10 MHz Efratom Rubidium LPRO-01 measurements

Target

- **Comparaison of two Efratom LPRO-01 OCXO 10 MHz sources (2nd one bought on eBay)**
- **Reference = 10 MHz output from the GPS disciplined Tekelec Epsilon Clock**

Why ?

- Locking a 106.5 MHz OCXO in a 10 GHz transverter with the most stable 10 MHz source possible, and without the use of a GPS-DO
- After a roughly x100 multiplication in the LO chain, it generates the adequate transverter LO (with either 144 or 432 MHz IF).
- And the resulting x100 multiplication gives the same x100 final LO derate possibility versus temperature and time, that must absolutely be minimised !

Abstract

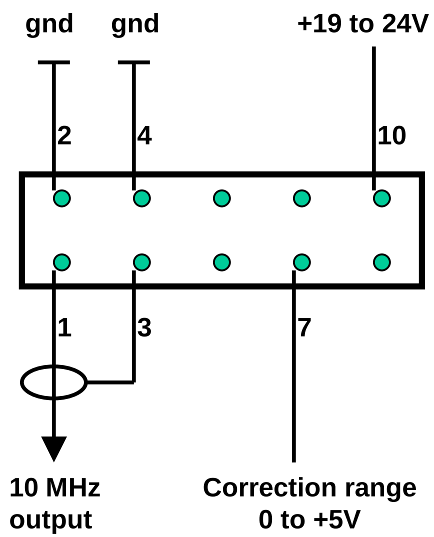
- DC conditions
- Measurement conditions with a GPS disciplined source taken as THE reference
- Frequency counter and Lissajoux comparaison
- Practical conclusion : LO derate AND precision

LPRO-01 DC conditions

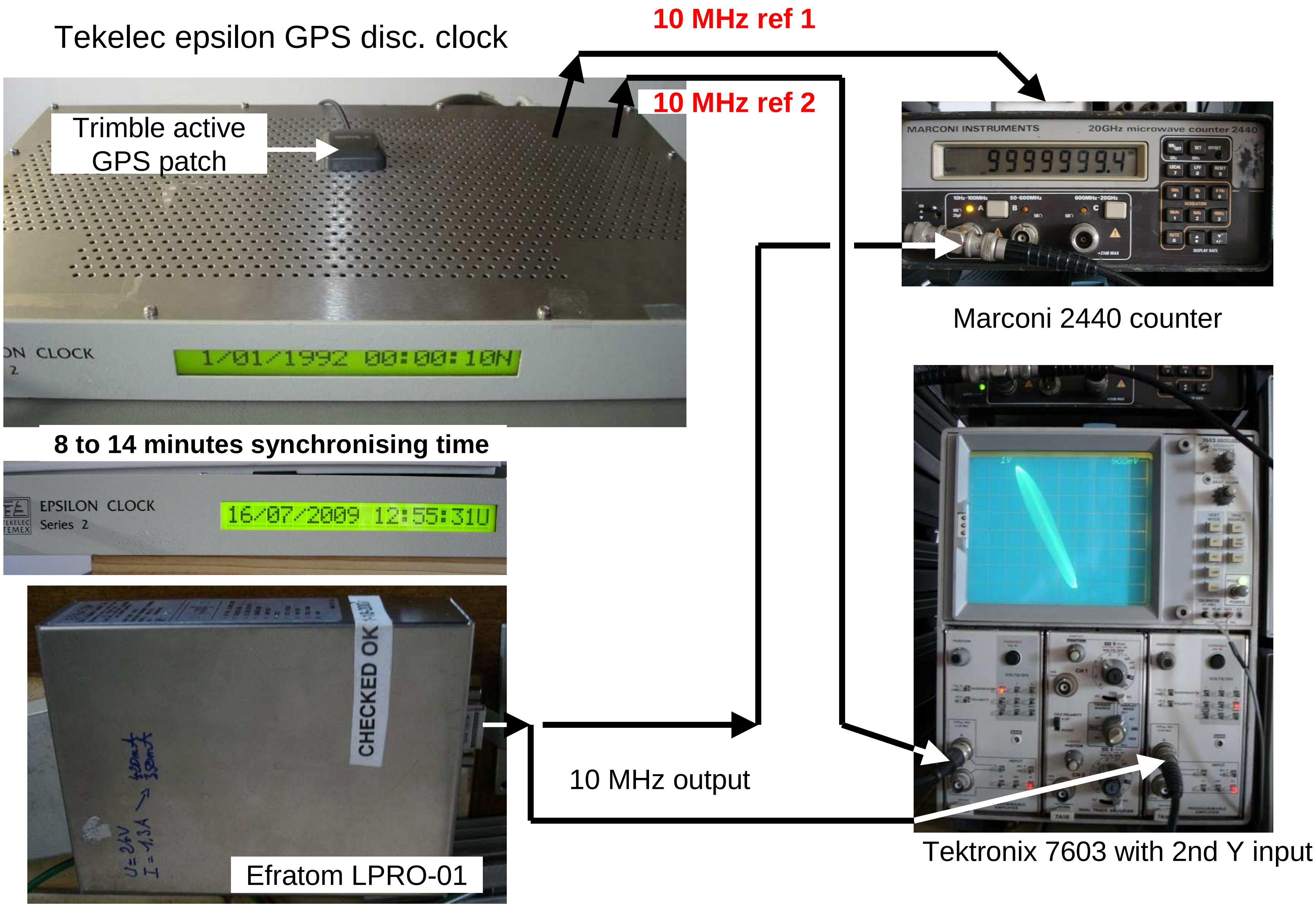
- U DC between 20 and 24V
- I= 1.3A at beginning, 420 mA after 5 minutes

