Meat&Doria **32043**
Hoffer Products **H32043**

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Rain Sensors

Our Premium Quality

A superior quality range, guaranteed by direct control of the entire process.

Design and production are supervised by the Group's engineers, in compliance with the original equipment specifications. Subsequently, each component undergoes end-of-line validation testing by the Quality team, with the aim of offering a product that always stands out for its quality, reliability, and durability.

Design | **Fleet Coverage** | **Testing** | **After-Sales Support**

What are they?

Vehicle rain sensors are electronic devices designed to **detect the presence and intensity of rain** on the windshield and **automatically activate the wipers**, without driver intervention.

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What are they used for?

The main purpose is to:

Improve safety by keeping the windshield always clean.

Increase driving comfort by avoiding continuous manual adjustments.

Optimize wiper speed based on the amount of rain.

Operation

The rain sensor is usually mounted behind the interior rearview mirror, in contact with the windshield.

The most common operating principle is optical:

1. The sensor emits an infrared beam toward the glass.
2. When the windshield is dry, part of the light is fully reflected.
3. When there are water droplets, part of the light is scattered.
4. The system interprets the variation and:
   - Activates the wipers
   - Automatically adjusts the speed (slow, fast, intermittent)

More water = faster wipers

Integration with other systems

In modern vehicles, the rain sensor can work together with:

Light sensor (automatically turns on headlights)

Automatic climate control

ADAS and onboard control units

Types

Type	Spread	Precision	Status
Optical (IR)	Very high	High	Standard
Capacitive	Low	Medium-low	Rare
Mechanical	Almost none	Low	Obsolete
Integrated	High in modern cars	Very high	Evolving

Our sensors fall into the first category.

Main advantages

- No driver distraction
- Greater focus on driving
- Reduced wear on glass
- Immediate response to changing weather conditions

Limitations and possible issues

- May not work properly if the windshield is very dirty
- In some conditions* it may be less accurate
- Windshield replacement often requires recalibration

*fog, insects, irregular water

Causes of replacement

The need to replace an infrared optical rain sensor may arise from both **direct sensor faults** and **vehicle-related interventions** that can compromise its proper functioning.

Why does it happen?

- The sensor is bonded to the windshield
- It operates through optical coupling (glass–sensor–gel)

When to replace the windshield?

- If the optical coupling is lost
- If the optical gel is damaged
- If the sensor does not adhere correctly

Consequences

- Irregular operation
- Control unit errors
- Incorrect sensitivity

Optical gel damage

What is optical gel? It is a transparent layer that removes air between the sensor and the glass and ensures proper reflection of IR light.

Causes of damage

- Aging
- Improper sensor removal
- Heat exposure
- Poor windshield replacement

Internal electronic failure

Types of faults

- Infrared LED not working
- Faulty photodiode
- Damaged electronic circuit

Common causes

- Voltage spikes
- Moisture ingress
- Internal defects
- Short circuits

Symptoms

- Sensor not recognized by the control unit
- Diagnostic errors (DTCs)
- Automatic function completely inactive

Mechanical damage or breakage

May occur during

- Rearview mirror removal
- Windshield replacement
- Internal impacts
- Sensor dropping

Typical damage

- Broken housing
- Damaged clips
- Scratched optical lens

Incompatibility or system updates

Rare but possible cases

- Control unit software updates
- Replacement with incompatible models
- Retrofit or vehicle modifications

Components to check and/or replace with the rain sensor

- Rain sensor
- Optical gel
- Mount/bracket
- Windshield (sensor area)
- Wiring/connectors
- BCM control unit

Most common error codes (generic)

B1101 / B1100: Rain sensor error; internal fault

Causes

Damaged sensor electronics

IR LED or photodiode failure

Moisture ingress

B1102: Rain sensor signal not plausible

Causes

Damaged optical gel

Air bubbles between sensor and glass

Incompatible windshield

B1103: Rain sensor not calibrated; incorrect calibration

Causes

Windshield replacement

New sensor without learning procedure

Control unit power loss

Uxxxxx (es. U0140, U1120): No communication with rain sensor

Causes

Broken wire

Disconnected connector

Pin oxidation

Manufacturer-specific codes (real examples)

Volkswagen, Audi, Skoda, Seat

Code	Meaning
01520	Faulty rain sensor
00978	Implausible signal
01304	No sensor communication

BMW

Code	Meaning
A559	Rain sensor failure
A554	No communication
A559-98	Plausibility error

Stellantis (Fiat, Peugeot, Citroën)

