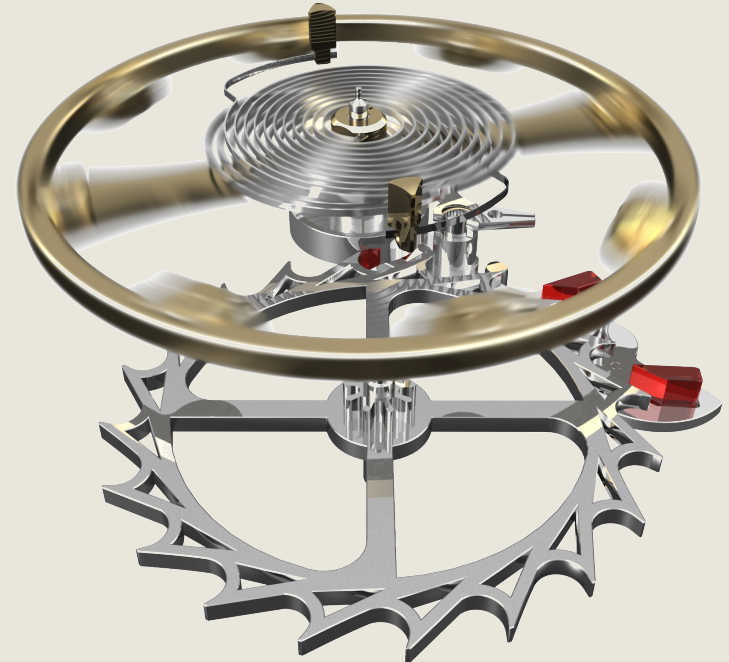
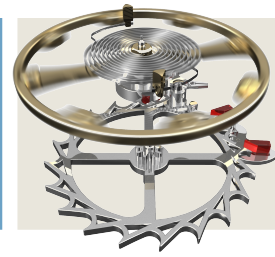


## VidéoBalisomètre

Antoine Châlons, software engineer  
[www.qmt.ch](http://www.qmt.ch)

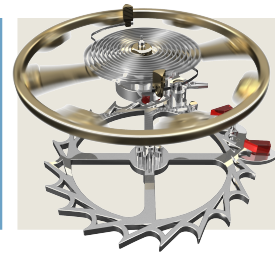


# First, a little bit of history



- 2003 : Audemars Piguet starts looking for new measurement technologies
- 2005 : The VidéoBalisomètre project starts with QUALIMATEST
- 2007 : The concept is presented at Chronometry International Congress
- 2009 : The fully functional VidéoBalisomètre is exposed at EPHJ
- 2010 : Final deliverly to Audemars Piguet
- 2011 : Audemars Piguet R&d Lab is asking for evolutions

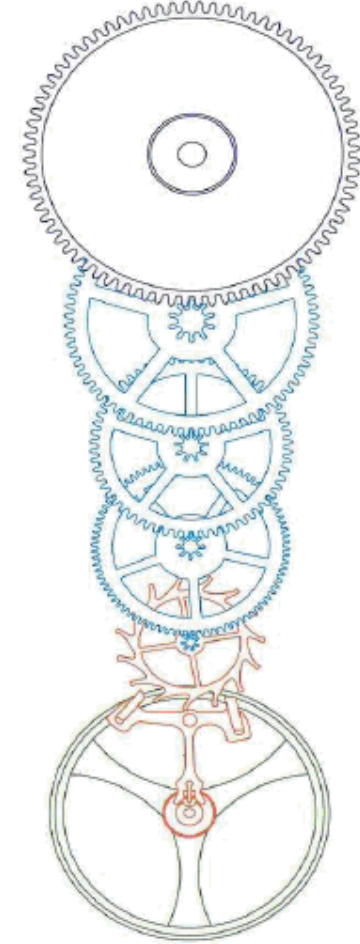
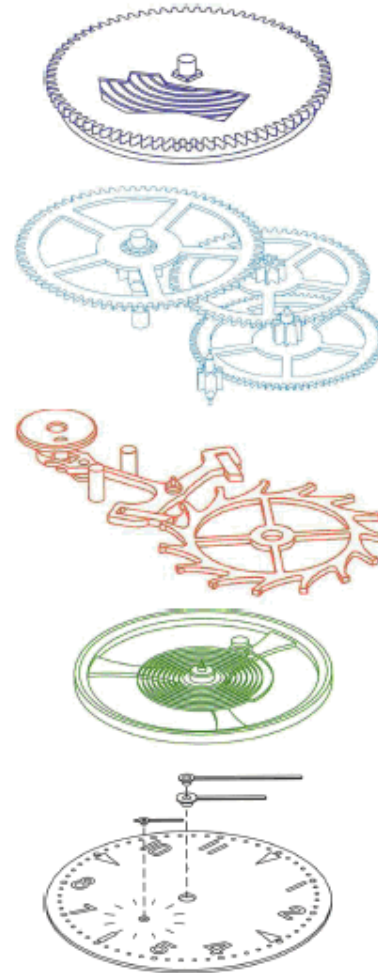
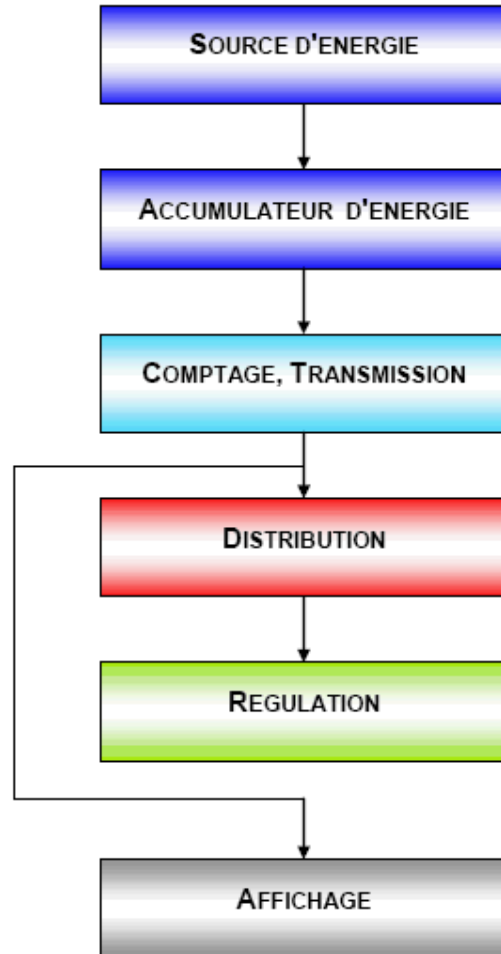
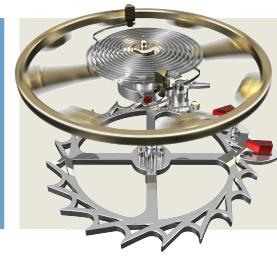
# Presentation summary



