APPLICATION NOTE · AN-PIR-01

Wireless PIR Motion Detector

Passive infrared presence sensor — 1 or 2 elements — 433.92 MHz RF transmitter with EETX433A

Application guide for wireless presence alarms using the EETX433A multifunction transmitter in passive sensor (PIR) mode, in single-element and dual-element (AND-gate) variants.

FREQUENCY	RF POWER
433.92 MHz	13 dBm

VARIANTS	RANGE
1 PIR · 2 PIR	10–12 m

VERSION	BASED ON IC	DEVELOPED BY	DATE
v1.0	EETX433A	Engeletron Engenharia	2026-06-25

Introduction

This application note describes how to build a **wireless motion detector** based on a passive infrared (PIR) sensor using the **EETX433A** multifunction transmitter in passive sensor mode. The EETX433A integrates a 433.92 MHz PLL oscillator, OOK/ASK modulator, power amplifier and the encoding and power-management logic in a single SOP-8 package, enabling a compact, ultra-low-power battery-powered product.

Two variants are presented that share the same firmware and the same RF transmission format, differing only in the number of PIR elements and in the trigger logic: the **1 PIR** variant fires on each motion detection of a single sensor; the **2 PIR** variant adds an ultra-low-power **AND** logic gate and only fires when both sensors detect motion **simultaneously**, reducing false alarms.

The IC electrical details (pinout, absolute ratings, operating conditions, RF frame format and code mapping) are given in the EETX433A datasheet and referenced throughout this document.

The Two Variants

1 PIR variant (single element)

A digital pyrosensor with ON/OFF output is wired directly to the sensor input (SENIN) of the EETX433A. On each detected motion, the sensor's rising edge triggers an RF transmission with the violation code. This is the simplest, most economical configuration, suited to common indoor environments.

2 PIR variant (dual-lens with AND gate)

Two independent digital pyrosensors have their outputs combined by an ultra-low-power **AND** logic gate; only the gate output goes to the EETX433A input. Thus the RF transmission only occurs when **both** sensors detect motion at the same time. This coincidence drastically reduces false triggers caused by air currents, insects or localized thermal changes, while keeping the same transmitted code as the 1 PIR variant.

