APPLICATION NOTE · AN-MAG-01

Wireless Magnetic Opening Detector

Magnetic contact sensor for doors and windows — Smart mode (open/close) and Violation mode — 433.92 MHz RF transmitter with EETX433A

Application guide for wireless opening sensors in alarm systems, using the EETX433A multifunction transmitter in magnetic sensor mode: Smart mode reports opening and closing; violation modes signal intrusion.

FREQUENCY 433.92 MHz	RF POWER 13 dBm
MODES Smart · Violation	SENSOR TMR / Reed

VERSION	BASED ON IC	DEVELOPED BY	DATE
v1.1	EETX433A	Engeletron Engenharia	2026-07-04

Introduction

This application note describes how to build a **wireless opening detector** for doors and windows — a magnetic alarm contact — using the **EETX433A** multifunction transmitter in magnetic 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.

The detector consists of a **magnet** fixed to the moving part (door or window leaf) and a board carrying the **EETX433A and a magnetic sensor** fixed to the frame. With the door closed, the magnet keeps the sensor in one state; on opening, the magnet moves away, the sensor switches and the IC transmits an RF event. The behavior is selected by the CFG pins at power-up, including a **Smart mode** that reports both opening and closing.

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 per-mode pin configuration is in the "Configuration Modes (CFG Pins)" table of the datasheet (page 5).

Operating Principle

Opening detection uses a **magnet + magnetic sensor** pair. The magnet is mounted on the moving leaf and the EETX433A board (with the sensor) on the fixed frame, aligned and coplanar. With the door closed the magnet sits near the sensor; on opening, the magnet **moves away**, the sensor output switches and generates a rising edge (0→1) on the **SENIN** pin, which triggers the RF transmission.

The magnetic sensor can be a **TMR** (magnetoresistive) device with digital ON/OFF output or a **reed switch**. TMR offers good gap tolerance and repeatability; reed is passive and simplest. Both deliver a digital signal to the SENIN pin, which the EETX433A monitors in sensor modes — but the way they are wired differs (see Wiring Schemes).

Unlike the PIR sensor, the magnetic sensor has **no stabilization time and no test mode**: it is always ready immediately after initialization. Any opening is detected instantly.

Wiring Schemes

The EETX433A accepts both types of magnetic sensor. The difference is the electrical interface to the SENIN pin — one is active, the other needs a pull resistor.

TMR sensor (active, 3 terminals)

The TMR sensor (U2) is powered from VDD/GND and delivers an already-conditioned logic level on the **VOUT** pin, wired **directly to SENIN** of the EETX433A. A decoupling capacitor (C5, 100 nF) next to the sensor stabilizes the supply. No pull resistor is needed since the output is active (push-pull). TMR offers good gap tolerance and repeatability, at the cost of a small quiescent current (a few µA).

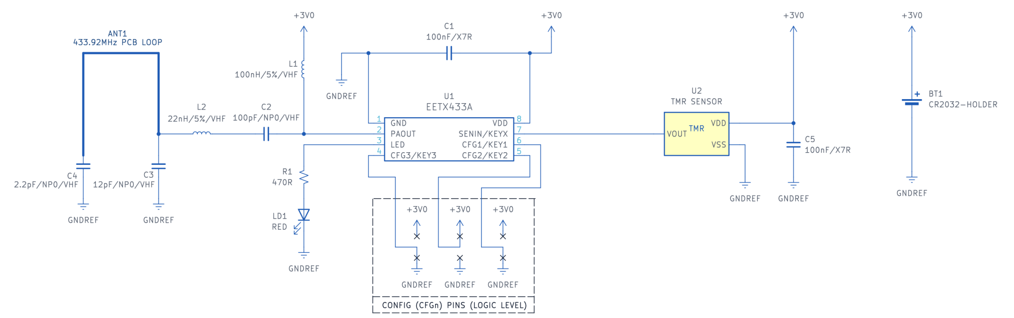

Figure 1: Wiring with an active TMR sensor — TMR VOUT straight to SENIN (EETX433A)

Reed switch (passive, 2 terminals)

The reed switch (SW1) is a dry, 2-terminal contact with no power. It is wired between SENIN and GND, and a **pull-up resistor (R2, 2.2 MΩ)** pulls SENIN to VDD. With the magnet near (door closed) the reed conducts and holds SENIN low; on moving the magnet away (opening), the reed opens and the resistor drives SENIN high, generating the **0→1** edge that triggers transmission. It is the simplest, near-zero-power solution, but requires the pull resistor and has a mechanical contact.

