Impact of Oscillator Noise on PTP Time Error – Part 1

OCP-TAP Meeting on August 12, 2020

Nazariy Tshchynskyy – Sr. Mgr, Customer Engineering
Gary Giust – Sr. Mgr, Product Marketing
Jeff Gao – Dir, Product Marketing

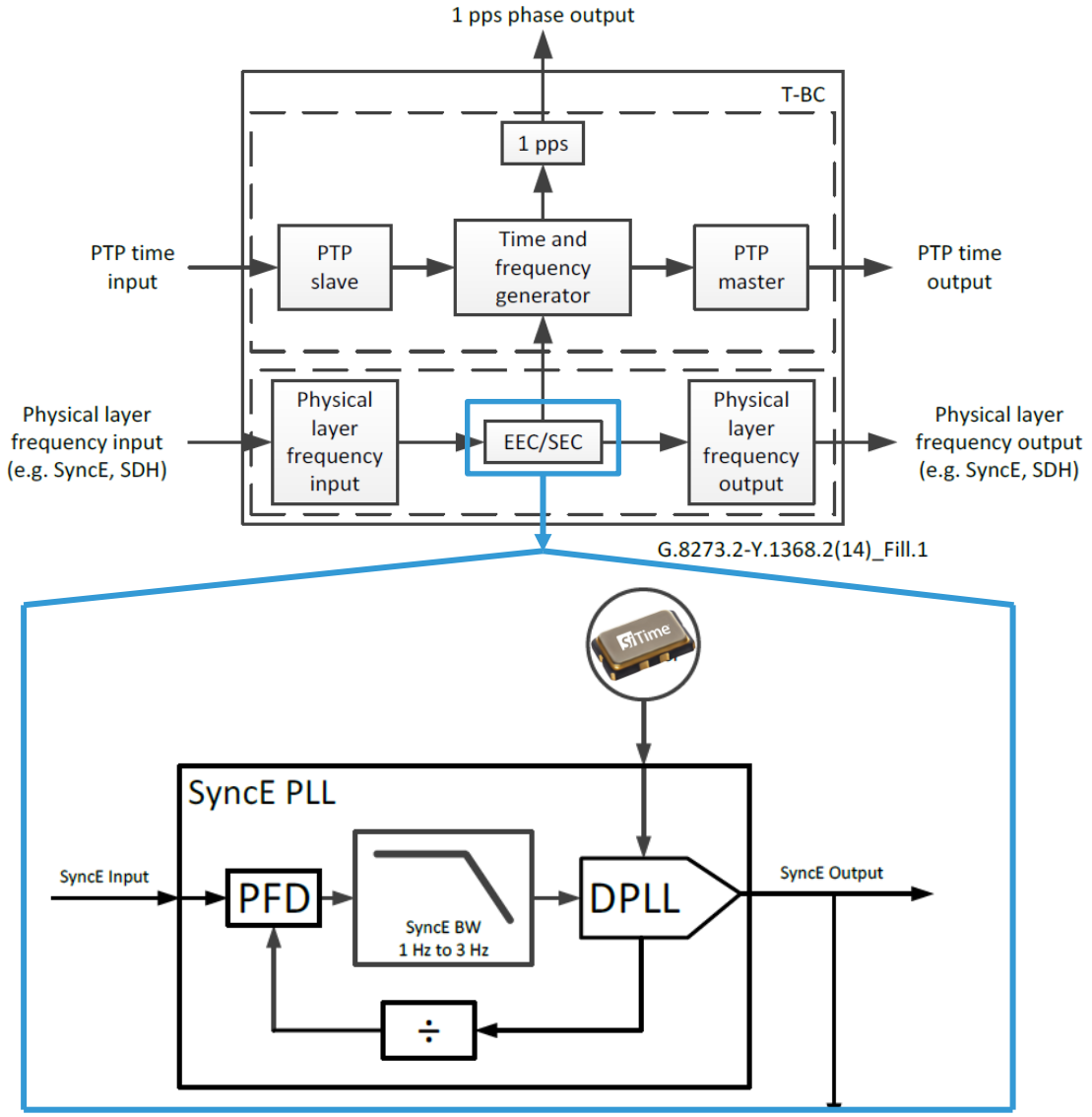
SiTime

Impact of Precision Oscillator Noise on PTP Time Error

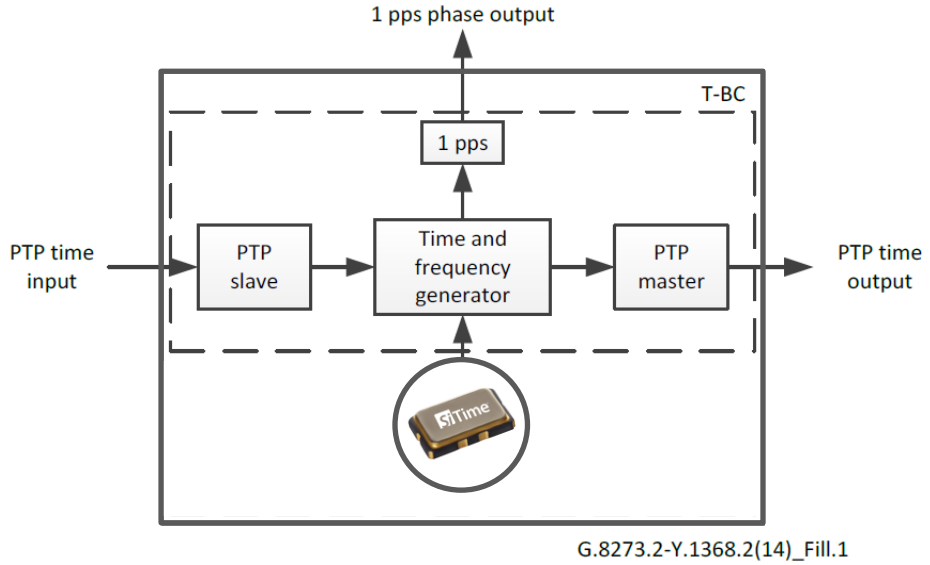