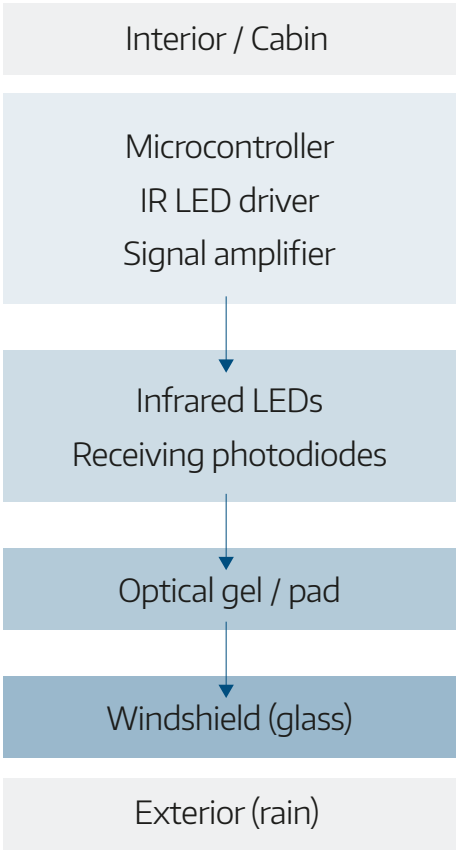
Code	Meaning
B1025	Rain sensor absent
B1026	Incorrect signal
B1027	Missing calibration

Mercedes-Benz

Code	Meaning
B2212	Faulty rain sensor
B2213	Signal error
B2215	Sensor not calibrated

Internal structure of an automotive rain sensor

SCHEME



Optical module (the heart of the sensor)

A Infrared LEDs

- Typically 850–940 nm IR LEDs
- Positioned at a precise angle relative to the vehicle
- Often multiple LEDs for:
  - Redundancy
  - Covering multiple detection points

B Photodiodes / phototransistors

- Placed next to the LEDs
- Receive internally reflected light
- Can be:
  - Analog (voltage level)
  - Digitized via ADC on the PCB

Optical interface: the gel

It is a **structural component**, not just an adhesive.

Main functions

- Ensures optimal optical contact
- Stabilizes the refractive index
- Reduces dispersion and unwanted reflections
- Compensates for micro-irregularities in the glass

Electronic PCB (internal electronic structure)

Inside the housing there is a **multilayer electronic board** with:

A Microcontroller

- Processes photodiode signals
- Filters noise, vibrations, dirty reflections
- Calculates:
  - Rain presence
  - Intensity
  - Rate of change

B Analog stage

- Operational amplifiers
- Low-pass filters
- Conversion of light signal > stable voltage

C LED driver

- Controls:
  - LED current
  - Modulated pulses
- Often operates in PWM to improve signal-to-noise ratio

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Communication with the vehicle

Internally, the sensor is equipped with a **LIN or CAN interface**, or an analog signal (in older vehicles). It **does not directly control the wipers**, but instead transmits data to the BCM (Body Control Module) or the wiper control unit, which then manages their operation.

Mechanical housing and shielding

A Plastic housing

- Opaque to block external light
- Shaped to ensure:
  - Proper pressure on the glass
  - Optical alignment

B EMI shielding

- Small metal shields or ground traces
- Protection against:
  - Electromagnetic interference
  - Ignition noise, alternator, ADAS systems

Typical rain sensor pinout (modern standard – LIN)

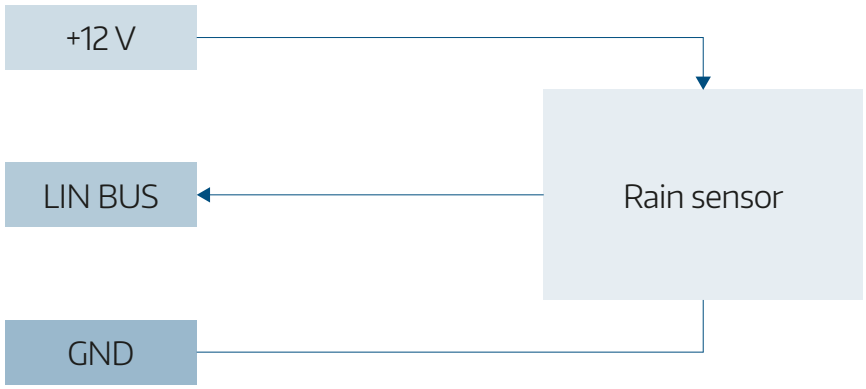
The most common connector has 4 pins.