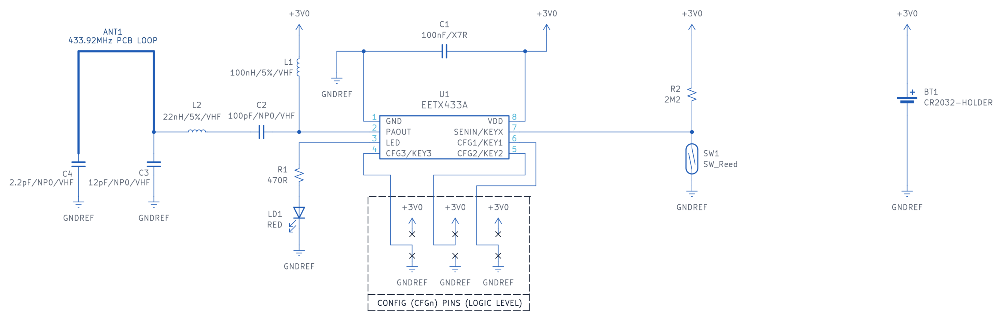

Figure 2: Wiring with a passive reed switch — reed + 2.2 MΩ pull-up resistor on SENIN (EETX433A)

Operating Modes

The mode is selected by tying pins CFG1, CFG2 and CFG3 to GND (level 0) or VDD (level 1) — sampled ONLY at power-up. Of the EETX433A's 8 modes, four are magnetic. The table below reproduces the pin configuration (datasheet, page 5):

MODE	FUNCTION	CFG3	CFG2	CFG1	SENIN
1	Violation	0	0	1	Input
2	Violation	0	1	0	Input
3	Smart (Open/Close)	0	1	1	Input
6	Violation	1	1	0	Input

> The CFG pins are sampled only at power-up; changes during operation are ignored. To enter the desired mode, tie each pin to VDD (1) or GND (0) per the table before powering the device.

Smart Mode (Mode 3) — recommended for supervision

In Smart mode the transmitter sends distinct codes for **opening** and **closing**, letting the alarm panel know the real state of the door/window. On **opening** (magnet moves away, SENIN 0→1) the **Open (A) = code 4** event is sent; on **closing** (magnet approaches, SENIN 1→0) the **Close (F) = code 5** event is sent. Low battery is signaled with **code 3**. Ideal for supervised panels that display "open/closed" per zone.

Violation Modes (Modes 1, 2 and 6)

In these modes the transmitter sends only the **Violation (V)** event — the opening, i.e. the magnet moving away — and **Low battery (B)**; closing is not reported. The violation code differs between modes (Mode 1 → 1; Mode 2 → 3; Mode 6 → 2), as does the battery code, so a single receiver can distinguish sensors/zones by code in addition to the unique 20-bit address. Suited to simple intrusion alarms where only the opening matters.

Transmitted Events and Codes

The 4-bit data field (D3D2D1D0) carries the event. The value depends on the configured mode — the same number means different events in different modes:

MODE	FUNCTION	Open (magnet away)	Close (magnet near)	Low battery
1	Violation	`V = 0001 (1)`	–	`B = 0011 (3)`
2	Violation	`V = 0011 (3)`	–	`B = 0001 (1)`
3	Smart	`A = 0100 (4)`	`F = 0101 (5)`	`B = 0011 (3)`
6	Violation	`V = 0010 (2)`	–	`B = 0001 (1)`

Legend: V = Violation (opening) · A = Open · F = Close · B = Low battery. The number in parentheses is the decimal value of the 4 transmitted bits. Since the frame does not carry the mode number, the meaning of the 4 bits depends on the unit's configured mode; the unique 20-bit address identifies the unit at the receiver.

Operating Sequence

After the battery is inserted, a brief initialization occurs and the sensor is immediately ready — there is no stabilization time or test mode. From then on, each opening (and, in Smart mode, each closing) generates a transmission. The LED visually indicates each stage.

Phase / Event	Condition	Transmits	LED
Initialization	Battery insertion	— (no transmission)	On ~2 s
Ready	Immediately after initialization	— (waiting for event)	Off
Opening	Magnet away · SENIN 0→1	Violation/open code · 24 packets (1,296 ms)	Blinks on transmit
Closing	Magnet near · SENIN 1→0 (Mode 3 Smart only)	Close code (F = 5)	Blinks on transmit
Low battery	VDD < ≈ 2.2 V confirmed	Battery code after the event	3 fast blinks

READY FOR IMMEDIATE USE

The magnetic sensor requires no stabilization time and no test mode (unlike the PIR sensor). After the ~2 s initialization, it is ready to detect any opening instantly. Transmission is fixed at 1,296 ms (24 packets), regardless of whether the sensor state changes again after the trigger.

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 detected event the LED blinks **3 times quickly**, waits **1 s** and transmits the **event code** (violation/opening or, in Smart mode, open/close); it then waits another **1 s** and transmits the **low-battery code** (3 in modes 1 and 3; 1 in modes 2 and 6). 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 $108\lambda \approx$ 54 ms. Each event sends 24 packets (1,296 ms).