- IEEE 1588 PTP is becoming the de facto synchronization standard in 5G and data center applications
- Requires high-quality local oscillator for best PTP performance
- Important to model impact of oscillator noise on PTP time error
  - Temperature sensitivity
  - Wander
  - Aging
- A dual-MEMS architecture can minimize PTP time error

Oscillators in IEEE 1588

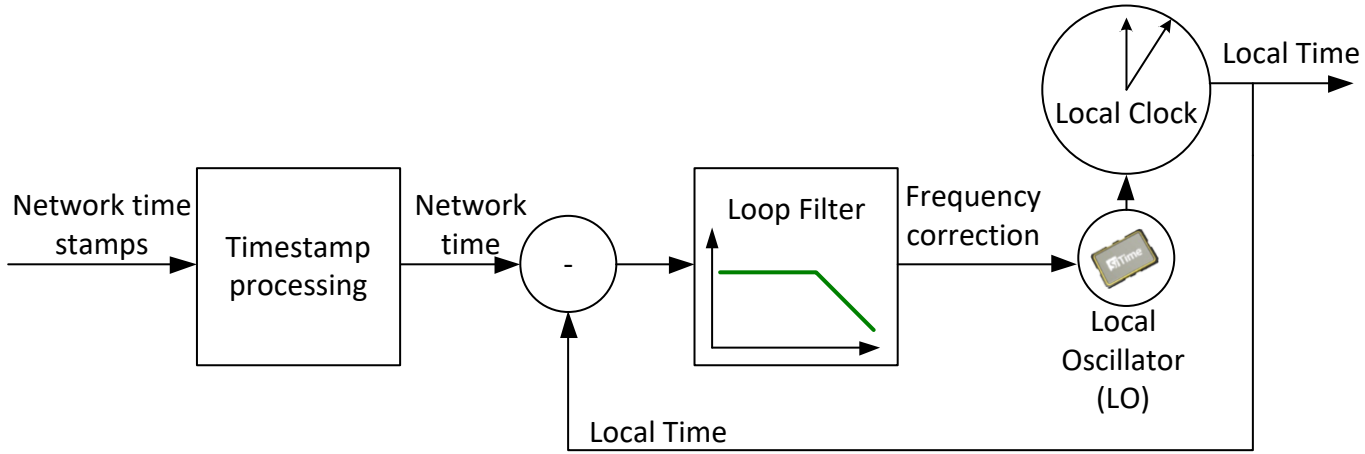
PTP with Physical Layer Frequency Support

