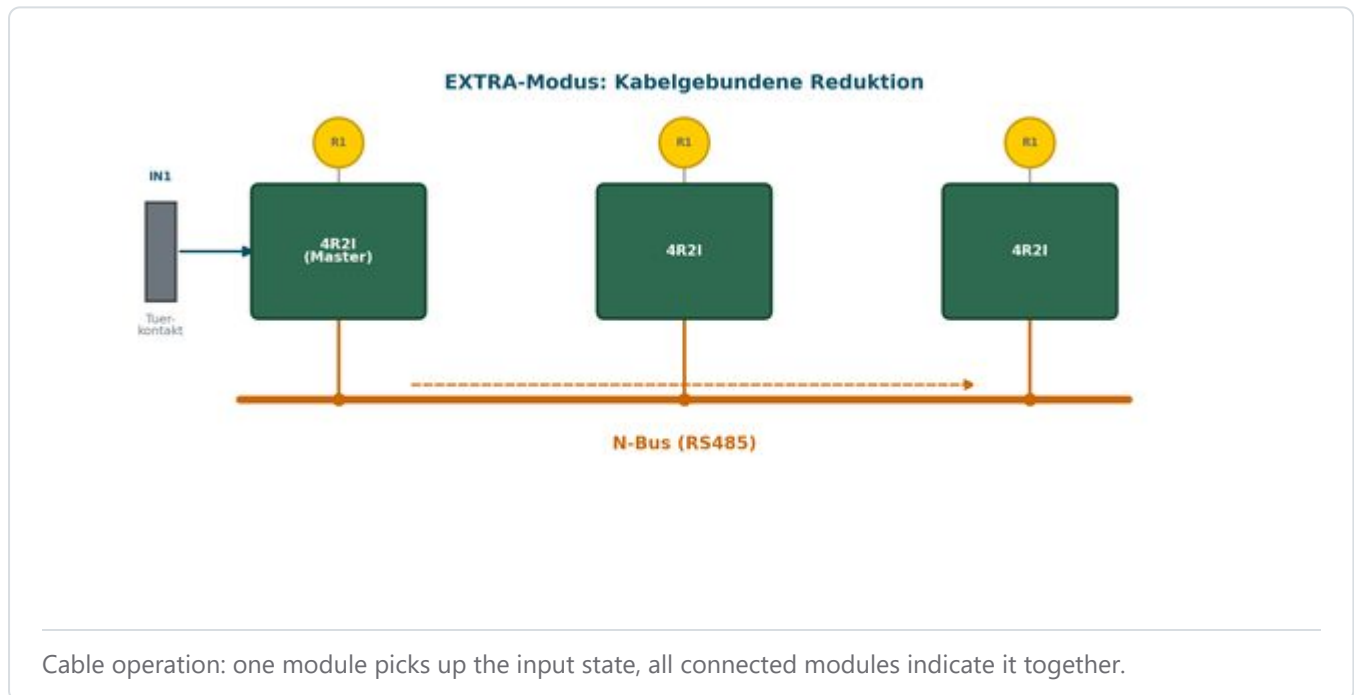
Terminal	SPOT / GATE	TAG (vehicle)	EXTRA
R1	Vehicle detected within the full radius	operates from reduction level 1	follows input IN1
R2	With TwinProx from the second vehicle onwards, otherwise same as R1	operates from level 2 — in addition to R1	follows input IN2
R3	Vehicle within half the distance	operates at level 3 — in addition to R1 and R2	not used
R4	Switched by the button on the vehicle or on the access module, behaviour set with S3.1/S3.2	Switched remotely by the nearest danger point while its IN2 is active	operates on IN1 or IN2
IN1	Suppresses the spot function while active — e.g. a gate-open contact	Triggers the highest reduction (R1–R3 all active, R4 drops out)	control input 1
IN2	Switches relay R4 on every vehicle within range	Reports the button state to the nearest danger point	control input 2

5.3 Indicator strip

Display style	Presentation
Simple	The colour of the whole strip shows the current reduction level — green, yellow, red
Graded	As "simple", with an additional moving indication of the approach
States	Each dot represents one relay or input — the right choice for commissioning and fault finding
Running light	Circulating animation for round housings and mirror versions

