

AN209 – STM 300 THERMO OR BATTERY POWERED

STM 300 THERMO OR BATTERY POWERED – POWER SUPPLY
ALTERNATIVES TO SOLAR PANEL

24 July 2026



Observe precautions! Electrostatic sensitive devices!

Patent protected:

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REVISION HISTORY

The following major modifications and improvements have been made to this document:

Version	Author	Reviewer	Date	Major Changes
1.0	CB		2010	Original version
1.1	CB		2020	ECT 300 to ECT 310, new Figures
2.0	AZ	JB	2026	Document maintenance

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Packing: Please use the recycling operators known to you.

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1 Introduction

As an alternative to a standard solar panel — for example in applications with little or no ambient light — the STM 300 module can be powered by another suitable external power source. Examples include a thermo generator based on a standard Peltier (Seebeck) element combined with the EnOcean ECT 310 energy harvester, or a small, low-cost Li/MnO₂ coin cell battery.

In sleep mode, the supply current of the STM 300 module is typically 0.2 μ A. During operation, current consumption depends strongly on the frequency of wakeups and radio transmissions, so the average current over time must be considered when calculating the module's average current consumption (see Figure 1). For more details, see chapter 2.11 of the STM 300 User Manual.

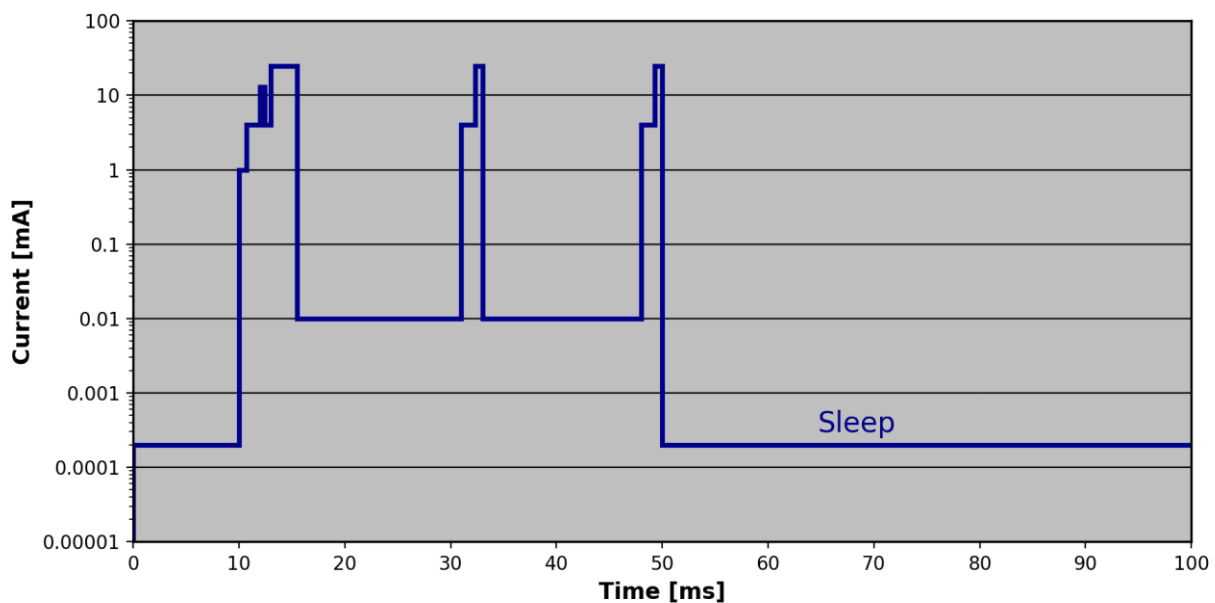


Figure 1 Current consumption of the STM 300

2 Module Average Current Consumption and Power Source Considerations

2.1 Calculation Example: Cyclic Measurement with Transmission Every 100 s

Using the table in chapter 2.11 of the STM 300 User Manual, the continuous supply current required for a given wake cycle and transmit interval setting can be found directly. According to the table (first, second, and last columns; see Table 1), an STM 300 requires a continuous current of 1.6 μ A to wake up every 100 seconds (wake cycle = 100) and transmit on every wake-up (transmit interval = 1):

$$I_{\text{STM}} \approx 1.6 \mu\text{A}$$

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Table 1 Continuous supply current of the STM 300 by wake cycle and transmit interval

Wake cycle [s]	Transmit interval	Continuous current required [μ A]
1	1	130.5
1	10	40.5
1	100	31.3
10	1	13.5
10	10	4.4
10	100	3.5
100	1	1.6
100	10	0.8
100	100	0.6

2.2 Using a Battery as a Power Supply

Even a modest battery capacity of 150 mAh (a CR2032 coin cell provides more than 230 mAh) would theoretically support about 10.7 years of continuous operation at this setting: $150 \text{ mAh} \div 0.0016 \text{ mA} = 93,750 \text{ h} \approx 3,900 \text{ days} \approx 10.7 \text{ years}$.