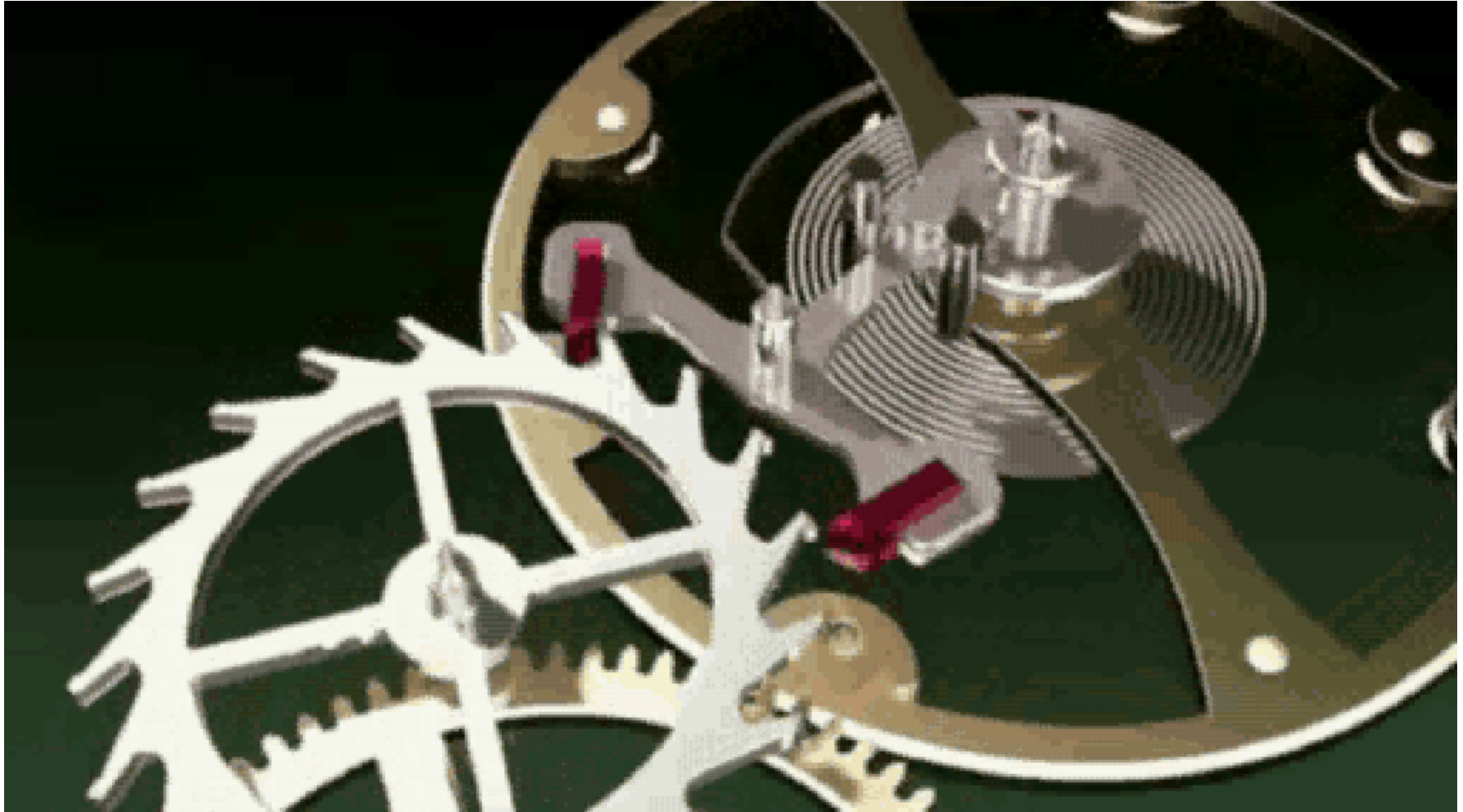
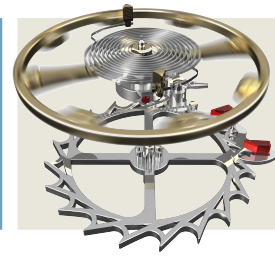
- What's the regulating organ... briefly
- The challenge submitted by Audemars Piguet
- Our answer :
- Measurement methods