5.4 Cable operation (EXTRA)

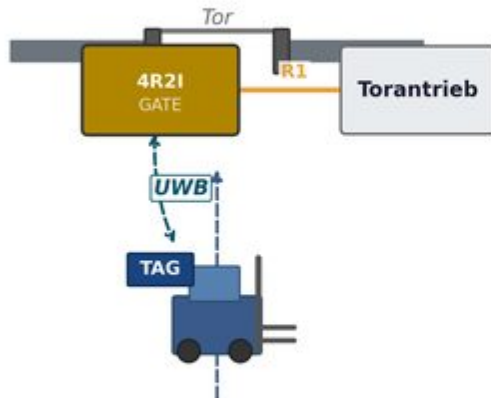
In cable operation the unit works without radio locating: the two inputs switch the relays directly, and every module connected through the device line adopts the same state. An open door contact can thus switch on all the warning lights in a zone at once. Whether the inputs respond to a closed or to an open contact is selected on block S2 — matching either normally-open or normally-closed switches.



5.5 Wiring examples

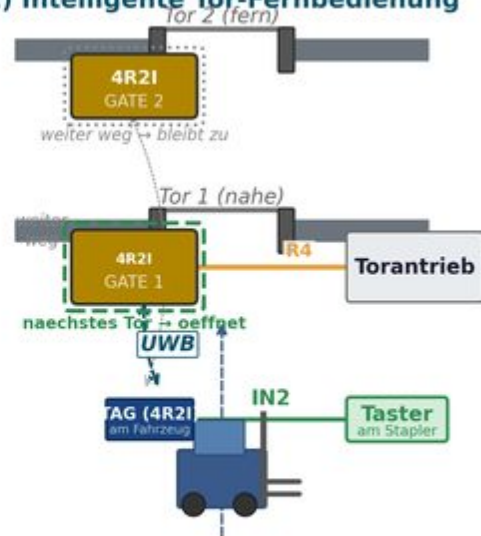
ICPROX-4R2I Verdrahtungsbeispiele

1) Tor oeffnet bei Annaeherung



TAG naehert sich → GATE misst Distanz
→ R1 zieht → Tor oeffnet automatisch
→ TAG entfernt sich → R1 faellt ab

2) Intelligente Tor-Fernbedienung

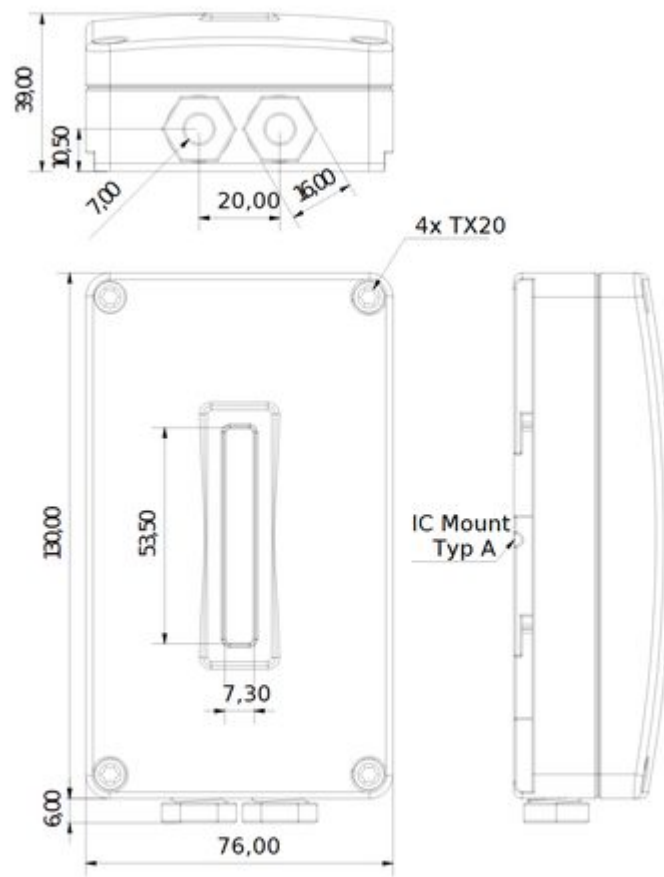


Fahrer drueckt Taste → IN2 am TAG
→ per UWB nur an naechstes GATE
→ R4 zieht → Tor oeffnet

Top: a gate opens as soon as an authorised vehicle approaches (R1). Bottom: the driver opens the gate with a button on the vehicle — the button state is transmitted by radio to the danger point, where it operates the relay.