The Two Variants

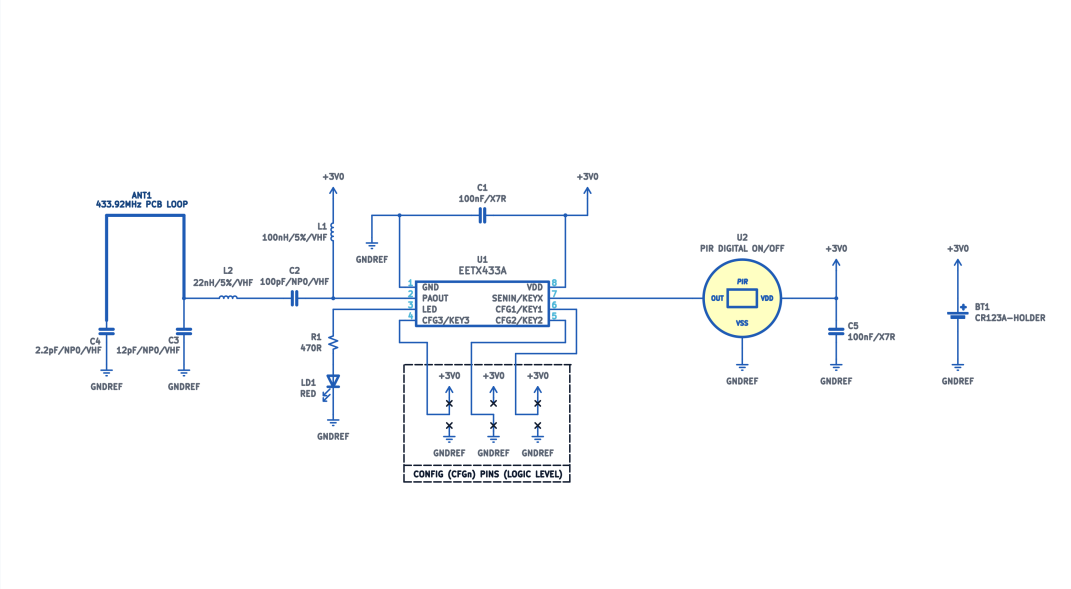

Figure 1: 1 PIR variant — single digital pyrosensor driving the EETX433A

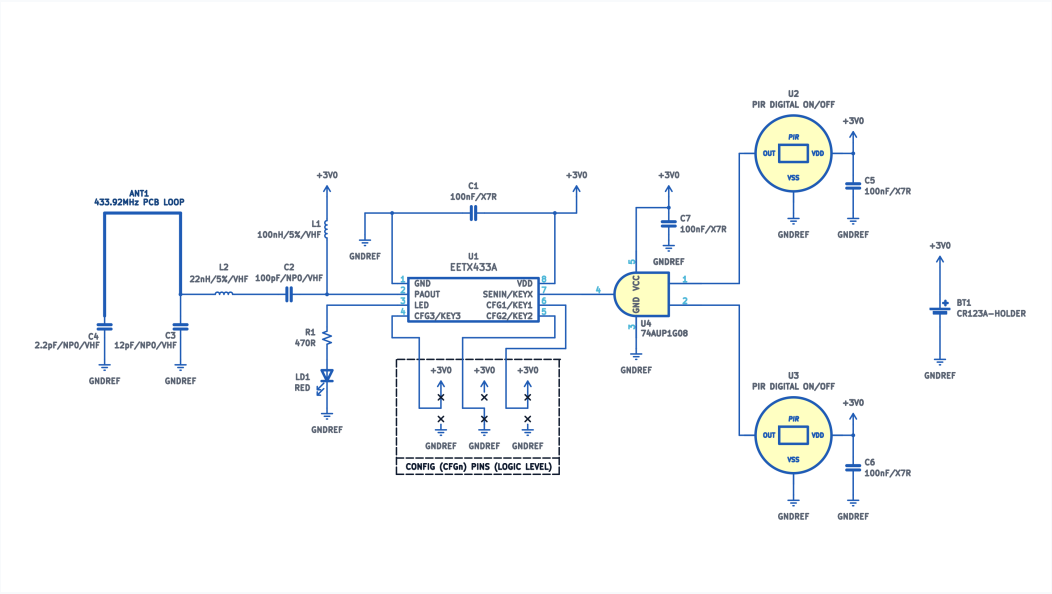

Figure 2: 2 PIR variant — two pyrosensors + AND gate (coincidence trigger) + EETX433A

Operating Sequence

After the battery is inserted, the sensor goes through four phases. The LED visually indicates each stage. The times below are fixed in firmware.

Phase	Duration	Re-arm	LED	Behavior
Initialization	2 s	—	On for 2 s	Visually confirms the sensor powered up and initialized correctly.
Stabilization	5 s	Restarts on any motion	Off	Environment reading. Do not move in front of the sensor for 5 continuous seconds; any motion restarts the count.
Test mode	10 min	5 s without motion	Fast blink 1.5 s on detection	Detection with fast re-arm to ease installation. Each detection sends the violation code.
Normal mode	Continuous	120 s without motion	Fast blink on detection	Low-power operation. After each trigger, 2 min without motion are required to re-arm.

RE-ARM RULE

To re-arm after a detection, a continuous interval without any motion is required (5 s in Test mode, 120 s in Normal mode). If motion occurs during that interval, the timer restarts and extends the pause until the motion-free time is met. Only then is the sensor ready for a new detection and transmission.

Sensitivity

The sensor features **automatic sensitivity with temperature compensation**. The gain is self-adaptive according to the environment and the average amount of motion, requiring no manual adjustment (no sensitivity trimpot or jumper). This keeps detection stable in both cold and warm environments.

Low-Battery Detection

The EETX433A continuously monitors the supply voltage in sensor mode. The nominal low-battery threshold is **2.20 V**, with ±5% (±0.10 V) tolerance — in practice the signaling may occur between 2.30 V and 2.10 V depending on component variation.

To avoid false warnings from momentary voltage dips, the condition must be confirmed on **two consecutive trigger events** with low voltage; only from the second event does the sensor signal low battery.

Once low battery is confirmed, on each motion detection the LED blinks **3 times quickly**, waits **1 s** and transmits the **violation code**; it then waits another **1 s** and transmits the **low-battery code**. The receiver can then alert the user to replace the battery.

Transmitted RF Signal

Transmission follows the EETX433A packet format: pulse-width OOK encoding at 433.92 MHz, with a basic time unit λ = 500 µs (each bit takes 3λ = 1.5 ms). Each packet contains pilot, start, 20 bits of programmable address (factory-unique), 4 bits of data and 4 bits of fixed anti-code, totaling 108λ ≈ 54 ms.

In passive sensor mode, the 4-bit data field carries the event: the **violation code** on each motion detection and the **low-battery code** when the undervoltage condition is confirmed. The 20-bit address uniquely identifies the sensor at the receiver. See the EETX433A datasheet for the full frame structure and code mapping.

Soldering and Reflow

Excess temperature can damage the EETX433A, causing thermal deformation of the package and a shift of the 433.92 MHz frequency. Therefore, use **low-temperature solder-paste alloys** and limit the peak to **≤ 210 °C for ≤ 10 s**.

The lead-free alloy **SnBi — Sn42Bi57Ag1** (180 °C peak, RoHS) is recommended. The **SnPb — Sn63Pb37** alloy (210 °C peak) is only the **absolute maximum limit** reference — never exceed 210 °C.

> **CRITICAL TEMPERATURE LIMIT**
>
> NEVER exceed a **210 °C** peak or **10 s** at peak. Above 210 °C the SOP-8 suffers thermal deformation and frequency drift. Always prefer the low-temperature alloy (SnBi).