# The regulating organ in the watch

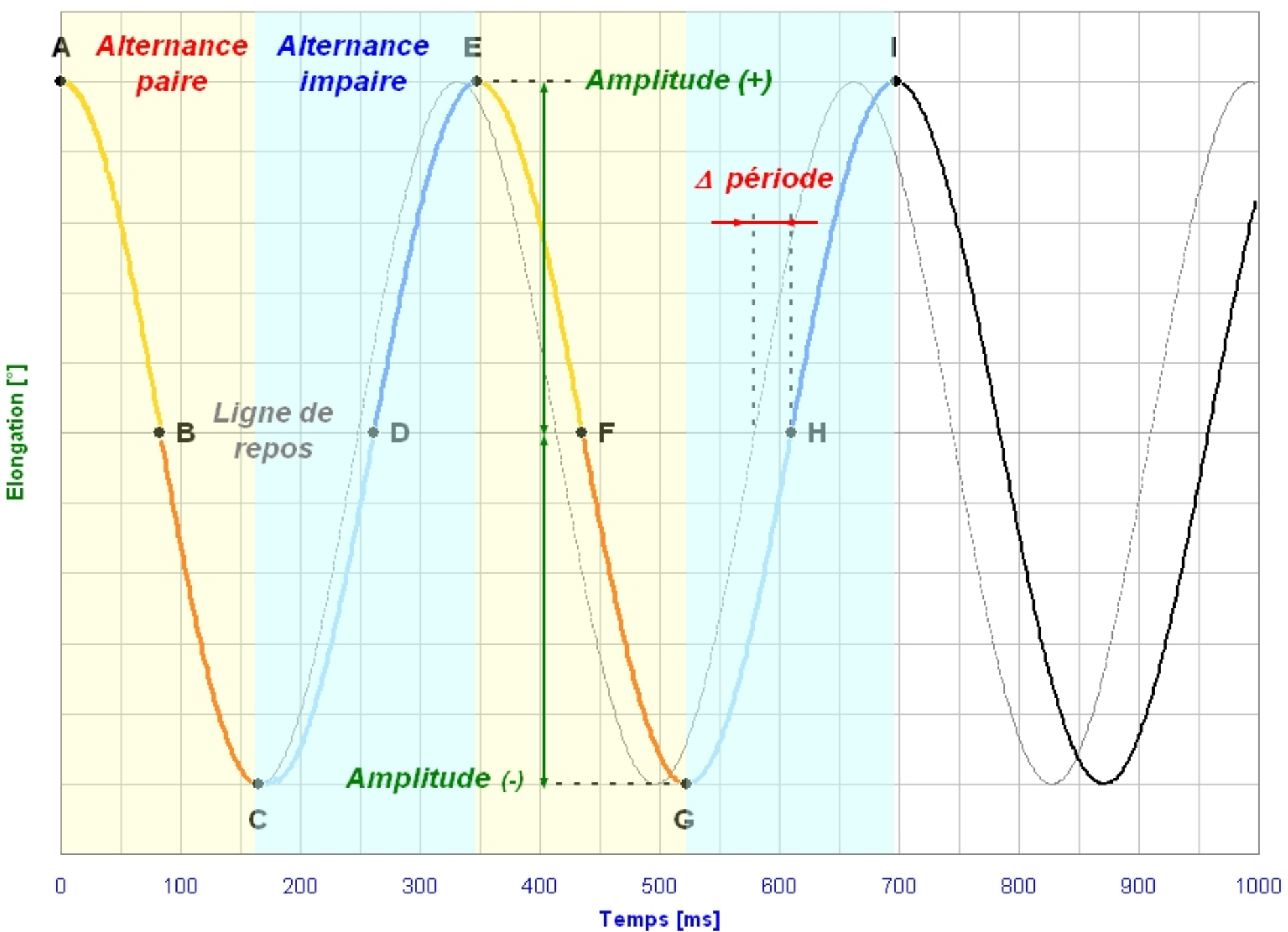


# The regulating organ in the watch



----- Position théorique

— Position mesurée



**A** *Alternance paire*

*Alternance impaire*

**E** *Amplitude (+)*

*Ligne de repos*

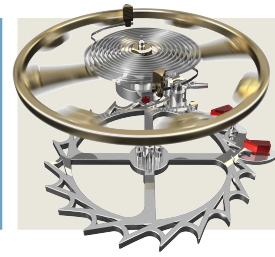
$\Delta$  période

*Amplitude (-)*

0 100 200 300 400 500 600 700 800 900 1000

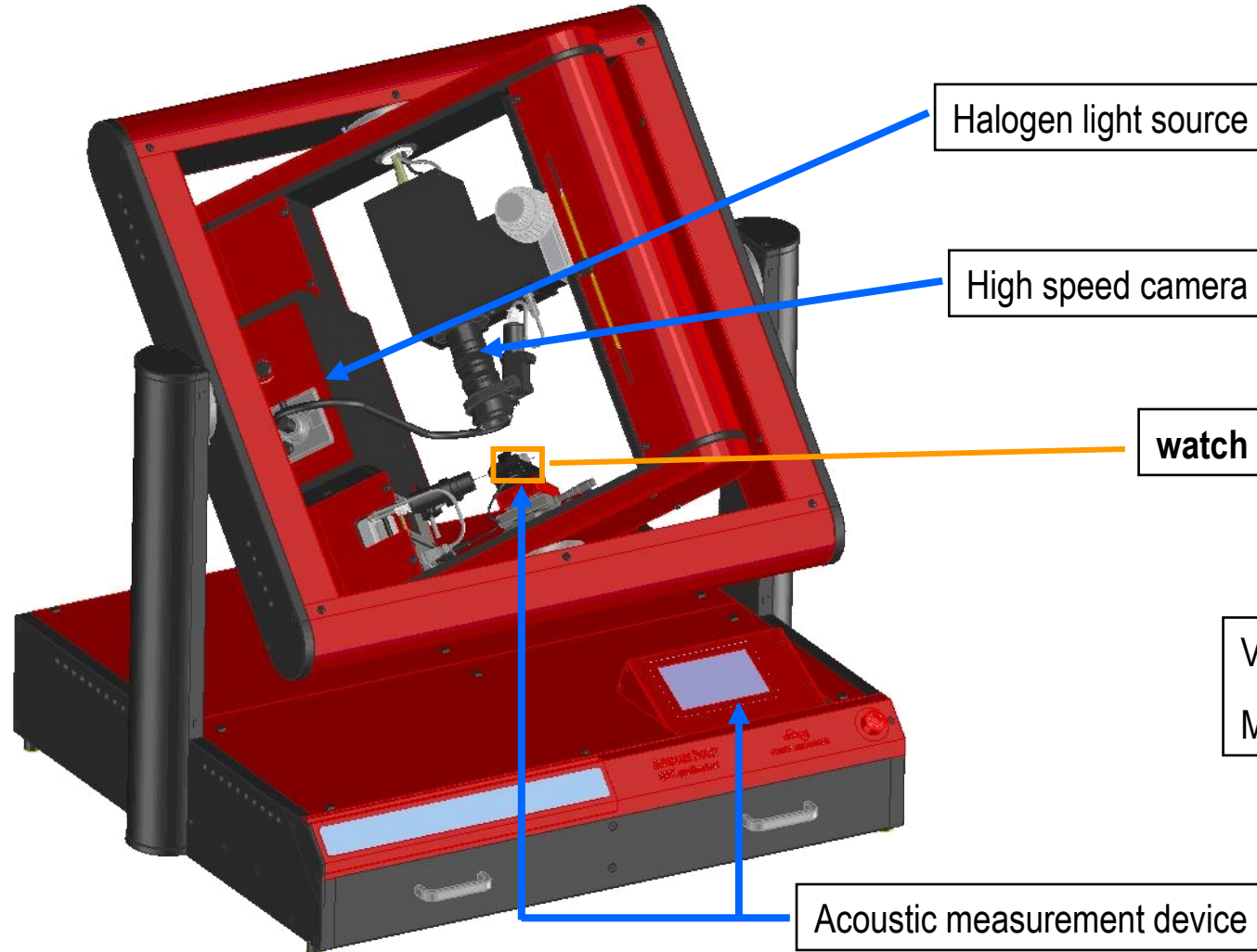
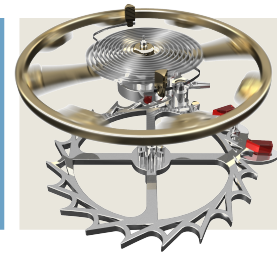
Temps [ms]