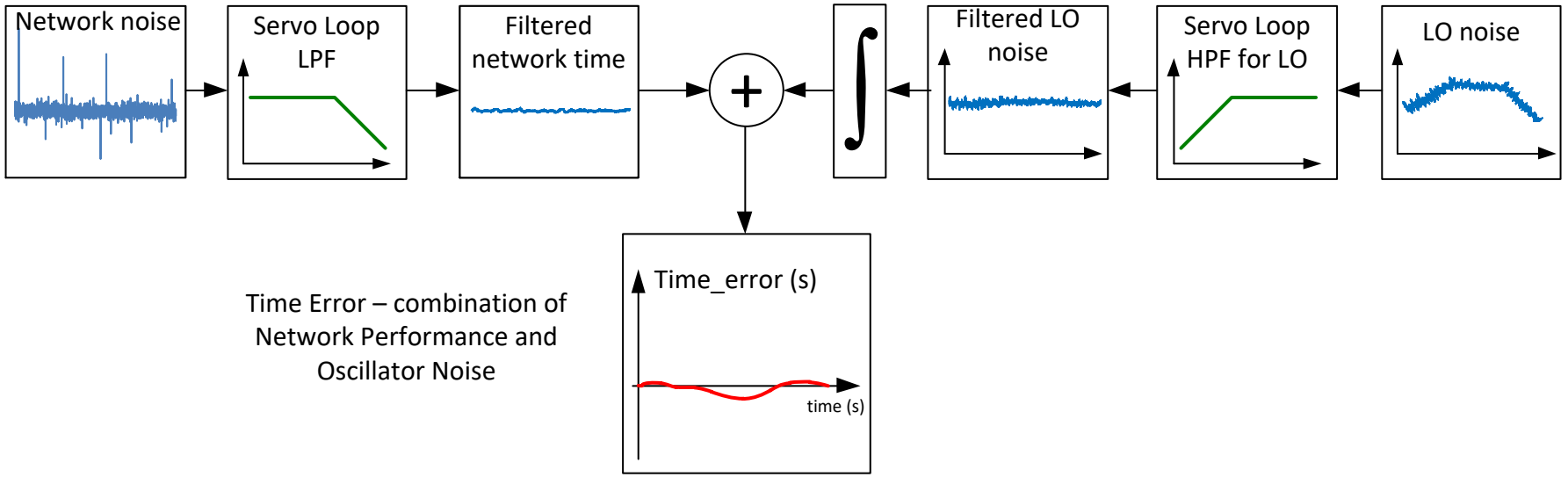


PTP without Physical Layer Frequency Support



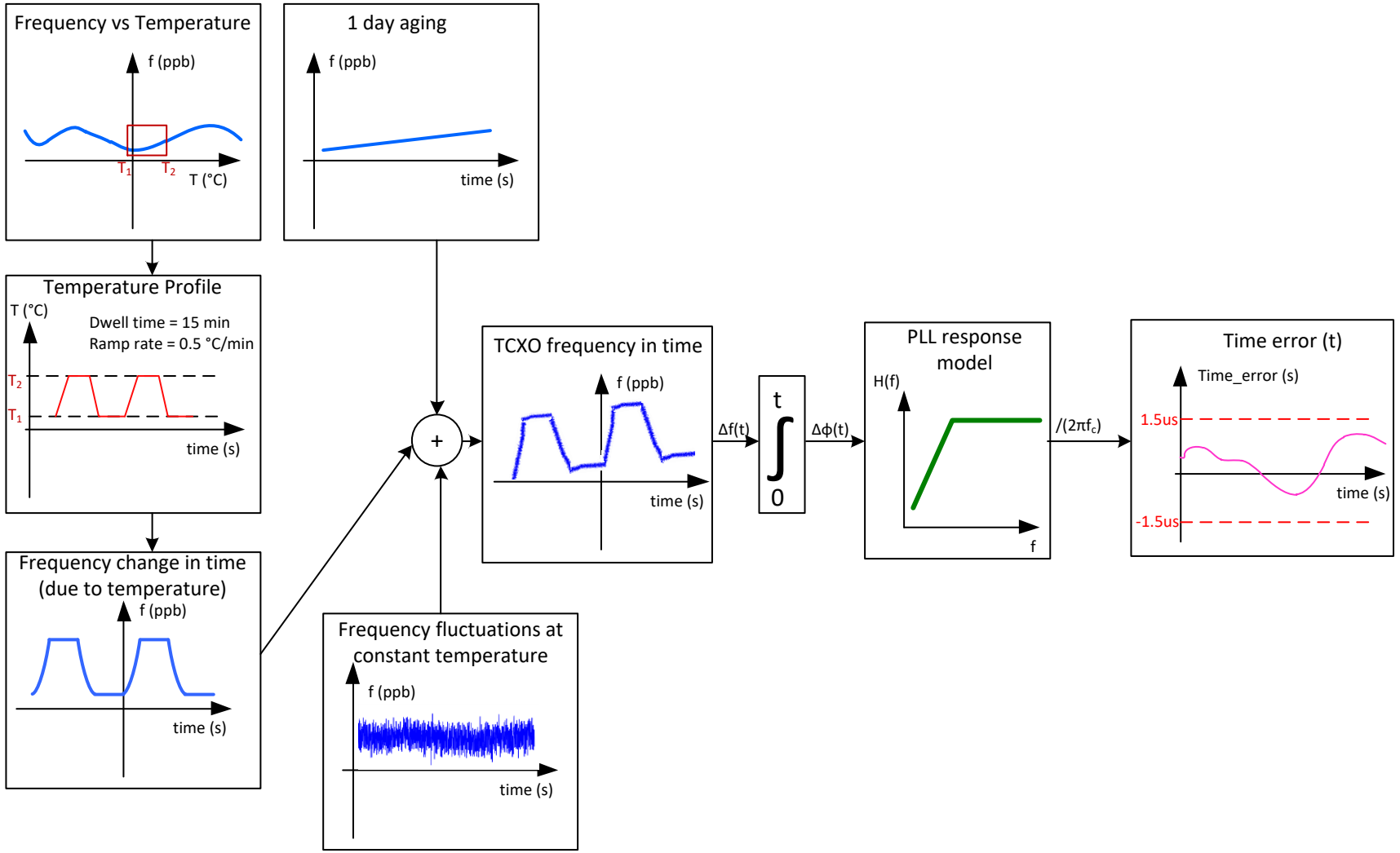
Connecting Oscillator Performance to IEEE 1588 Time Error