6 Technical data

Property	Value
Part number	902.199B
Locating method	ultra-wideband (UWB), 6.5 GHz
Detection radius	1.5 m – 19 m, adjustable in steps
Range	up to 30 m with clear line of sight, typ. 10–20 m in a built-up environment
Operating modes	SPOT, GATE, TAG, EXTRA
Relay outputs	4 × volt-free, extra-low voltage only (SELV/PELV)
Inputs	2 × for volt-free contacts to GND
Indication	8 × multi-colour LED, four display styles
Configuration	4 switch blocks of 4 switches each, no PC required
Groups	4 device groups, usable as a filter on the vehicle
Power supply	24 V DC, its own supply
Accessories	ICPROX-SEC access control, version in a mirror housing (902.200A001)
Housing	industrial design, IP65



Dimensional drawing of the ICPROX-4R2I.

7 Troubleshooting

Symptom	Possible cause / remedy
Unit does not react to vehicles	Check operating mode and radius; select the "states" display style and watch whether anything is detected at all
Changing the switches has no effect	The setting is only read at power-up — briefly switch the power off
Only certain vehicles react	The device group at the danger point and the group filter on the vehicle do not match
Zone does not change when passing through	A gate needs two units, and the vehicle must see both. Check that both carry the same device group (S3.3/S3.4) and that the radius reaches beyond the gate
Zone changes unexpectedly somewhere else	Two gates share the same device group — gates of different gates are then compared with each other. Give every gate its own group
Range clearly too short	Mounted behind metal or mesh; fit the unit higher and more freely
Reduction stays active for too long	Switch SmartPass on (S4.2) — release then happens as the vehicle moves away instead of at the outer edge
R2 never operates	TwinProx is active and only one vehicle is in the area — this is the intended behaviour
Spot function has no effect	IN1 is permanently active and suppresses the spot function — check the wiring
Relay operates but the load stays off	The contacts are volt-free and do not switch mains voltage — fit an interposing relay or contactor
Settings unexpectedly reset	EXTRA mode with any S2 position other than exactly "S2.1 only" or "S2.2 only" performs a factory reset at power-up

For further questions our support team will be glad to help: **In-Circuit Solutions GmbH** · Boltenhagener Str. 124, 01109 Dresden, Germany · www.in-circuit.de

7.1 Related manuals

- **Configuration aid for the slide switches**
- Printable quick-reference leaflet (folds to pocket size, included with every unit)
- ICPROX system overview
- ICPROX-SEC — access control
- ICPROX-CPU — vehicle control unit

8 Terms explained

The key terms of this manual at a glance. The corresponding switch settings are described in chapter 4, the operating behaviour in chapter 5.

Reduction level

System-wide levels 1 to 3 used to slow a vehicle down: typically level 1 = warning, level 2 = braking, level 3 = stopping. The relays on the vehicle unit operate cumulatively — at level 2, R1 and R2 are engaged, at level 3, R1 through R3. The highest level that currently applies always wins; requests from several sources add up to at most level 3.

Inner reduction (S1.3 in SPOT mode)

A spot requests a reduction from every vehicle within its detection radius. Without inner reduction this request is **+1** throughout the radius — the vehicle is switched one level stricter than the rest of its surroundings currently demand. With inner reduction enabled, the outer half stays at +1, while below **half the distance** the spot requests **+2**. This creates a two-stage protective ring around the danger point: restrained on the outside (say, a warning), decisive on the inside (say, braking).

Example with an 8 m radius: between 8 and 4 m the vehicle is reduced by one level, below 4 m by two levels. The spot's local relay R3 operates at half the distance regardless of this setting.

Spot function

Determines whether and when the vehicles are reduced — normal operation, no vehicle reduction, SmartPass or TwinProx. The local relays and the indicator strip switch identically in all four settings (section 5.1).

SmartPass

Early release as the vehicle moves away: the spot remembers the vehicle's closest approach and lifts its reduction as soon as it has moved two metres beyond that point — instead of only at the outer edge of the radius. If the vehicle approaches again by one metre, it is reduced once more.

TwinProx

Reduction only with two or more vehicles in the detection area at the same time — the situation that makes a junction dangerous. A single vehicle passes freely while R1 operates locally as an early warning; R2 and the vehicle reduction follow from the second vehicle onwards.