# The challenge submitted by Audemars Piguet



- Measures to perform **continuously** :
  - Balance wheel amplitude from  $400^\circ$  to  $0^\circ$  with  $0.5^\circ$  accuracy
  - Balance wheel max speed with  $1^\circ/\text{ms}$  accuracy
  - Frequency accuracy in seconds/day with 1s/d accuracy
    - for  $F = 3 \text{ Hz} > T \sim 333.3333333333\dots \text{ ms}$
    - If we measure  $T = 333.0 \text{ ms}$  then the watch gains 86.4 seconds each day
    - If we measure  $T = 333.337 \text{ ms}$  then the watch loses 1 seconds each day
- The measures can last from 60 seconds up to 10 days
- The watch can be placed in any orientation

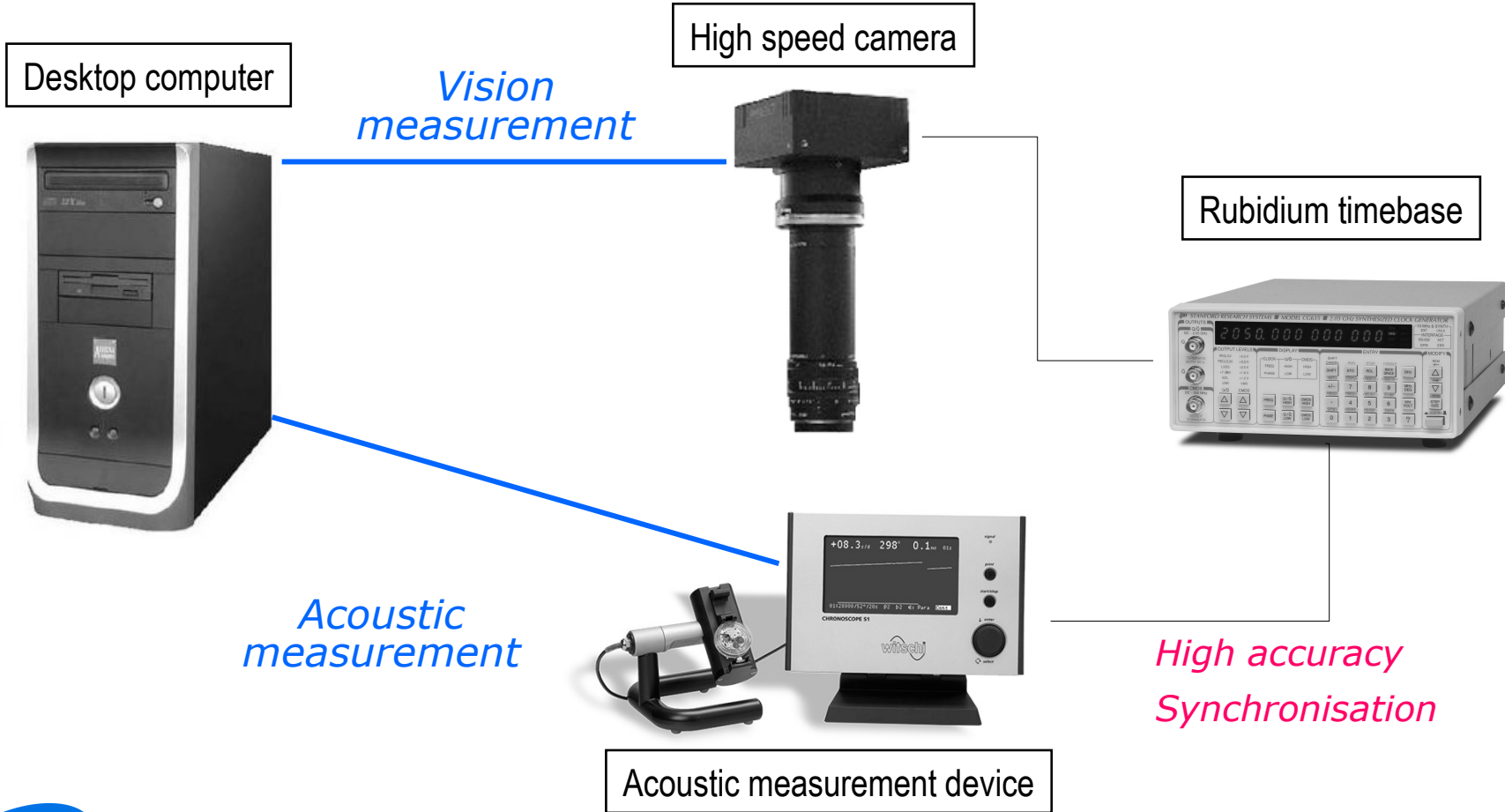
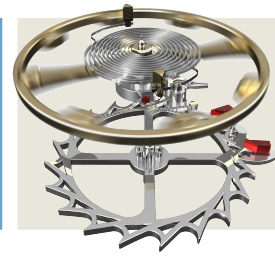
# Our answer : the VidéoBalisomètre



