



Parkit Tag

Technical Report

A battery-free smart parking sensor that tells whether a bay is free or occupied



1. Overview

The Parkit tag is a small, low-profile sensor fixed on the surface of a parking bay. It detects when a vehicle arrives or leaves and reports at once by radio to a Parkit gateway, which passes the information to the Parkit cloud dashboard, so that the state of every bay can be followed remotely.

The tag has no battery and no cables. Four small solar panels, one on each sloping side, charge a supercapacitor that keeps the tag working through the night. The electronics are sealed with resin from the back, so the tag needs no maintenance once installed.

Main features

- **Vehicle detection:** magnetic detection of the vehicle above the bay, confirmed after the vehicle has settled;
- **Fast reporting:** a change is reported within seconds, with a regular "still here" message every minute;
- **Battery-free:** four solar panels and a supercapacitor; no battery to replace;
- **Sealed:** resin-filled from the back to protect the electronics;
- **Environment:** temperature, humidity and pressure at the bay;
- **Self-monitoring:** alarms if the tag is moved, knocked, or runs low on energy;
- **Wireless:** Bluetooth Low Energy to the gateway, NFC for a phone tap at installation.

About this issue. This report describes the current Parkit tag. The hardware and enclosure are in their final form; the vehicle-detection software is in field testing, and detection accuracy figures will be published after the trials. Figures are rounded.

2. How the system fits together

NFC: tap with a phone to read the tag status

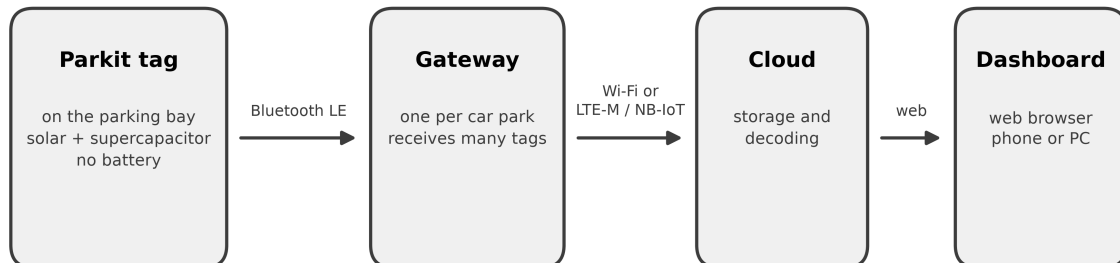


Figure 1. From the parking bay to the dashboard

Each tag broadcasts short radio messages. It does not pair or connect with anything, so one gateway can listen to all the tags in a car park at once. The gateway uploads the messages over Wi-Fi or the mobile network to the cloud, where they are decoded and shown on the Parkit dashboard. The gateway is described in a separate technical report.

3. How vehicle detection works

A vehicle is a large mass of steel, and it changes the Earth's magnetic field around it. The Parkit tag measures that change. It does so in two stages, so that it uses as little energy as possible:

Stage	What happens
1. Wake-up	A motion sensor in the tag feels the vibration of a vehicle arriving or leaving and wakes the tag. Between events the tag sleeps.
2. Settling	The tag waits until the vibration has stopped for about 2 seconds (at most about 15 seconds), so that it measures a vehicle at rest.
3. Measurement	A magnetic sensor measures the field and compares it with the field of the empty bay. A large difference means the bay is occupied.
4. Report	If the state has changed, the tag sends the new state at once, three times in quick succession.

The tag learns the field of the empty bay by itself and updates it each time the bay is free, so slow changes (temperature, nearby structures) do not build up into errors. Whether the engine is running makes no difference: the measurement depends on the steel of the vehicle, not on its electrics.

Status. The detection method and its settings are implemented and are being tested in the field. Detection accuracy will be reported once the trials are complete.

4. What the tag measures

Quantity	Reported as	Notes
Bay state	Free / occupied	Sent at once on a change, and every minute
Magnetic change	Strength of the change	Shows how clearly the vehicle is detected
Air temperature	°C	At the bay surface
Relative humidity	%RH	
Barometric pressure	hPa	
Solar input	V	Light reaching the tag
Energy store	V	How much energy the tag has left
Moved or tampered	Alarm	The tag's orientation changed, for example if it was lifted
Impact	Alarm	The tag was hit

5. Communications

Link	Details
Tag to gateway	Bluetooth Low Energy 5 advertising. One-way broadcast: no pairing, no connection, any number of tags per gateway. Transmit power up to +8 dBm.
Message rate	A regular message every minute, and three messages within seconds of a vehicle arriving or leaving.
Alarms	Sent at once, as a short burst, then repeated while the condition lasts.
NFC	Tap with a phone to read the tag's identity, firmware version and status at installation. A tap also restarts the tag, the only reset needed for a sealed unit.

Gateway to cloud	Wi-Fi or the mobile network (LTE-M / NB-IoT). See the gateway technical report.
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6. Power

The Parkit tag runs only on light. Four small solar panels, one on each sloping side of the housing, charge a supercapacitor through an energy-harvesting power manager. With a panel facing each direction, the tag collects light whatever the position of the sun and whichever way the bay faces. The supercapacitor does not wear out with daily charging the way a battery does.

Power	Value
Solar panels	Four, one on each side of the housing
Each panel	Maximum working voltage 0.5 V, maximum working current 250 mA, power 0.125 W
All four panels	0.5 W in full sun
Energy store	Supercapacitor; no battery
Consumption	Very low: the tag sleeps between events and the magnetic sensor is read only when needed. Measured figures for the Parkit tag will be added in the next issue
Start-up	Automatic once there is light



One of the four solar panels



A tag beside a parked car

Figure 2. Solar panels on the sloping sides

7. Self-monitoring and alarms

Alarm	Meaning
Low energy	The energy store is getting low
Supply dip	The supply sagged during a radio message
Temperature out of range	Temperature below -10°C or above 60°C
Moved or tampered	The tag was lifted or its orientation changed
Impact	The tag was hit
Restart	The tag restarted, with the reason (watchdog or an internal fault)

A watchdog restarts the tag automatically if the software ever stops responding.

8. Mechanical



Top: the arrow shows the orientation



Back: resin-filled

Figure 3. The Parkit tag from above and from below

Item	Details
Housing	Low-profile square housing, about $12 \times 12 \times 2.6$ cm, with sloping sides
Solar panels	Four, set into the sloping sides
Sealing	The housing is filled with resin from the back, which seals and protects the electronics
Installation	Fixed on the surface of the parking bay; an arrow on the top shows the direction of the bay
Maintenance	None: no battery, no buttons, no cables; NFC tap for status and restart
Ratings	Load (drive-over) and ingress (IP) ratings not yet formally tested

9. Specification summary

	Parkit Tag
Detects	Vehicle presence (free / occupied) by magnetic measurement, woken by vibration
Also measures	Temperature, humidity, pressure; solar and energy-store levels
Alarms	Moved or tampered, impact, low energy, supply dip, temperature, restart
Reporting	At once on a change (three messages), and every minute
Radio	Bluetooth Low Energy 5, broadcast, up to +8 dBm
Field access	NFC: status by phone tap, restart by tap
Power	Four solar panels (0.125 W each) and a supercapacitor; no battery
Housing	About $12 \times 12 \times 2.6$ cm, resin-filled, surface-mounted
Backhaul	Through the Parkit gateway: Wi-Fi or LTE-M / NB-IoT to the cloud dashboard
Status	Hardware complete; vehicle detection in field testing

Figures are typical and rounded. Specifications may change without notice.

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