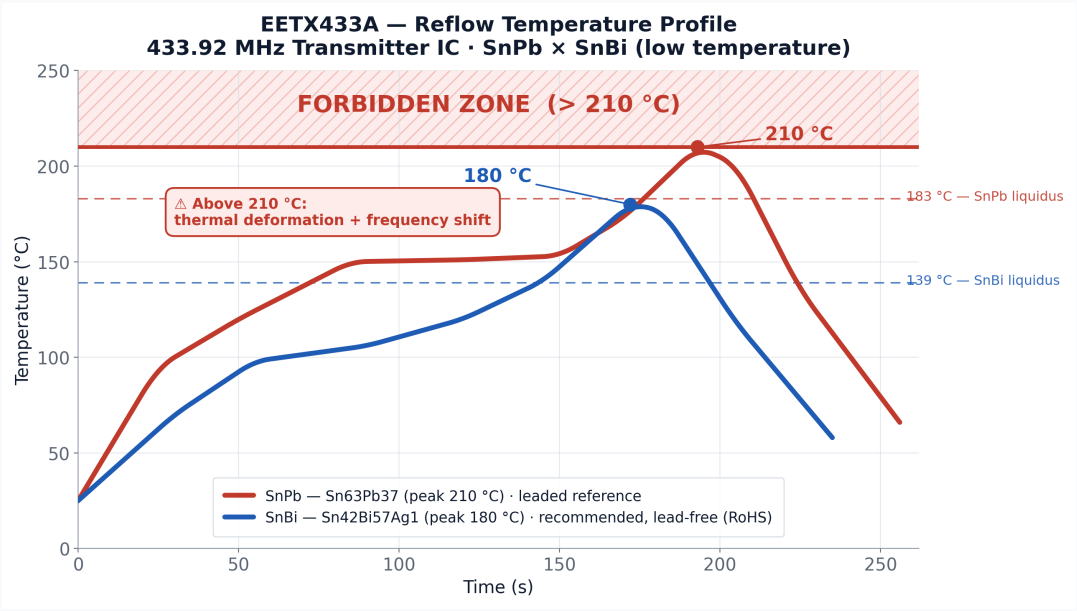

Figure: Reflow temperature profile — SnBi (recommended) × SnPb (max. limit 210 °C)

Soldering and Reflow

Phase	SnPb · t (s)	SnPb · T (°C)	SnBi · t (s)	SnBi · T (°C)
Ramp-up	0–90	25→150	0–60	25→100
Preheat (soak)	90–150	~150	60–120	100→120
Ramp to peak	150–190	150→210	120–170	120→180
Peak (reflow)	190–200	210 (≤10 s)	170–180	180
Cooling	200–255	210→70	180–235	180→60

SnBi (Sn42Bi57Ag1, lead-free, RoHS) — recommended. SnPb (Sn63Pb37) is the leaded reference; 210 °C is the absolute maximum limit. Ramp-up ~1.2–1.4 °C/s · cooling ≤ 3–4 °C/s · max. 2 reflow cycles. Hand soldering (samples): tip ≤ 300 °C, contact ≤ 5 s.

Technical Characteristics

Values for the complete sensor system (EETX433A IC + PIR + battery). Rest current differs between variants due to the number of active pyrosensors.

Parameter	1 PIR	2 PIR
Operating frequency	433.92 MHz	433.92 MHz
Channels	1	1
Modulation	OOK / ASK	OOK / ASK
RF power (typ.)	13 dBm	13 dBm
Supply voltage	3.0 V nom. (2.0–3.6 V)	3.0 V nom. (2.0–3.6 V)
Battery options	1× CR2032 / 1× CR123 / 2× AA(AAA)	1× CR2032 / 1× CR123 / 2× AA(AAA)
Transmit current	12 mA	12 mA
Rest current	12 µA	22 µA
Detection range	10–12 m	10–12 m
Trigger logic	Motion (1 sensor)	AND coincidence (2 sensors)
Low-battery threshold	2.20 V ±5%	2.20 V ±5%
IC package	SOP-8	SOP-8

IC RF and standby per the EETX433A datasheet (13 dBm; 800 nA standby). System rest current is dominated by the pyrosensor(s).

Application Guidelines

- **Placement:** install the sensor at 2.0–2.2 m height, with the lens facing the area to protect and the expected motion **crossing** the field of view (higher sensitivity to transverse than to radial motion).
- **Avoid heat sources:** keep the sensor away from direct sunlight, headlights, heating/air-conditioning units and surfaces that change temperature quickly.
- **Initialization:** after inserting the battery, keep the area free of motion during stabilization (5 s) for a clean environment reading.
- **Antenna:** use the printed 433.92 MHz loop antenna per the reference schematic and the EETX433A datasheet; avoid routing ground plane or nearby metal around the antenna.

- **2 PIR variant:** align both elements so they cover the same crossing zone — the trigger only occurs on the coincidence of both detections.

> To learn more about the EETX433A and obtain the full datasheet, visit: **engeletron.com.br**