Volume	: < 1 m <sup>3</sup>
Masse	: ≈ 100 kg



# Our answer : the VidéoBalisomètre



Mesure Standard

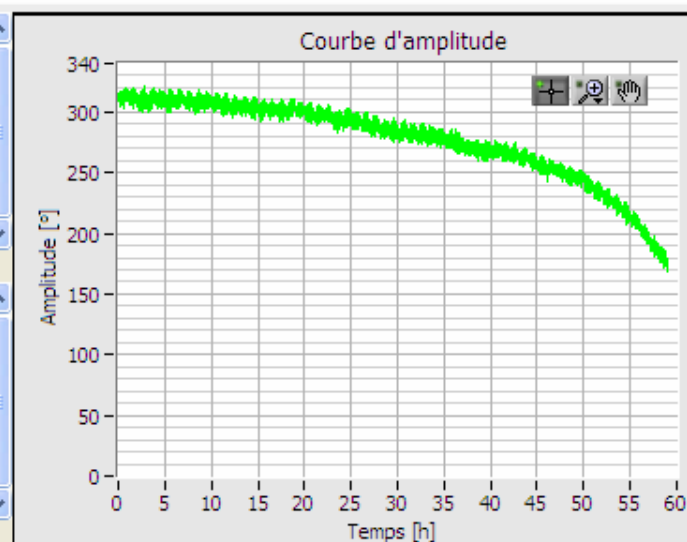
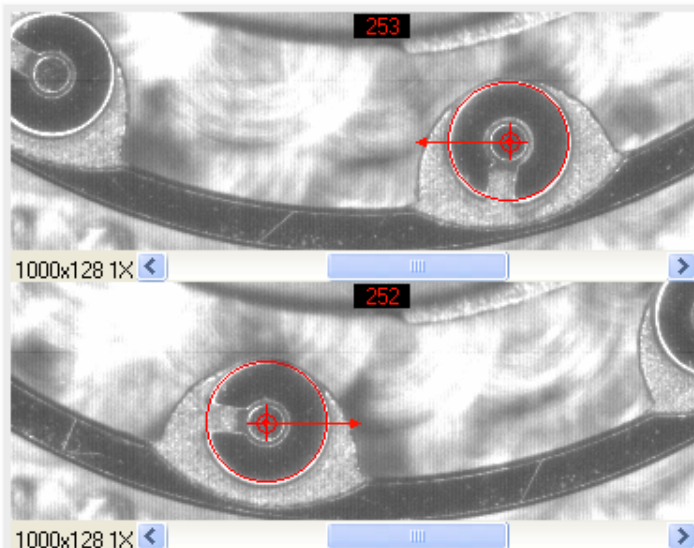


1.0 x



Général

Arrêter la mesure



Marche [s/j]

10.85

10.41

10.57

Amplitude [°]

170.2

162.4

Repère [ms]

0.2

0.2

Vitesse Max [°/ms]

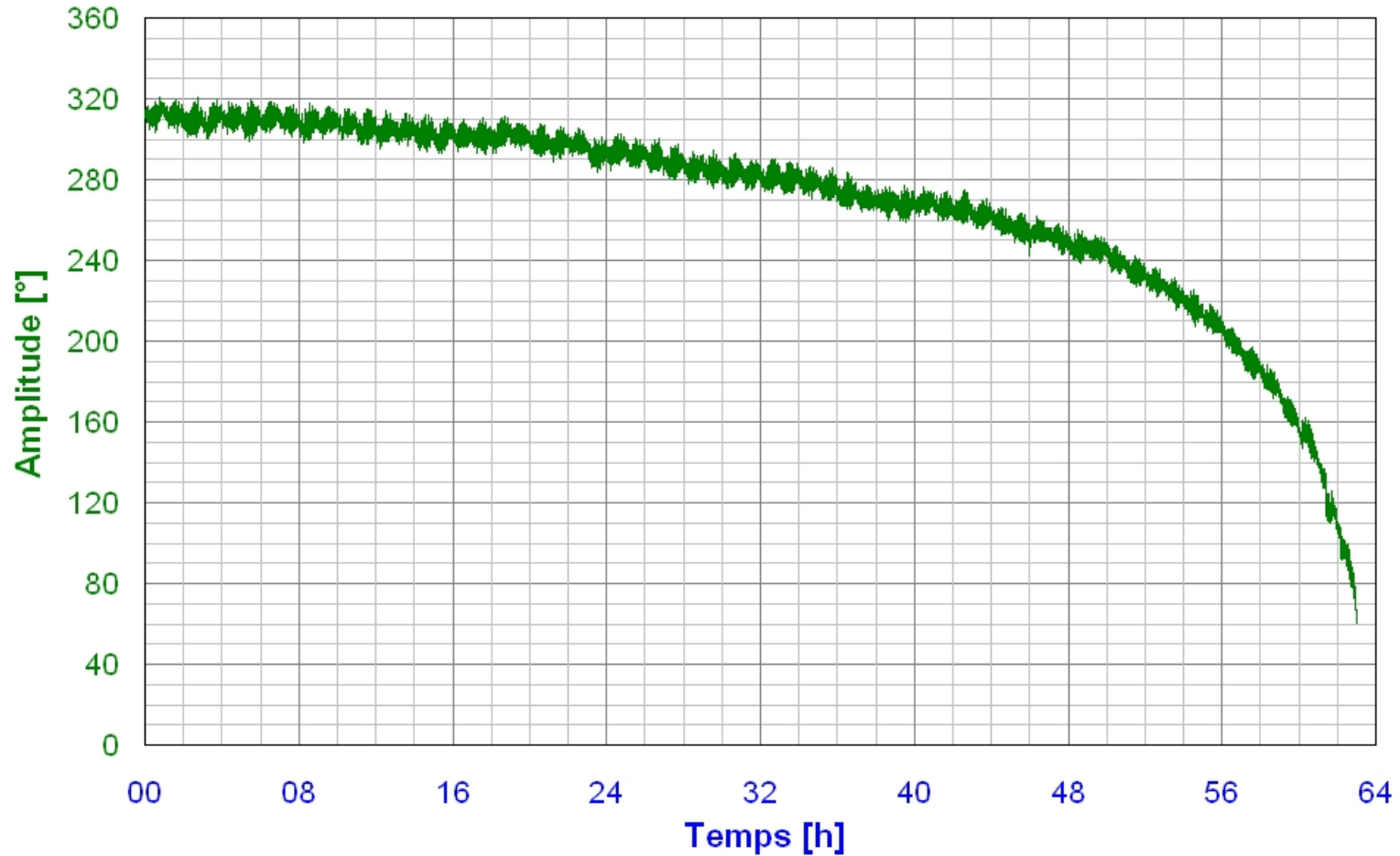
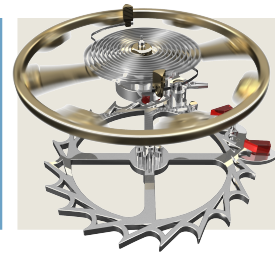
4.0