Gate level and zone

A gate marks a zone transition. Its level (0 to 3) is the zone number the vehicle adopts when passing through; gates with level 2 or 3 additionally reduce vehicles to level 2 or 3 below half the distance.

A gate always consists of **two units** — one per side, each carrying the zone number of its side. The vehicle compares their distances and adopts the zone of the nearer one; this is how the direction of travel through the gate is derived. A single gate therefore does **not** trigger a zone change.

Device group

Four groups separate types of traffic. A danger point belongs to exactly one group; on the vehicle the group filter defines which groups it responds to. This allows, say, tow trains to pass a forklift spot without reacting.

On gates the group serves a **second purpose**: it identifies which two units belong to the same gate. The vehicle only ever compares gates of the **same group** with each other. In a site with several gates, **each gate therefore gets its own device group**, and both units of one gate share it.

Detection radius

The distance from which a spot or gate detects vehicles: base radius 4 m (1.5 m with short range) plus the additions set on block S2, up to 19 m. The figure applies to a clear line of sight — racking, walls and vehicles reduce the range.

ICPROX-4R2I

Configuration aid — setting the slide switches, without a PC and without software

Document rev. **1.0** Date **2026-08** Part no. **902.199B** Supplement to the user manual

1 How to use this page

The entire behaviour of the ICPROX-4R2I is held in four switch blocks of four switches each. This page saves you the arithmetic: in the configurator (section 2) you choose in plain words what the unit should do, and immediately get the matching switch picture to compare against.

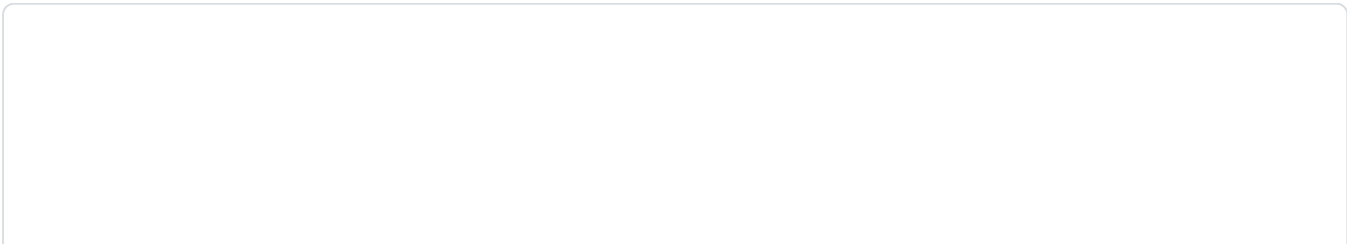
- On the board the blocks run from left to right in the order **S4 – S3 – S2 – S1**.
- The four switches of a block are numbered **1** to **4** on the block itself — switch **1** on the right, switch **4** on the left.
- Switch up (towards the printed **ON**) means **on**, down means **off**.

Block	Defines
S1	Operating mode (SPOT, GATE, TAG, EXTRA) and the options belonging to it
S2	Detection radius in SPOT and GATE · in EXTRA the variant of cable operation
S3	Behaviour of relay R4 and device group · in TAG the group filter
S4	Spot function (SmartPass, TwinProx) and display style of the indicator strip

Tip: The switch positions are only read at power-up. Set them first, then apply power — and briefly switch the power off after every change.

2 Configurator

Select the operating mode, then the options. The switch picture below always shows the setting to be transferred to the unit.





Operating mode	SPOT — danger point
Detection radius	4 m
Vehicle reduction	+1 across the whole radius
Device group	0
Relay R4	unused
Spot function	normal operation — reduces every vehicle within the radius
Indicator strip	simple

Note for printing: The selection buttons are hidden in print; the switch picture and the summary of the last setting remain. A finished configuration can thus be printed as a sheet to accompany the installation.