Sensor-side view 1 2 3 4

Pin functions

Pin	Signal name	Function
1	+12 V (Terminal 30 or 15)	Power supply
2	GND (Ground)	Electrical reference
3	LIN BUS	Communication with BCM
4	Wake / Ignition	Activation (not always present)

Simplified wiring diagram



The sensor does not directly control the wipers

It sends digital data to the BCM via LIN

The BCM decides wiper speed and mode

Common wiring errors

Error	Symptom
LIN <> +12V reversed	Sensor dead
Unstable ground	Irregular wiper operation
Missing wake signal	Sensor does not activate
Incorrect gel	False readings

Important note on calibration

After windshield or sensor replacement, or after electrical work, **many vehicles require software calibration** (via OBD diagnostics).

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Keyless Handles

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What is the Keyless system?

Keyless handles are part of a **vehicle's keyless access and start systems** (Keyless Entry / Keyless Go). They allow doors to be opened and locked without physically using a key, thanks to **secure wireless communication between the vehicle and the electronic key**.

The system improves:

Comfort of use

Perceived **quality** and "**premium**" feel of the vehicle

Access speed

Main Components of a Keyless Handle

Several electronic and mechanical components are integrated inside or near the handle:

LF Antenna (Low Frequency)

Transmits and receives short-range signals to verify the presence of the key in the immediate vicinity of the door.

Capacitive / Touch Sensor

Detects hand proximity or contact:

- Inner side: **unlock**
- Outer side: **lock**

Physical Button (Optional)

Protected microswitch, used in some models as confirmation or redundancy.

Local Control Module / Wiring

Manages sensor signals and sends them to the vehicle control unit.

BCM / Keyless Control Unit

Validates the encrypted key signal and controls the locks.

System Operation (Simplified)

1 Detection

The capacitive sensor detects contact or the presence of a hand on the handle.

2 Authentication

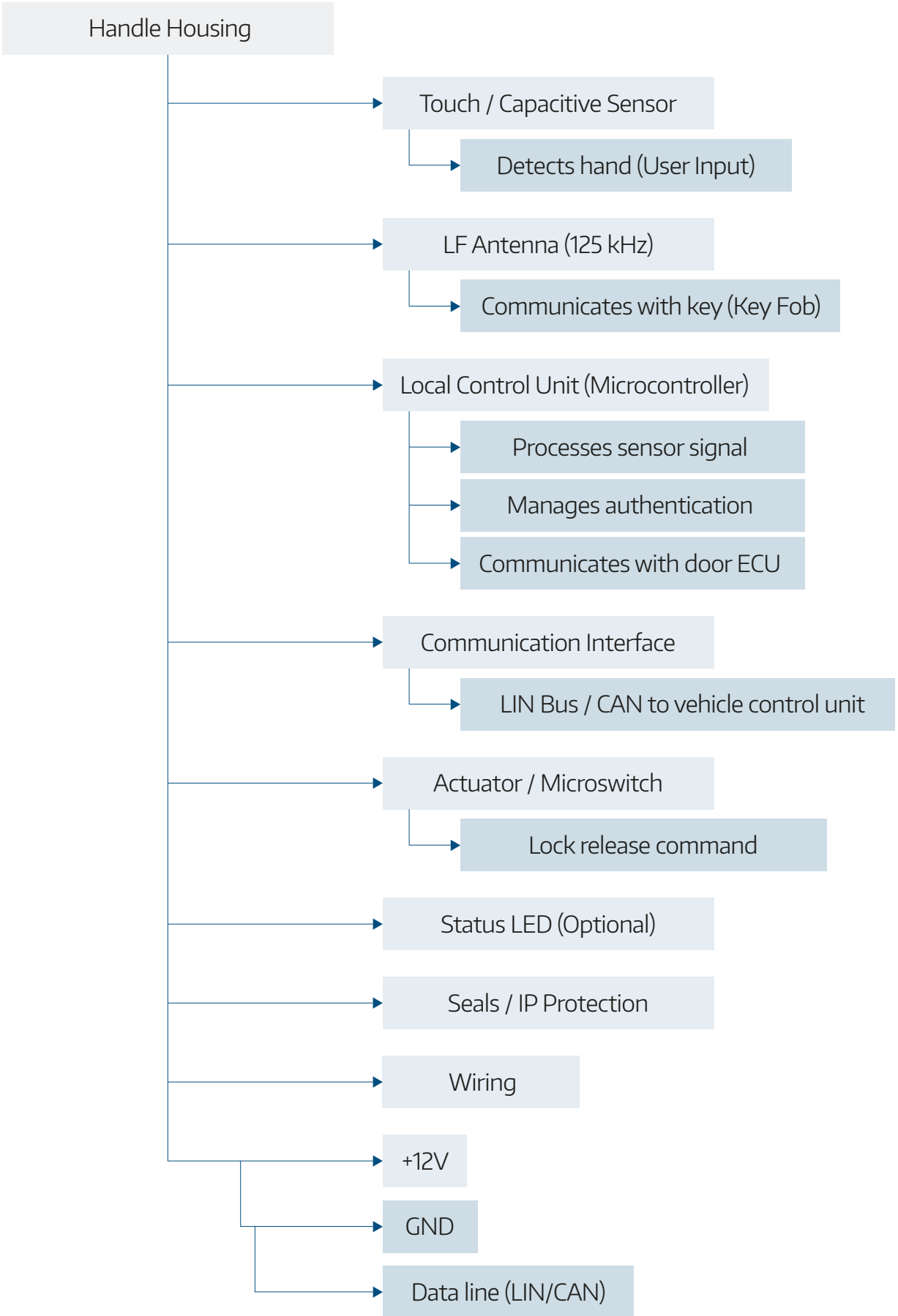
The LF antenna queries the key; if present and valid, the key responds with an encrypted code.

