EnOcean

STM 300 THERMO OR BATTERY POWERED –
Power Supply Alternatives to Solar Panel

Applications based on STM 300 in environments without enough Illumination

Alternatively to the use of solar panels, e.g. in applications with no or not enough light, STM 300 devices can also be powered by another suitable external power sources like i.e. thermos-generators based on a standard Peltier (Seebeck) element and the EnOcean ECT 310 energy harvester or even a small low cost Li/MnO2 coin battery.

Background: in sleep mode, the supply current of the STM 300 module is typically 0.2 µA. In operation mode, current consumption strongly depends on the frequency of wake ups and radio transmissions, so the average current over time has to be considered for calculation of the module average current consumption, see Fig.1 below.

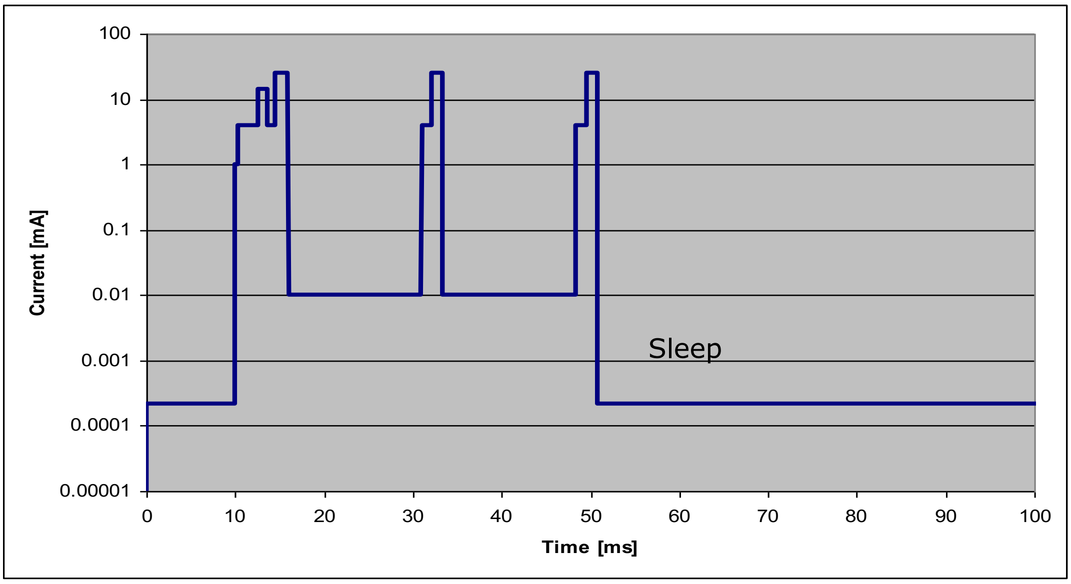

Fig.1: Typical Current Consumption of STM devices

Module Average Current Consumption and power source considerations

Calculation Example: Cyclic measurement with transmission every 100 s.

Using correspondingly table of the STM 300 User Manual required averaged continuous supply current depending of Wake cycles and Transmit interval settings can be easily found.

According the mentioned table (first, second and last column, see Table 1) STM 300 needs a **1.6 µA** continuous averaged current to wake up every 100 seconds (**Wake cycle = 100 s**) and transmit by every Wake (**Transmit Interval=1**):

I_STM ≈ 1.6 µA

Wake cycle [s]	Transmit interval	Current required cont. operation (µA)
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

Table 1

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Using Battery as power supply:

Even a small battery capacity of 0.150 Ah (a coin cell CR2032 has > 0.230 Ah) would theoretical mean about 10 years continuously function for this settings (150 mAh = 0.0016 mA x X h => X = 150 mAh / 0.0016 mA = 93750 h => 3900 days).

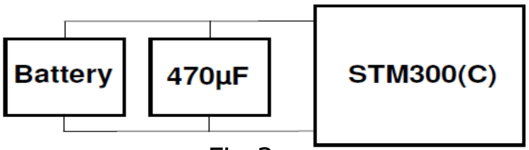

Fig.2

Bearing in mind that energy stored in a battery cannot be fully drawn for this purpose (means only approx. 60% of its nominal capacity until the voltage drops below about 2.2 V can be used) a single CR2032 coin cell still allows more than 6 years of continuous function. During this period, STM 300 can wake up and transmit more than 2 million times. Please notice that in order to ensure the needed peak current capability up to approx. 40 mA without damage, the coin cell battery must be buffered by an external low leakage and low impedance capacitor (not on STM 300 included, in this case 470 µF see Fig.2.)

For low cost applications, manganese dioxide lithium 3 V coin cell batteries can be used. Depending on the application energy requirements, different sizes can be chosen. Generally, please consider the limited lifetime behavior of batteries, even if the energy balance calculation indicates a longer operation time. It also could be useful to have a control of the supply voltage to know in time when the battery voltage fails below a certain limit, to change it before fails.

Using thermo-generator (i.e. ECT 310 + Peltier element) as power supply (Fig.3):

Considering again the Table 1 relation (same scenario, I_STM ≈ 1.6 µA) and considering an averaged STM 300 supply voltage of 2.8 V results the long term averaged required power at the transmitter to send every 100 seconds:

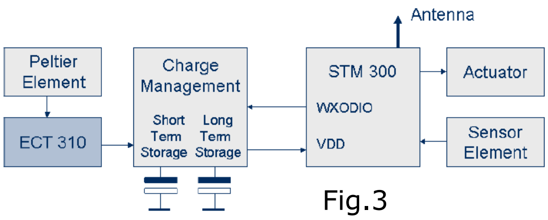

Fig.3

P = U x I: or P = 2.8 V **x** 1.6 µA = 4.5 µW.

An ECT 310 based thermo-generator would deliver this power by > 2 K temperature difference as shown in Fig. 4 (ECT 310 User Manual):

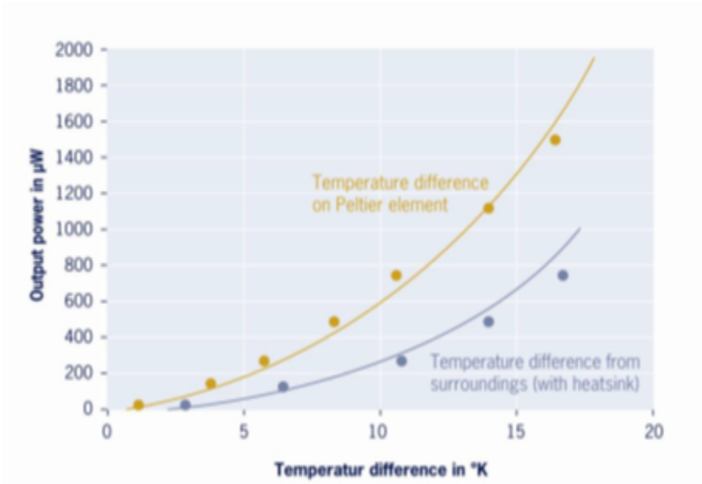

Fig.4

The Peltier element output, (12.5 mV/K) would deliver in this case only 25 mV. Considering for the ECT 310 at this absolute lowest operational input voltage a conversion efficiency of 20%, about 22 µW of continuous input power (delivered by the Peltier element) are therefore required. The energy storage devices (Fig.3) connected at the ECT 310 output have two functions: they must store (long term) the continuous delivered low energy at least between two consecutive transmissions and deliver (short term) the required transmission peak current.

Peltier element used:

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

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