LPRO-01 DC conditions

Connector output pinning



Measurement conditions

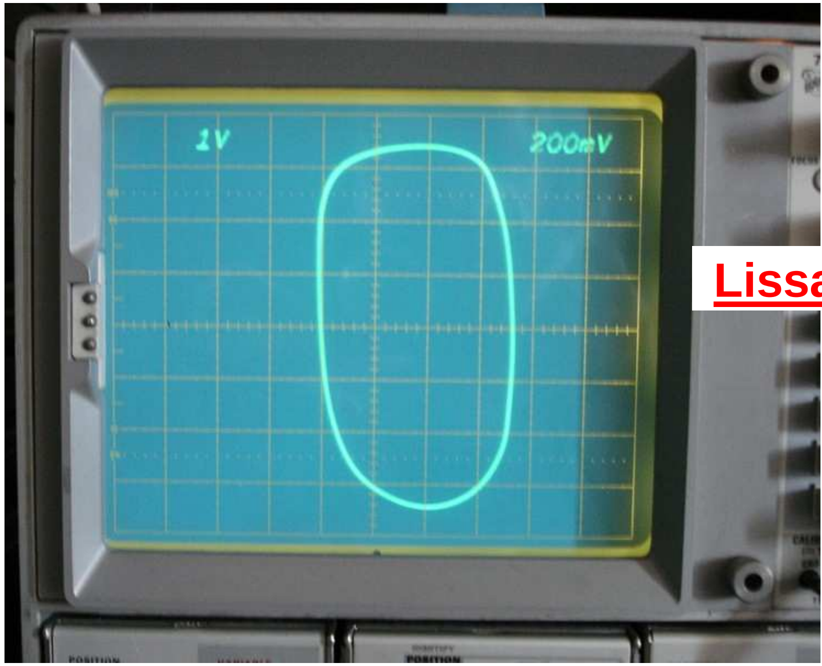


Rough measurement comparaisons

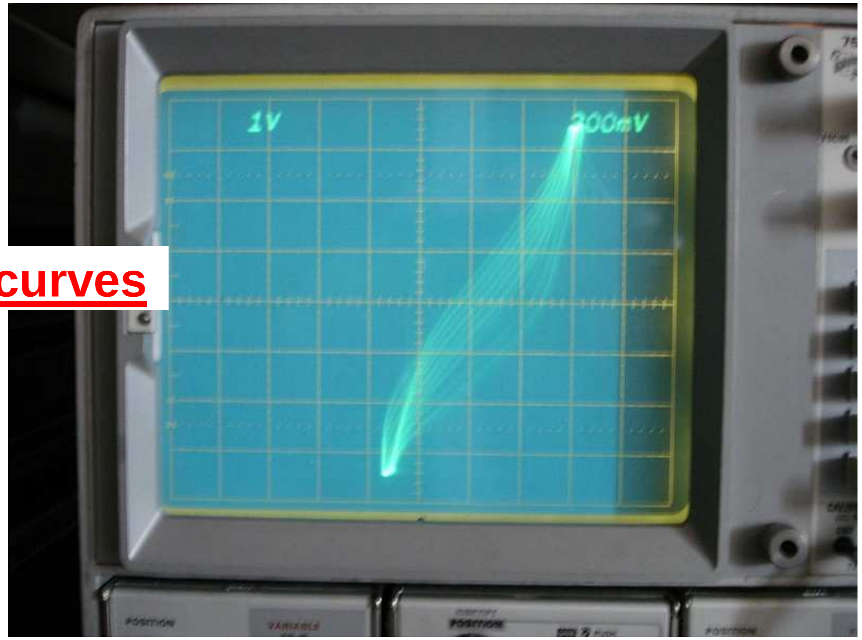
Good one (F6AJW)