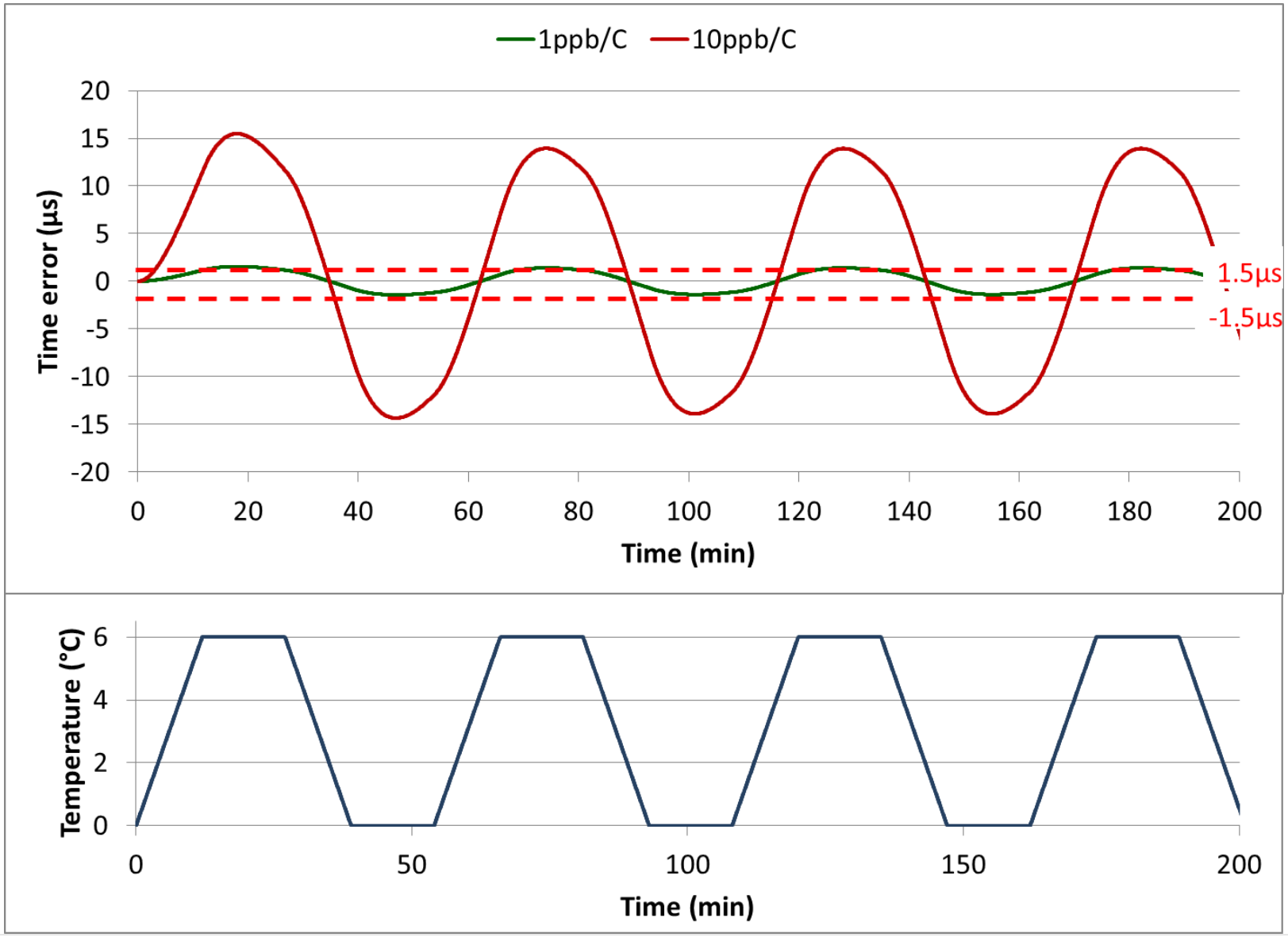


Time Error – combination of Network Performance and Oscillator Noise