3 All settings at a glance

3.1 Operating mode (S1.1 and S1.2)

S1.1	S1.2	Mode	Application
off	off	SPOT	Danger point: detects vehicles within the set radius and reacts locally
on	off	TAG	Vehicle unit: carries out the requests of the danger points through its own relays
off	on	GATE	Zone transition: like SPOT, and additionally hands the vehicle its zone
on	on	EXTRA	Cable operation without radio locating — or factory reset

3.2 Mode options (S1.3 and S1.4)

Mode	S1.3	S1.4
SPOT	Inner reduction: below half the distance the vehicle is reduced by +2 instead of +1 — detailed explanation	Short range: base radius 1.5 m instead of 4 m
GATE	Gate level 0 to 3: off/off = 0 · on/off = 1 · off/on = 2 · on/on = 3. The vehicle adopts the level as its zone number; levels 2 and 3 additionally reduce vehicles to level 2 or 3 below half the distance	
TAG	Relays R1–R3 as normally-closed contacts (tamper-proof)	Evaluate the ICPROX-SEC access control
EXTRA	no function	

3.3 Detection radius (S2, SPOT and GATE only)

Switch	Added to the base radius
S2.1	+8 m
S2.2	+4 m
S2.3	+2 m
S2.4	+1 m

Base radius 4 m, or 1.5 m with short range. The switches that are on add up — all four on gives 4 m + 15 m = 19 m.

3.4 Relay R4 and groups (S3)

Mode	Switch	Meaning
SPOT / GATE	S3.1 / S3.2	Relay R4 — switched by the button on the vehicle (IN2) or on the access module: both off = unused · S3.1 on = a button press switches it on, R4 holds while the vehicle remains within range and releases automatically afterwards · S3.2 on = R4 operates while the button is held
	S3.3 / S3.4	Device group 0 to 3: off/off = 0 · on/off = 1 · off/on = 2 · on/on = 3. In GATE mode it also identifies the gate: both units of one gate share a group, every further gate uses a different one
TAG	S3.1 – S3.4	Group filter: one switch per group the vehicle responds to. All off = respond to every group. With access control (S1.4 on) the groups come from the access module — the filter has no effect

3.5 Spot function and indicator strip (S4)

Switch	Meaning
S4.1 / S4.2	Spot function — the relays and the indicator strip switch identically in all four settings; it only determines whether and when vehicles are reduced: both off — normal operation: every vehicle within the radius is reduced S4.1 on — no vehicle reduction: vehicles pass unaffected; the unit signals and switches locally only (e.g. warning light, counting, commissioning) S4.2 on — SmartPass: release already as the vehicle moves away (closest approach + 2 m); if it approaches again by 1 m, it is reduced once more both on — TwinProx: reduction only with two or more vehicles at the same time; a single vehicle passes freely while R1 operates locally as an early warning, R2 from two vehicles
S4.3 / S4.4	Indicator strip: both off = simple · S4.3 on = graded · S4.4 on = states · both on = running light

3.6 Cable operation and factory reset (EXTRA)

S2.1	S2.2	Effect
on	off	Cable operation high-active: the inputs respond when the contact is open (normally-closed switch, e.g. a safety door). S2.3 and S2.4 must be off
off	on	Cable operation low-active: the inputs respond when the contact is closed (normally-open switch, e.g. a limit switch). S2.3 and S2.4 must be off
any other position		Factory reset — all stored settings including the zone are erased at power-up

Caution: In EXTRA mode, every S2 position other than "S2.1 only" or "S2.2 only" triggers the factory reset at power-up and erases the stored settings irreversibly. Check the S2 position carefully before switching on.

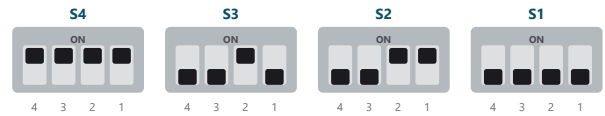
4 Four typical settings

Danger point, 10 m



- S1: all off — SPOT, base radius 4 m
- S2.2 + S2.3 on — +6 m, giving a 10 m radius
- S3: all off — R4 unused, group 0
- S4.4 on — indicator strip shows states

Junction with signal (TwinProx)



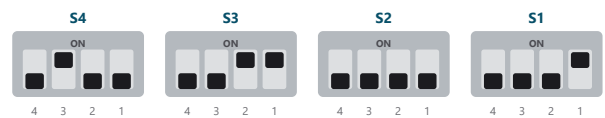
- S1: all off — SPOT
- S2.1 + S2.2 on — +12 m, giving a 16 m radius
- S3.2 on — R4 as a maintained switch for the signal
- S4.1 + S4.2 on — TwinProx · S4.3 + S4.4 on — running light