Bad one

ΔF -0.6 Hz

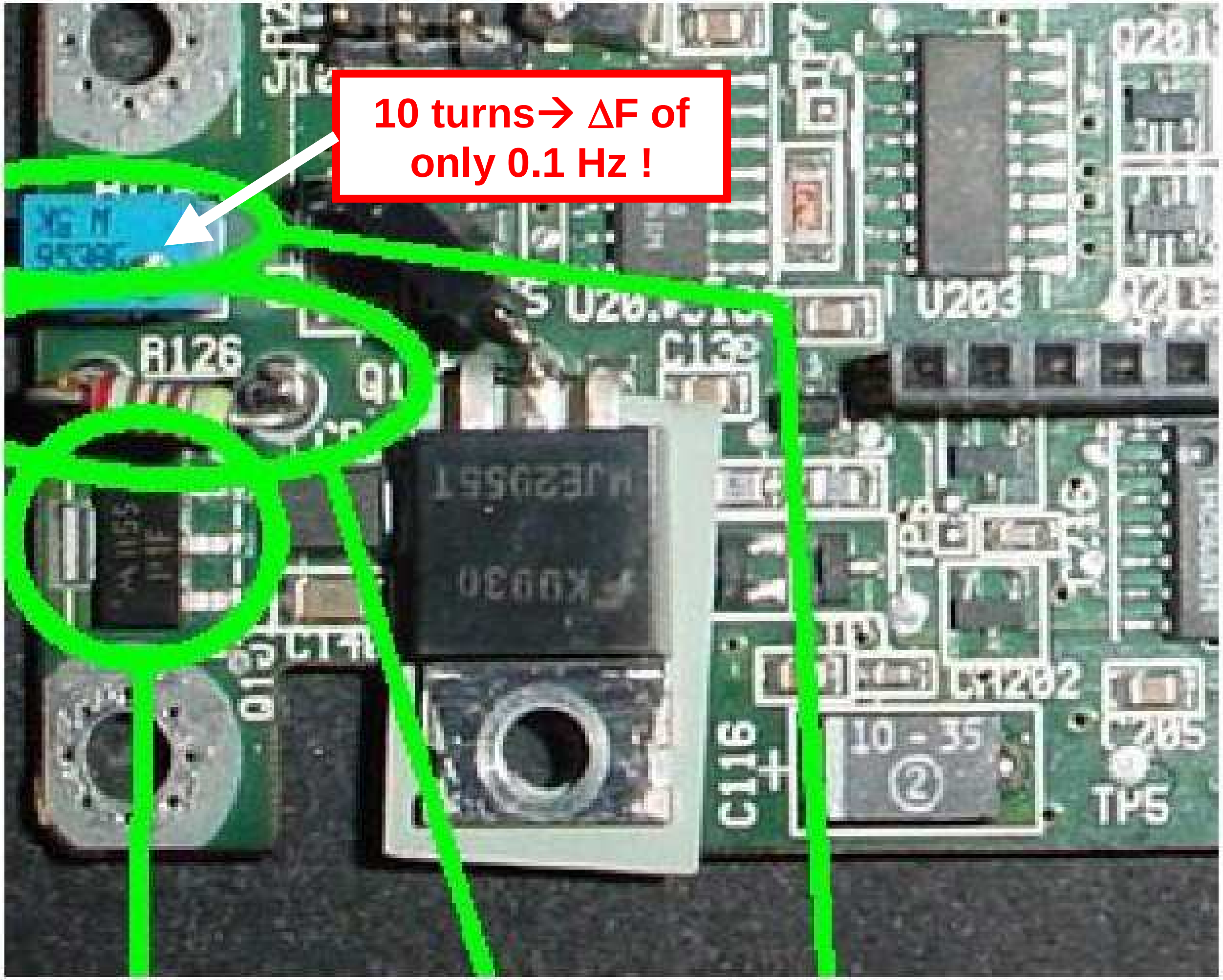


Lissajoux curves



Action on 10 turns trimmpot R116 → Delta F = 0.1Hz