Vision

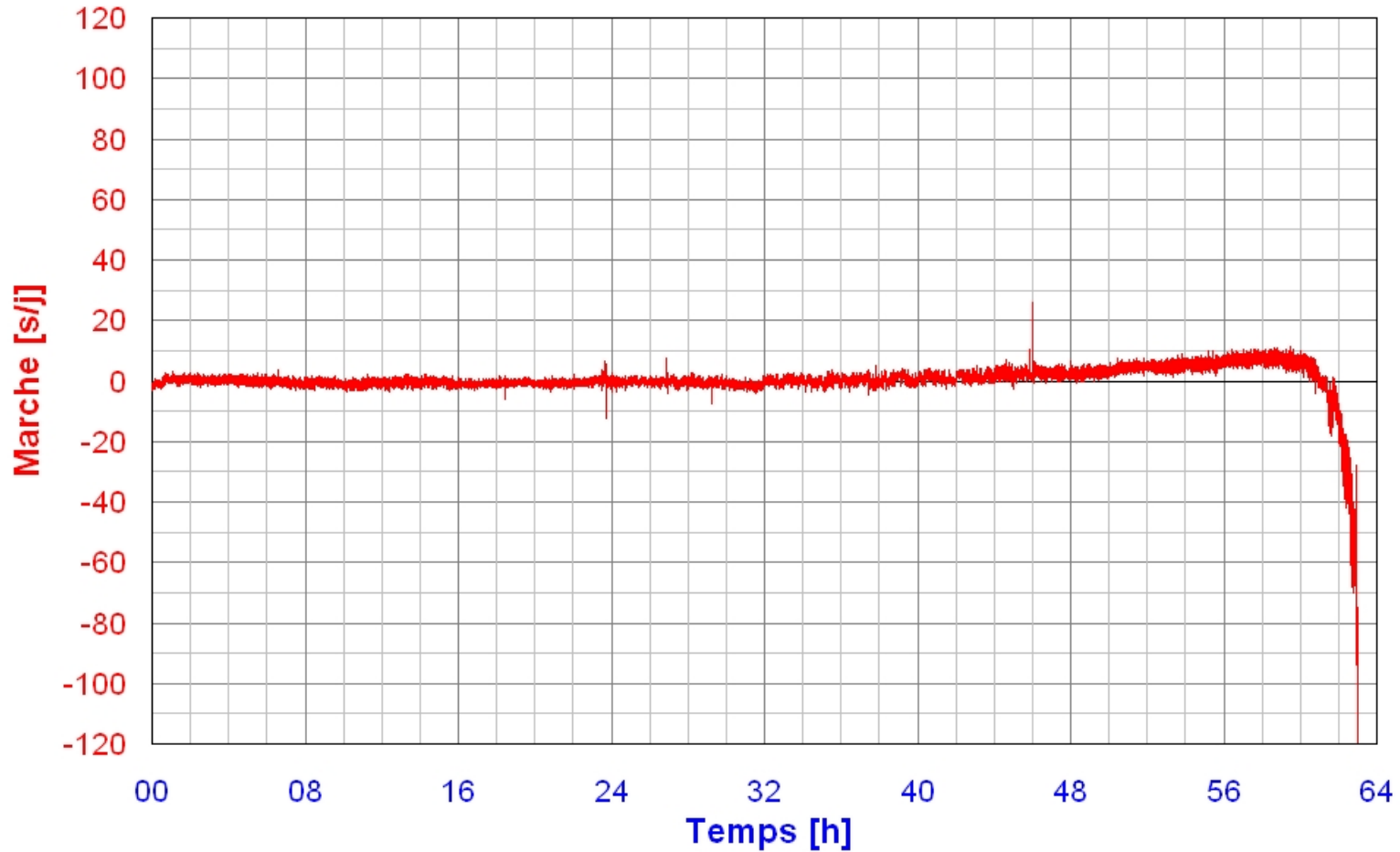
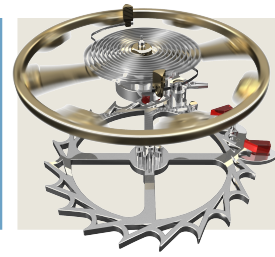
Acoustique Directe