In practice, only about 60% of a battery's nominal capacity can be used for this purpose, since the voltage drops below approximately 2.2 V before the cell is considered fully discharged. Even so, a single CR2032 coin cell still provides more than 8 years of continuous operation, during which the STM 300 can wake up and transmit more than 2.5 million times. Note that to support the required peak current of approximately 40 mA without damaging the cell, the coin cell battery must be buffered by an external low-leakage capacitor. This capacitor is not included on the STM 300 (see Figure 2).

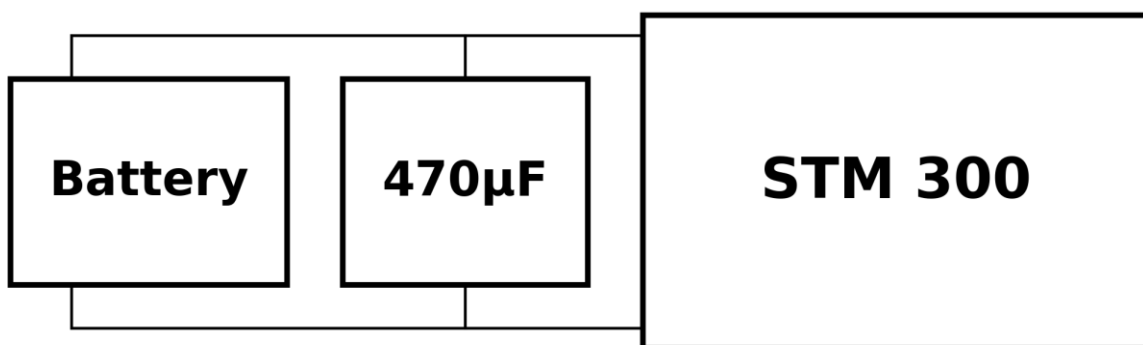


Figure 2 Buffering a coin cell battery with a low-leakage capacitor

For low-cost applications, a standard manganese dioxide lithium 3 V coin cell battery can be used; different capacities can be selected depending on the energy demand. Keep in mind the limited lifetime of batteries, even where the energy balance calculation indicates multi-year operation. It can also be useful to monitor the supply voltage so that a falling battery voltage is detected in time and the battery can be replaced before it fails.

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2.3 Using a Thermo Generator (ECT 310 + Peltier Element) as a Power Supply

Considering again the relationship from Table 1 (same scenario, $I_{STM} \approx 1.6 \mu A$) and an STM 300 supply voltage of 2.7 V, the long-term average power required by the transmitter to send every 100 seconds is:

$$P = V \times I = 2.8 V \times 1.6 \mu A \approx 4.5 \mu W$$

An ECT 310-based thermo generator can deliver this power with a temperature difference of more than 2 K, as shown in Figure 4 (see the ECT 310 User Manual).

At a temperature difference of 2 K, the Peltier element's output voltage (12.5 mV/K) is only 25 mV. Assuming a conversion efficiency of 20% for the ECT 310 at this lowest operational input voltage, approximately 22 μW of continuous input power (delivered by the Peltier element) is required. The energy storage device C* at the ECT 310 output (Figure 3) then has two functions: it must store the small amount of continuously delivered energy (approximately 4.3 μWs) between two consecutive transmissions (i.e., over 100 seconds), and it must deliver the required peak current.