In magnetic sensor mode, the 4-bit data field carries the event code according to the configured mode (see the Events and Codes table): violation or open/close, and low battery. Since the frame does not carry the mode number, the meaning of the 4 bits depends on the unit's mode; the 20-bit address uniquely identifies the sensor at the receiver. See the EETX433A datasheet for the full frame structure and code mapping.

Technical Characteristics

Values for the complete magnetic-contact system (EETX433A IC + magnetic sensor + battery). The RF, voltage and data-format characteristics are the same as the EETX433A.

Parameter	Value
Operating frequency	433.92 MHz
Channels	1
Modulation	OOK / ASK
RF power (typ.)	13 dBm
Supply voltage	3.0 V nom. (2.0–3.6 V)
Battery options	1× CR2032 / 1× CR123 / 2× AA(AAA)
Transmit current	12 mA
Rest current (IC standby)	800 nA
Sensor type	Digital ON/OFF TMR or reed switch
Available magnetic modes	1, 2, 3 (Smart), 6
Transmission duration per event	1,296 ms (24 packets)
Low-battery threshold	2.20 V ±5%
IC package	SOP-8

IC RF and standby per the EETX433A datasheet (13 dBm; 800 nA standby). Total rest current depends on the chosen sensor: a reed switch is passive (≈ IC standby); an active TMR sensor adds typically a few µA.

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).

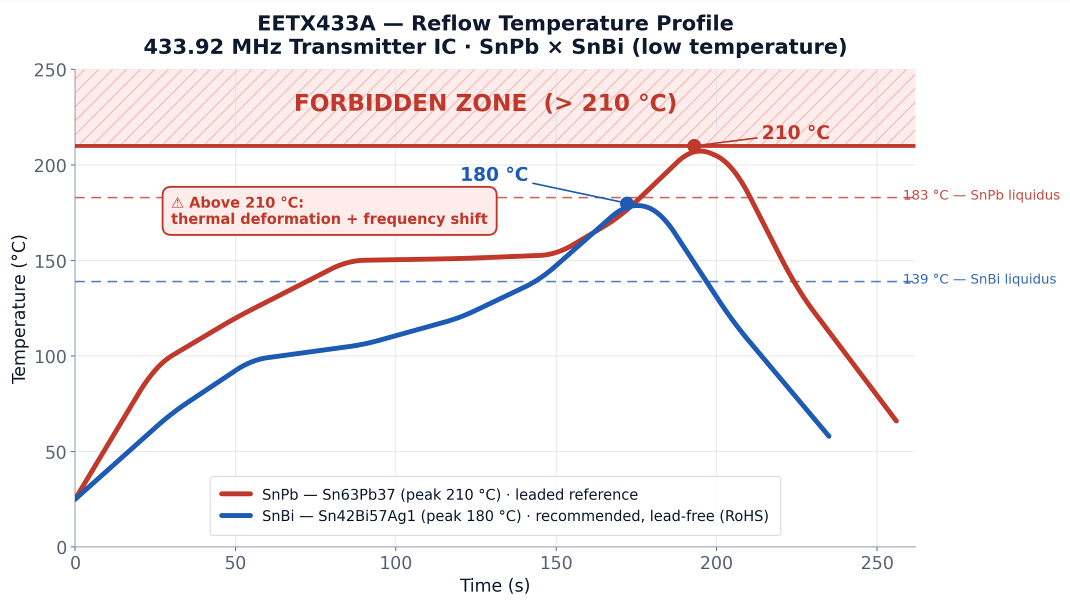

Figure: Reflow temperature profile — SnBi (recommended) × SnPb (max. limit 210 °C)

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.

Application Guidelines

- **Magnet–sensor alignment:** mount the magnet on the moving leaf and the board (with the sensor) on the fixed frame, aligned and coplanar, with the smallest possible gap in the closed position. Respect the sensor's sensitive axis / polarity marking.
- **Operating gap:** check the switching distances (pull-in / drop-out) of the chosen sensor and keep margin — opening must move the magnet beyond drop-out, and closing must bring it back within pull-in.
- **Metal surfaces:** avoid mounting the assembly on ferromagnetic materials (steel) that divert the field; if unavoidable, use non-magnetic spacers and re-validate the gap.
- **Sensor choice: TMR** tolerates larger gaps and is more repeatable (costs a few µA); **reed** is passive (~zero power) but needs the pull-up resistor and has a mechanical contact.
- **Mode selection:** use **Mode 3 (Smart)** when the panel needs to know open/closed (supervision); use violation modes (1, 2, 6) for simple intrusion alarms. Set the CFG pins per the modes table at power-up only.
- **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.

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