Gate as zone transition, zone 2



- S1.2 + S1.4 on — GATE, zone number 2
- S2.1 on — +8 m, giving a 12 m radius
- S3.1 on — R4 by button, self-holding · S3.3 on — group 1
- S4: all off — indicator strip simple

Vehicle unit, groups 0 and 1



- S1.1 on — TAG
- S2: no meaning
- S3.1 + S3.2 on — responds to groups 0 and 1
- S4.3 on — indicator strip graded

5 Notes

- Only change the switches with the power off; the setting is read at power-up.
- The detection radius applies to a clear line of sight. Racking, walls and vehicles reduce it.
- Danger point and vehicle must belong to the same group, otherwise the vehicle will not react.
- A **gate consists of two units**, one per side. Both carry the same device group — that is how the vehicle recognises they belong together. With several gates, each gate gets its own group.
- The **states** display style is the most useful one for commissioning: each dot shows one relay or input.

For a full description of connections, operating behaviour and troubleshooting see the ICPROX-4R2I user manual.

For further questions our support team will be glad to help: **In-Circuit Solutions GmbH** ·
Boltenhagener Str. 124, 01109 Dresden, Germany · **www.in-circuit.de**

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ICPROX-SEC

User Manual — RFID access control for vehicles and doors

Document rev. **1.0** Date **2026-08** Part no. **902.206**

1 Product overview

The ICPROX-SEC checks who is allowed to move a vehicle or open a door. It reads RFID cards without contact and passes the rights stored on the card on to the ICPROX system. Without a valid card the safety circuit stays open — the vehicle will not move off.

- Contactless reading of common RFID cards to ISO 14443 (13.56 MHz)
- The rights are held on the card, not in the device — one card works on every vehicle it is cleared for
- Two ways of using it: permanent driver authorisation on a vehicle, or short-term release at a door
- Eight-way indicator for reading, authorisation and vehicle state
- Connection for an external push-button, for example to open a gate
- Connection and power through one single cable



Left, the ICPROX-SEC (902.206) fitted to a vehicle or a door; right, the ICPROX-SECW desktop unit (902.206B) used to write the cards.

2 Connections and controls

Item	Function
Reading area	Hold the card centred in front of it; reading distance is a few centimetres
Device line	Connection to the control unit on the vehicle, or to the infrastructure module at the door — data and power in one cable
External push-button	Volt-free contact; with an authorised card it triggers the assigned action (e.g. opening a gate)
Indicator	Eight multi-colour dots, see section 5.1 for their meaning

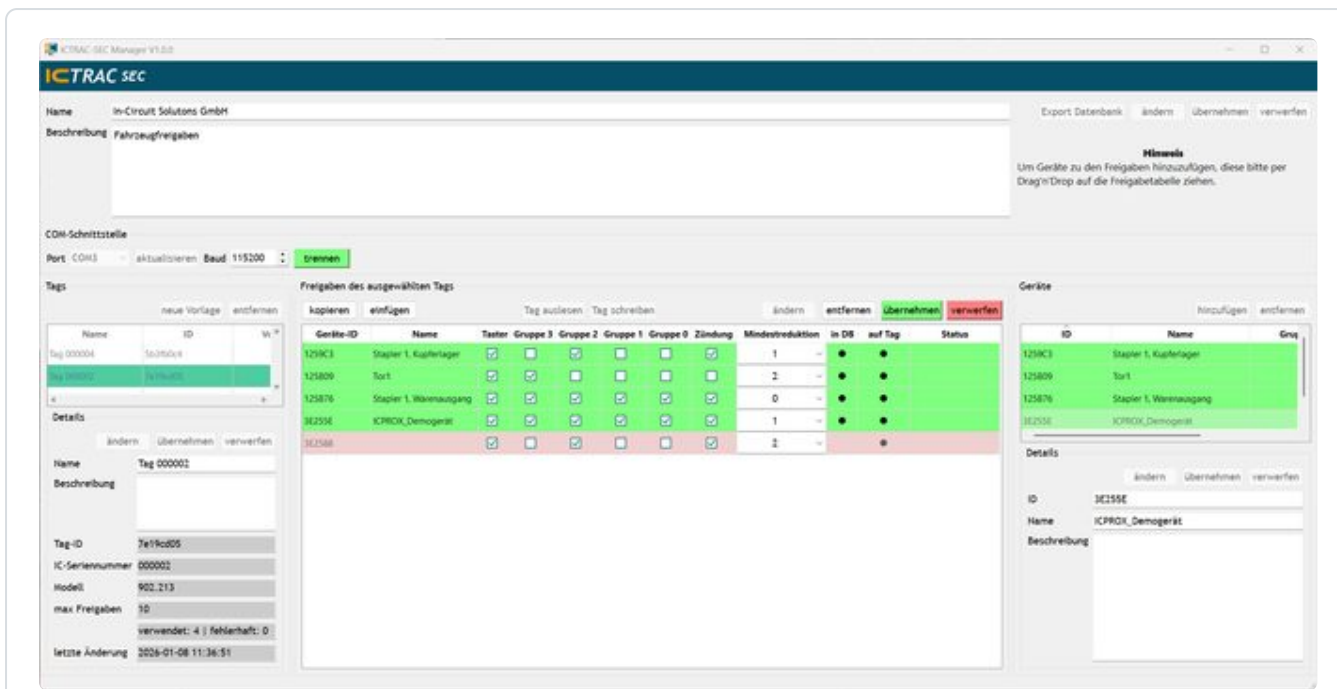
Caution: Access control is not a substitute for a mechanical safeguard. It prevents unauthorised persons from driving off, but it does not stop a parked vehicle from rolling away. Cards must be assigned to individuals and must not be left on the vehicle.