C field adjustments



Q10, PZT2222 R126 R116

Fig 9, C field resistor

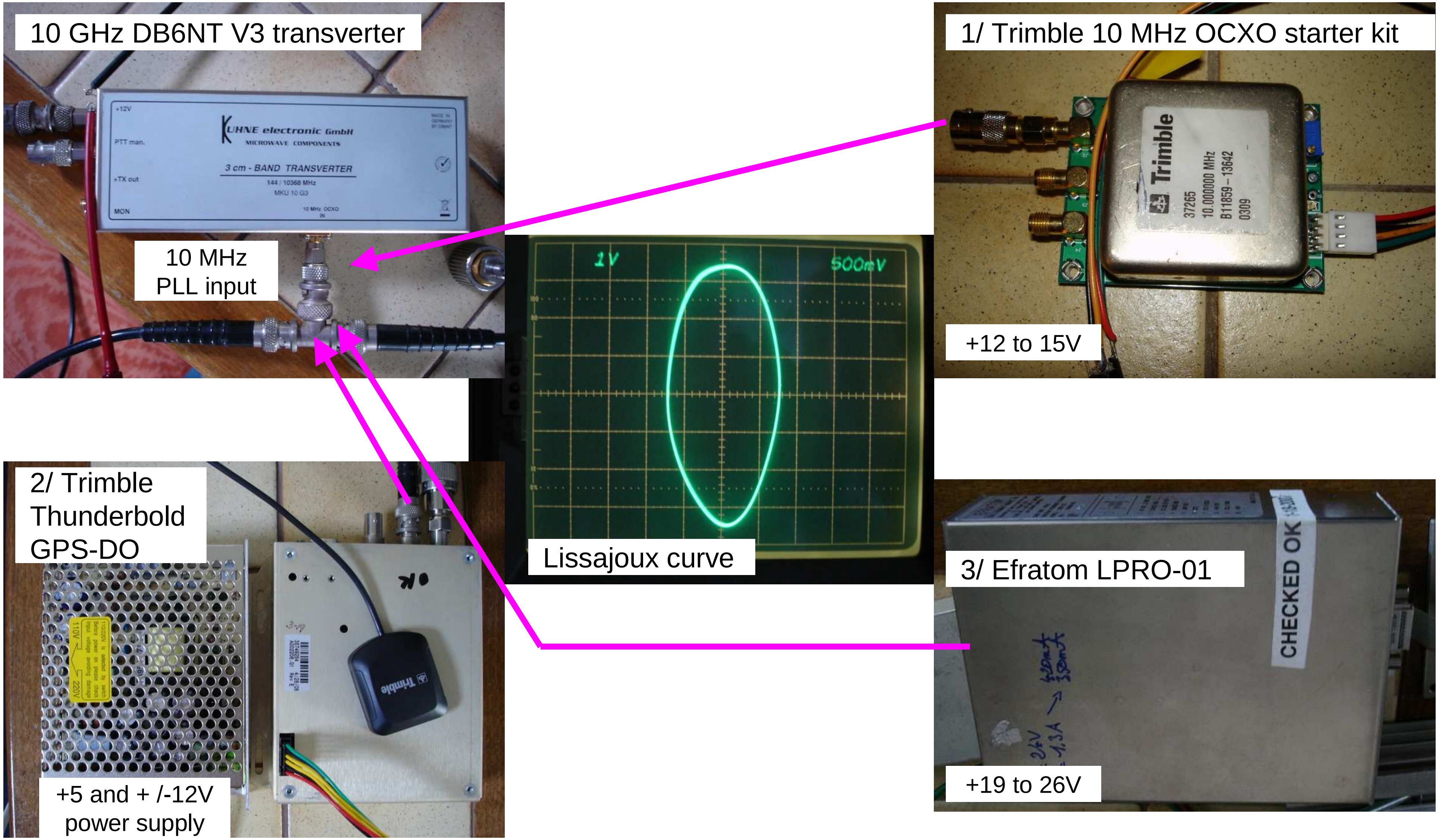
Conclusion : practical LO derate obtained