S1 RS232

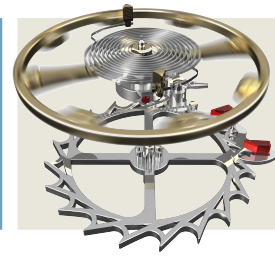
# Measure with escapement



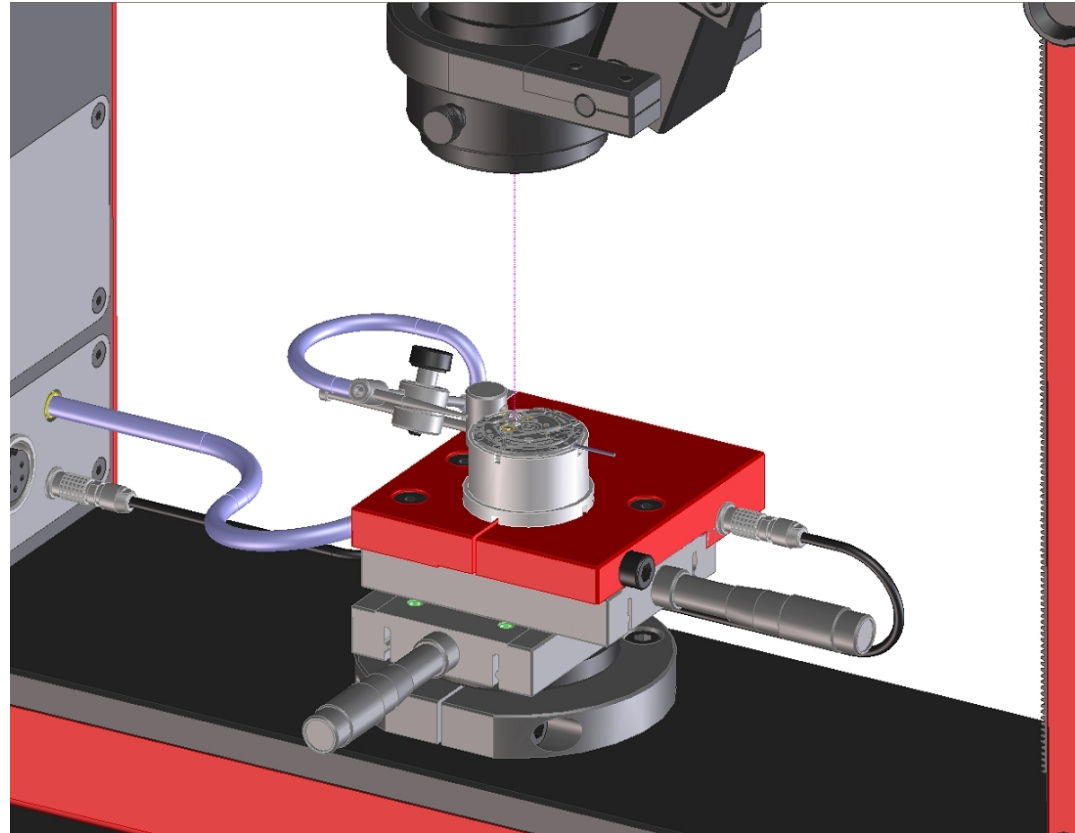
# Measure with escapement



# Measure without escapement



- The regulating organ is a free oscillating system
- A triggered pneumatic system will start the oscillation
- Only the vision measurement are possible
- Measure will last between 30 and 90 seconds only

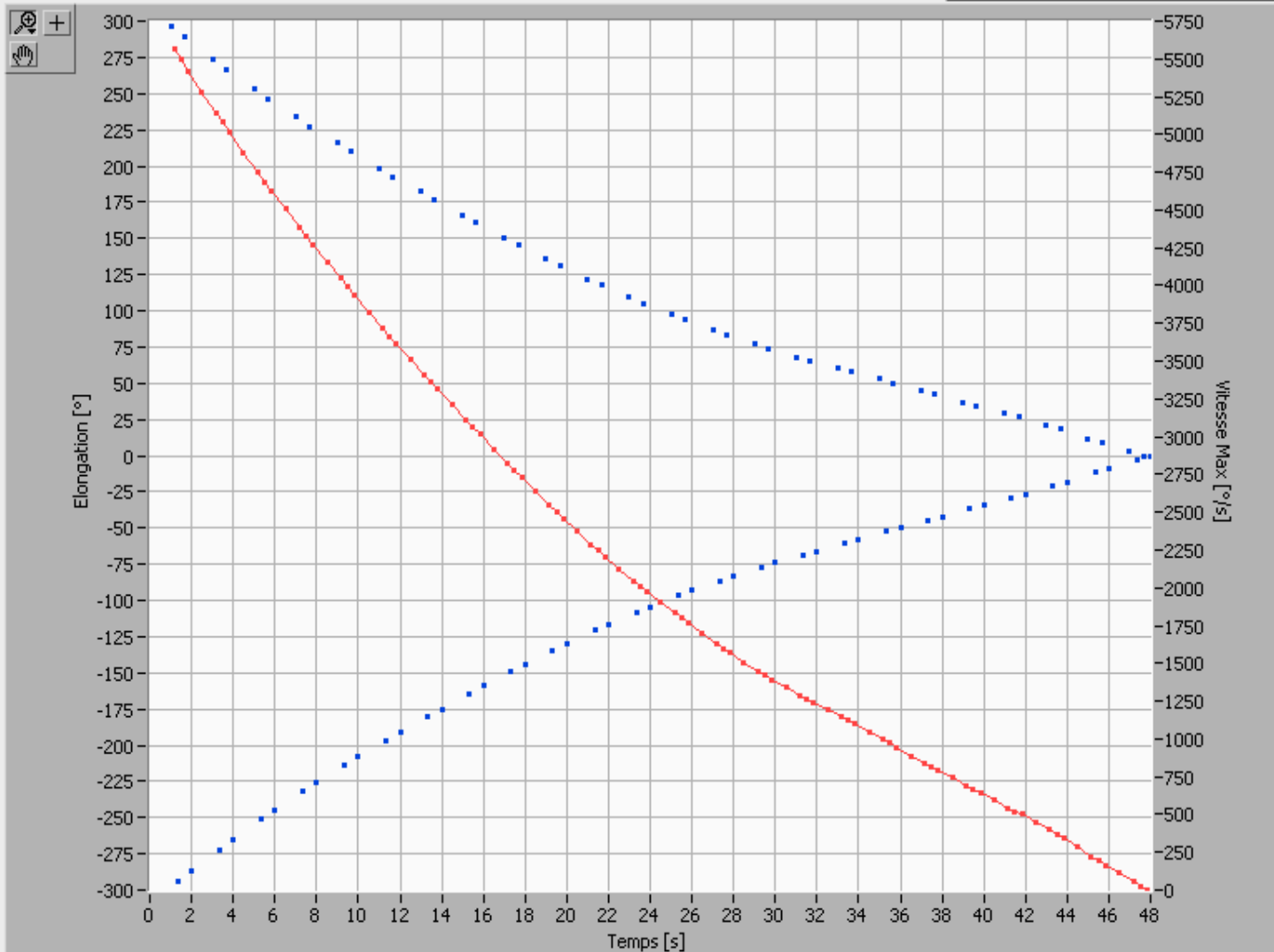


Continuer

amplitude et vitesse



élongation Vitesse Max



Amortissement	Facteur de Qualité
0.06919	136.207
Amortissement A	Facteur de Qualité A
-0.05027	187.482
Amortissement B	Facteur de Qualité B
-0.05021	187.722