3 Commissioning

1. **Choose the position:** On a vehicle within easy reach of the driver; at a door at hand height next to the passage. The reading area must be freely accessible.
2. **Mount the unit:** Do not fit it directly onto large metal surfaces — this noticeably reduces the reading distance. An intermediate plastic layer helps.
3. **Connect:** Wire up the device line. On a vehicle it runs to the control unit, at a door to the infrastructure module. No separate power supply is needed.
4. **Connect the push-button:** If a gate or danger point is to be switched, wire the external push-button to the terminals provided.
5. **Prepare the cards:** Write the rights onto the cards using the ICPROX-SECW desktop unit (section 4).
6. **Check:** Present an authorised card — the indicator acknowledges the read and the vehicle can be driven. Then verify with a card that is not authorised.

4 Cards and rights

The rights are written onto the card and not stored in the reader. A new driver therefore simply receives a card written accordingly; nothing needs to be changed on the vehicles themselves. Writing is done with the **ICPROX-SECW** desktop unit (902.206B) and the accompanying Windows software **ICSecManager**.



ICSecManager — device list, rights per device, and writing the card.

Right stored on the card	Meaning
Vehicle release	Closes the safety circuit so that the vehicle can be driven. Without this right it stays locked
Minimum reduction	How far the vehicle may be reduced for this driver — this distinguishes experienced from inexperienced drivers
Door and gate release	Allows a gate or danger point to be switched using the button on the unit or from the display
Device assignment	Which vehicles and infrastructure devices the rights apply to — configurable per device

Tip: Cards can be read back and rewritten at any time. If a card is lost, it is removed from the assignment on the device concerned; all other cards remain valid unchanged.

5 Operating behaviour

5.1 Indicator

Indication	Meaning
Yellow	Card detected and authorised — the unit is waiting for the button to be pressed
Red	No valid card, or the right for this device is missing
Green, steady	Button pressed, the action is running
Green, flashing	Button released, the action has finished
First two dots	Mirror the state of the vehicle: operation and current reduction level

5.2 Vehicle mode and door mode

Application	Behaviour
On a vehicle	The card is presented once and then applies for the duration of the shift. The release ends when the vehicle is switched off
At a door	The release is short-lived: if the button is not pressed within a few seconds it expires and the card has to be presented again

6 Technical data

Property	Value
Part number	902.206
Card format	ISO 14443, 13.56 MHz
Reading distance	a few centimetres, contactless
Rights management	stored on the card, configurable per device
Indicator	8 × multi-colour LED
External push-button	1 × volt-free contact
Connection	RS485, twisted pair, shielded
Power supply	through the device line
Accessory	ICPROX-SECW (902.206B) desktop unit with ICSecManager software