Transverter derate	106.5 MHz LO	10 MHz locking reference	Final x 100 derate à 10 GHz	Max derate à ΔT =10°C
DB6NT V1	Qz at room temperature		2.5 kHz/°C	25 kHz
DB6NT V2 or V3	Qz with CTP oven		<1 kHz/°C	10 kHz/°C
DB6NT V2	External OCXO		<500 Hz	5 kHz
DB6NT V3		10 MHz OCXO	= 100 times OCXO derate	= 100 times OCXO derate
DB6NT V3		10 MHz LPRO-01 Rubidium	<100 Hz	<100 Hz
DB6NT V3		Disciplined GPS clock	<10 Hz	<10 Hz

Final frequency precision achieved

- Totally depending of the initial source precision center frequency
- Example : a 10 MHz Rubidium source with an initial central frequency error of -0.6 Hz (end of life) gives a final LO frequency resulting error of -60 Hz à 10 GHz
- But what is a 60 Hz error on our 10 GHz hamband ? Sure better than the initial 2.5 kHz/°C

DB6NT V3 PLL comparaison with 10 MHz OCXOs & GPS-DO



DB6NT V3 PLL comparaison with 10 MHz OCXOs & GPS-DO

Receiving a 10 GHz signal coming from an HP 8672a synth, 10 MHz GPS-DO locked
Rx ensemble : FT-817nd + 10 GHz DB6NT V3 transverter with 10 MHz PLL

10 MHz PLL references	Stabilisation time (min)	Frequency error à 20°C (kHz)	I_0 (mA)	Istab à 12V(mA)
None (DB6NT alone à 10368.100 MHz)	>15 to 20	+17 kHz	230/12V	
Trimble OCXO starter kit	>6	+300 Hz	315/12V	157/12V
Trimble Thunderbold GPS-D0 + antenna patch	>3 (usable) >6 (GPS locked)	+200 Hz None		
Efratom LPRO-01	3min 30sec	None (<10Hz)	1450/21V	520/21V

- 10 MHz absolute time reference : Tekelec Epsilon GPS-DO + antenna patch from F6AJW
- RF source : HP 8672a synthesiser à 10368.100 MHz locked to same Tekelec GPS-DO ref

NB:
- after adequate warming time, an HP 8672a synth unlocked has an error of about 200 Hz à 10368 MHz
- The Trimble Thunderbold needs a +-12V and a +5V power supply
- LPRO-01 power suply between +19 and +26V