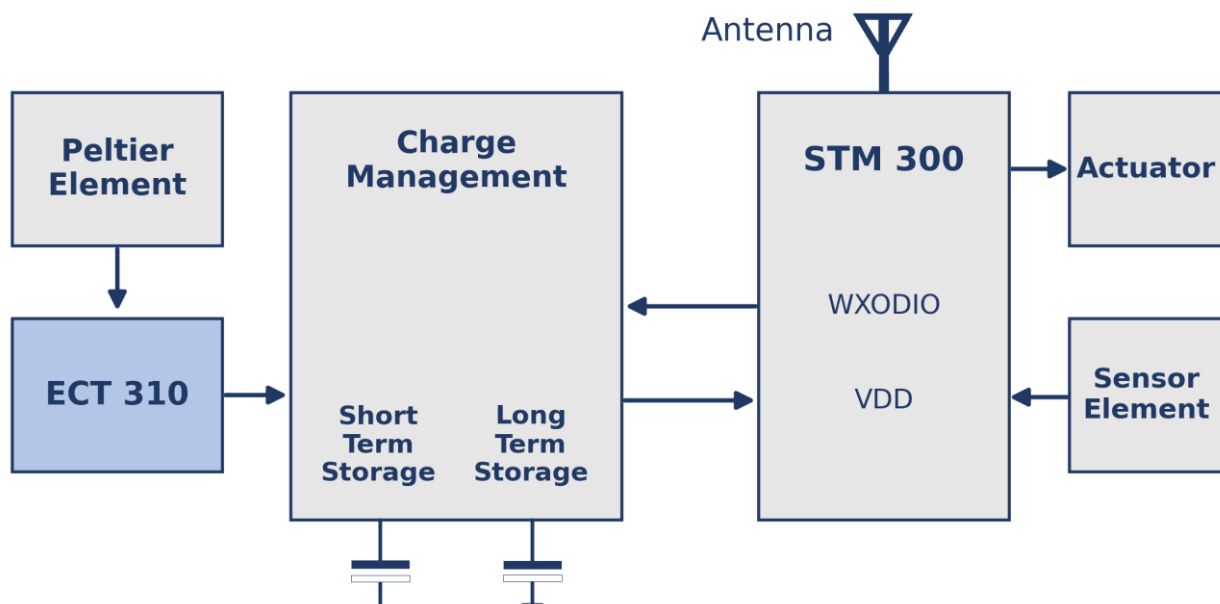


Figure 3 Thermo generator (ECT 310 + Peltier element) as a power supply

Note that in this case, a permanent temperature difference of at least 2 K between both sides of the Peltier element must always be available. Otherwise, an appropriate energy storage management circuit is recommended (see STM 300 User Manual).

Figure 4 shows typical ECT 310 performance in combination with a Peltier element (TEC2L-15-15-5.6) and a heat sink (SK 426). Performance is affected by the variance in components and by environmental conditions such as air flow.

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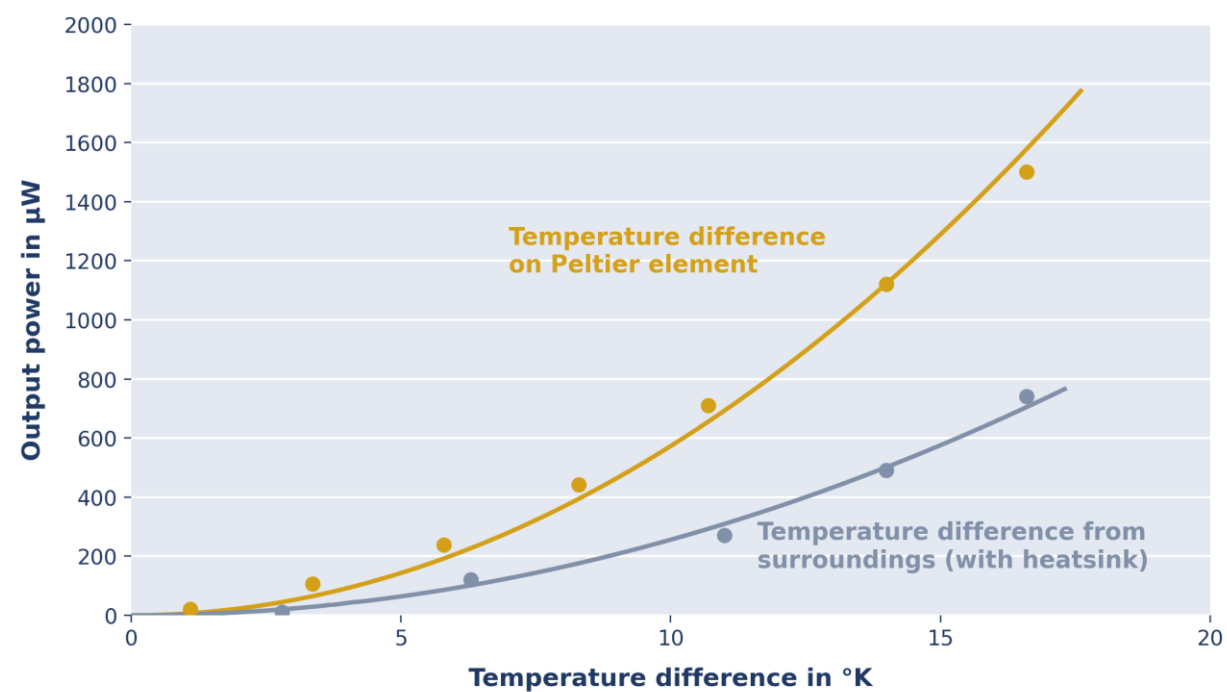


Figure 4 Typical ECT 310 output power vs. temperature difference

The thermo generator performance shown in Figure 4 was measured with the following Peltier element.

Table 2 Peltier element specifications

Type	TEC2L-15-15-5.6/73CS (www.eureca.de)
Temperature coefficient	12.5 mV/K
Internal resistance	1.44 Ω
Thermal conductivity	0.046 W/K

For more details on specific system performance and considerations regarding thermo generator dimensioning, please consult the ECT 310 and EDK 300 user manuals.

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