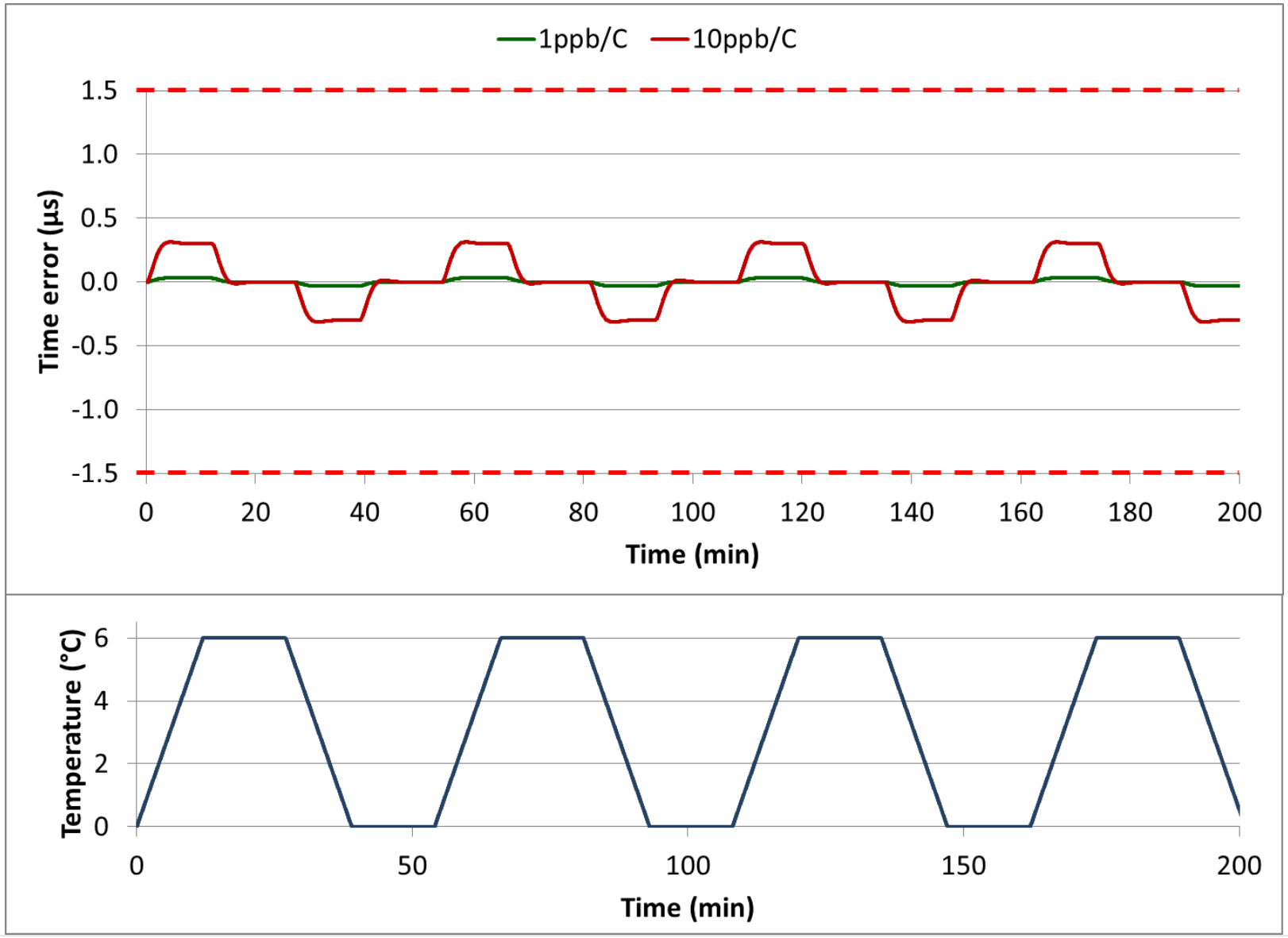
Modeling the Time Error Contribution from Local Oscillator