7 Troubleshooting

Symptom	Possible cause / remedy
Card is not read	Hold the card centred and closer to the reading area. Metal directly behind the unit reduces the reading distance
Indicator stays red	The card carries no right for this device. Check the assignment in ICSecManager and rewrite the card
Vehicle will not move despite a card	The "vehicle release" right is missing, or the safety circuit is not routed through the relay intended for it
Release expires immediately	The unit is running in door mode — press the button immediately after presenting the card
Button has no effect	The card has no door/gate right, or the button is not connected. The indicator must be yellow before pressing
No indication at all	Check the device line; the unit is powered exclusively through it

For further questions our support team will be glad to help: **In-Circuit Solutions GmbH** ·
Boltenhagener Str. 124, 01109 Dresden, Germany · **www.in-circuit.de**

7.1 Related manuals

- ICPROX system overview
- ICPROX-CPU — vehicle control unit
- ICPROX-4R2I — infrastructure module

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ICPROX-KEY

User Manual — Configuration key granting access to the web interface

Document rev. **1.0** Date **2026-08** Part no. **902.230**

1 Product overview

The ICPROX-KEY is the key to setting up an ICPROX vehicle. It has neither buttons nor a display: as soon as it is powered and near the vehicle, the control unit enables its web interface. Remove the key and the set-up network disappears again — so during everyday operation the vehicle does not broadcast an open Wi-Fi network.

- Enables the `ICPROX-Setup` web interface of the control unit
- Powered over USB — a power bank, laptop or any charger will do
- No cabling to the vehicle, no installation, nothing to operate
- Effective throughout the area around the vehicle (roughly 10 to 20 m)
- Compact key-fob design with a permanently attached cable



ICPROX-KEY (902.230) — angled view and overall view with the permanently attached USB cable.

2 Connections and controls

Item	Function
USB plug (type A)	The only connection. It is used for power only — no data is exchanged with the device it is plugged into
Housing	No controls. The key works as soon as it has power

Tip: Treat the key like a real one: whoever holds it can change a vehicle's settings. Unplug it after set-up and keep it in a safe place.

3 How to use it

1. **Power the key:** Plug the USB connector into a power bank, laptop or charger.
2. **Bring it near the vehicle:** The key has to be within the area around the vehicle; a line of sight is not required.
3. **Join the set-up network:** Open the Wi-Fi list on your smartphone or laptop and select `ICPROX-Setup` . Alternatively scan the QR code shown on the vehicle display.
4. **Open the browser:** The control unit's web interface appears. Change settings, check the connected devices or update the firmware.
5. **Unplug the key:** When you have finished, disconnect the power — the set-up network is then switched off again.

If the WiFi connection doesn't work, there is an alternative setup tool via USB cable: wiki.in-circuit.de/icprox/icprox_setup_tool_en.html.

4 Operating behaviour

The control unit scans for an approved key at short intervals. When it finds one it switches the set-up network on; if the key is absent for a longer period it switches it off again. Any open browser session ends at that point.

If several vehicles are parked next to each other, one key can enable the web interface on all of those it is approved for. Several entries then appear in the Wi-Fi list; you can identify the vehicle you want by the name shown on its display.

5 Technical data

Property	Value
Part number	902.230
Operating principle	proximity detection via 2.4 GHz Wi-Fi
Effective range	approx. 10–20 m
Power supply	USB type A (power bank, laptop, charger)
Cable	approx. 40 cm, permanently attached
Dimensions	approx. 35 × 30 × 12 mm (without cable)
Controls	none



Front, bottom and close-up of the cable outlet.

6 Troubleshooting

Symptom	Possible cause / remedy
Network ICPROX-Setup does not appear	Check the power source (some power banks switch off at low load), move closer to the vehicle and refresh the Wi-Fi list on your device
Connection drops	The key has been removed or lost power — plug it back in
Web interface does not open	Confirm the connection to the ICPROX-Setup network; some devices switch to mobile data automatically when there is no internet — disable that for the duration of the set-up
Control unit does not react to the key	The key is not approved for this vehicle. Please contact our support team
Several vehicles in the list	Normal when vehicles are parked close together. Pick the right one by the vehicle name shown on its display

For further questions our support team will be glad to help: **In-Circuit Solutions GmbH** ·
Boltenhagener Str. 124, 01109 Dresden, Germany · www.in-circuit.de

6.1 Related manuals

- ICPROX system overview
- ICPROX-CPU — vehicle control unit

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