3 Action

The vehicle control unit enables door unlocking or locking.

If the key is invalid or outside the authorized area, access is denied.

Structural Diagram



Usage Modes

Passive entry (Automatic Unlock)

Approaching the vehicle with the key and touching the handle unlocks the door.

Retractable Handles

Extend automatically when the key approaches and retract when the vehicle is in motion.

Touch Lock

Touching a dedicated external surface locks the vehicle.

System Security

The Keyless system integrates several security measures:

Encrypted communication between key and vehicle

Protection against **Relay Attacks**:

- RSSI measurements
- UWB technology on newer models

Electromagnetic compatibility testing (EMC) to avoid interference from smartphones or RF devices

Clearly defined unlock zones to prevent unintended opening

Quality Controls and Product Validation

Incoming Quality Checks	Dimensional verification of components
	Visual inspection
	Material testing (strength, hardness)
	Production batch verification
In-Process Checks	Monitoring molding parameters (temperature, pressure)
	Verification of correct assembly (component presence)
	Torque checks
	Basic functional test of mechanical movement

Functional Tests	Opening/closing test
	Actuation force measurement (ergonomics)
	Spring return verification
	Noise testing (NVH)
Electronic Tests (if present)	Touch/capacitive sensor verification
	LED lighting test (if integrated)
	Communication with vehicle control unit
	Electrical consumption test
Endurance Tests	Repeated opening/closing cycles: **50k–100k cycles**
	Structural strength test (tensile > 500 N)
	Real-use simulation
Environmental Tests	Operation from –40°C to +85°C
	Thermal shock (hot/cold)
	Salt spray test (corrosion)
	Water/rain test (IP rating, high-pressure washing)
	UV resistance

Final Aesthetic Inspection	Visual defects (scratches, bubbles, paint issues)
	Color uniformity
	Component alignment

Final Inspection and Release	Full functional test
	Batch traceability
	OK / reject marking
	Packaging and protection compliance

Common Failure Symptoms

- Door does not open on touch
- Intermittent operation
- Opening only on one side of the vehicle
- Keyless error messages on dashboard
- Key not recognized

Common Diagnostic Errors (Examples)

Code	Description
B1A50	LF antenna handle – open circuit

Code	Description
B1A52	LF antenna signal implausible

Code	Description
B1A41	Handle sensor electrical fault

Code	Description
B1A43	Capacitive sensor – erratic signal

Code	Description
B1A20	Abnormal electrical consumption

Recommended Diagnostic Checks

- Electronic diagnosis on **BCM / Comfort Module**
- **Power supply** and **wiring continuity** check
- Check for **water ingress and connector condition**
- **Key battery** verification

Preventive Maintenance

- Avoid pulling wiring during door disassembly
- Update BCM software when required by manufacturer
- Replace handle in case of sensor degradation

Criteria for Identifying Aesthetic Variants

A **standardized approach** is used to manage aesthetic variants, enabling a clear distinction between different product configurations. Color is used to uniquely identify the specific finish, while the "primer" variant refers to the version supplied paint-ready for subsequent surface processing.

Related Products

Door lock actuators

Meat&Doria **31852**
Hoffer Products **3100852**

Wiring harness kits

Meat&Doria **25029**
Hoffer Products **25029**

Electric tailgate actuators

Meat&Doria **301076**
Hoffer Products **H301076**