élongation

Numéro du mouvement

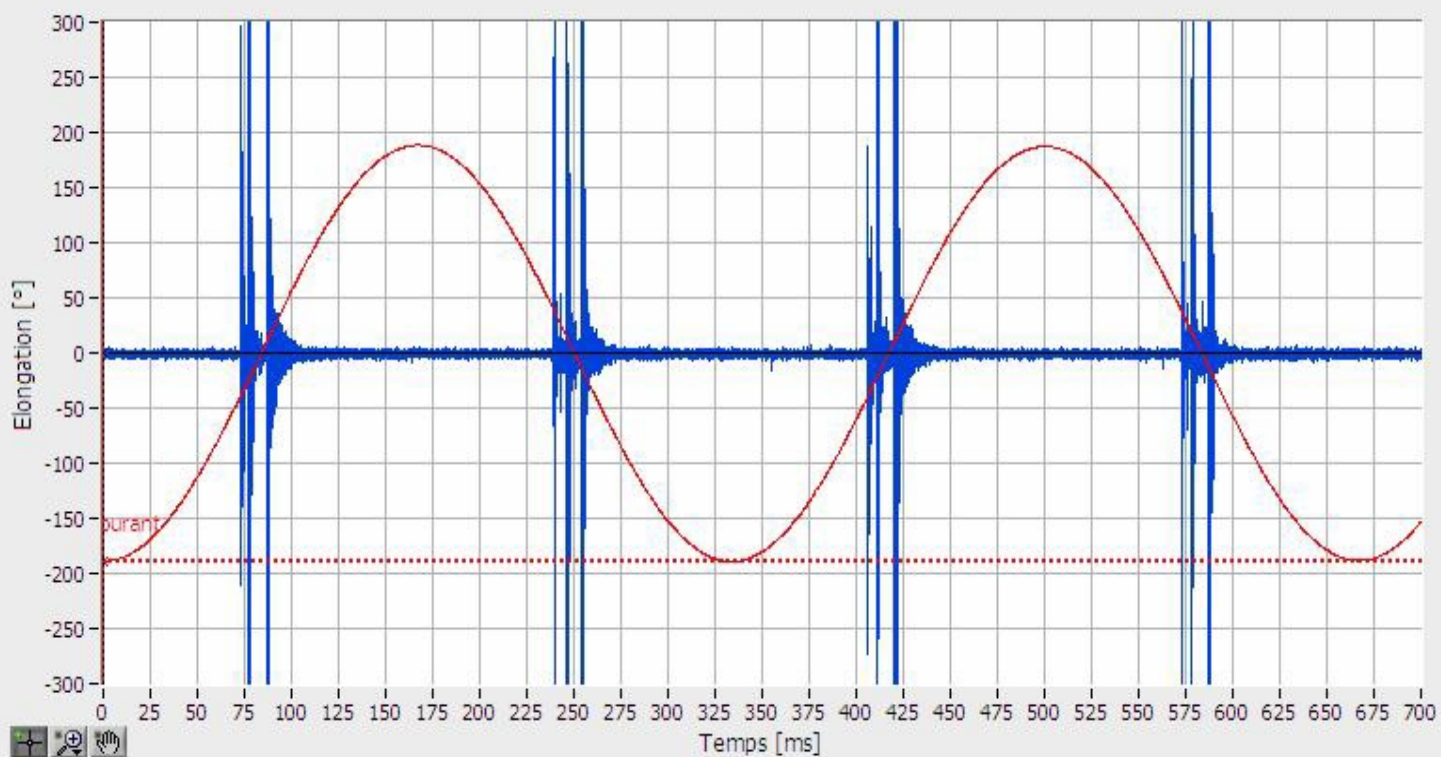
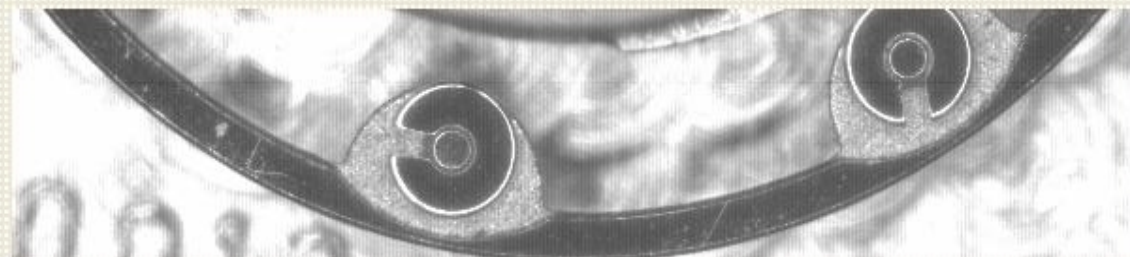
123456

Fréquence [Hz]

3



Sequence Erreur

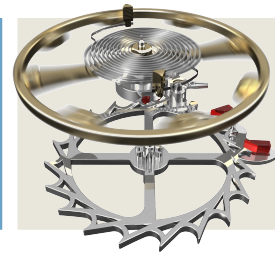


Elongation   
Signal Digital   
Signal Acoustique

point courant 0 -189



# If you want to know more



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  - +41 – 22 884 00 30
- Find us on the Web
  - [www.qmt.ch/](http://www.qmt.ch/)
  - [info@qmt.ch](mailto:info@qmt.ch)