PTP Time Error for 1 ppb/°C and 10 ppb/°C TCXO (time constant = 10 min)

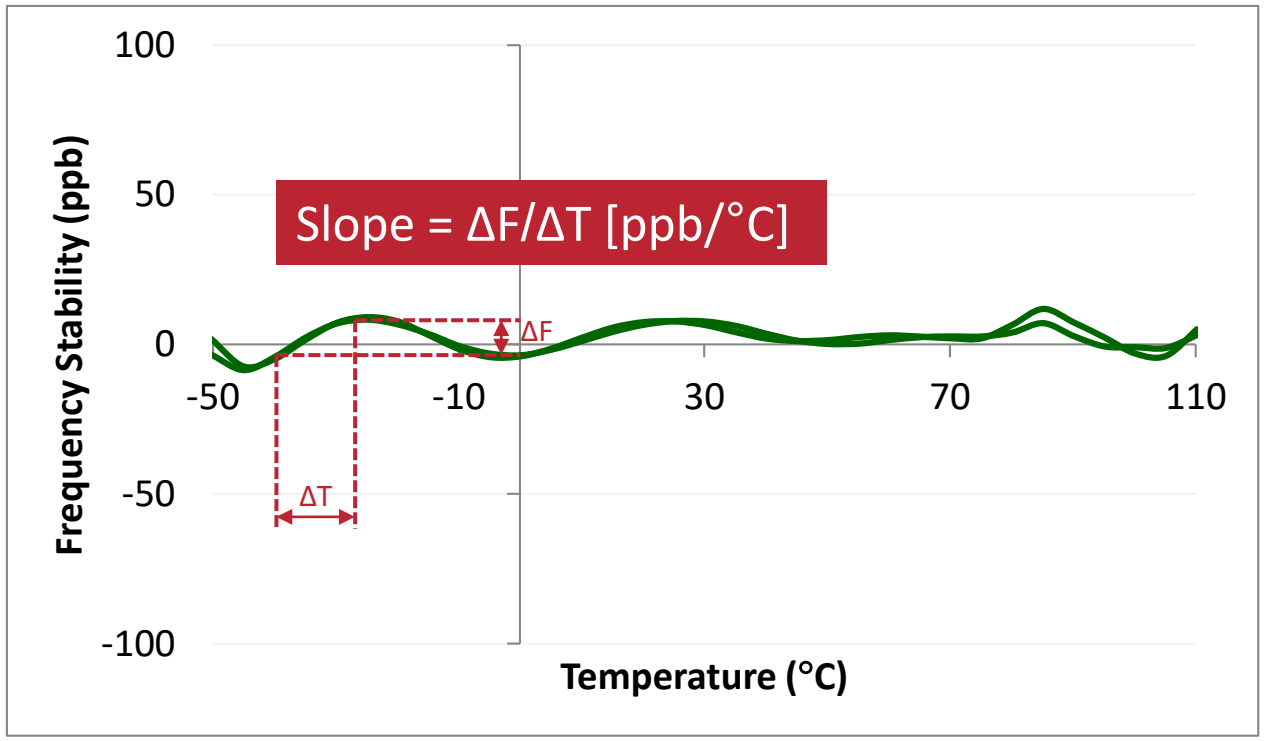


PTP Time Error for 1 ppb/°C and 10 ppb/°C TCXO (time constant = 1 min)



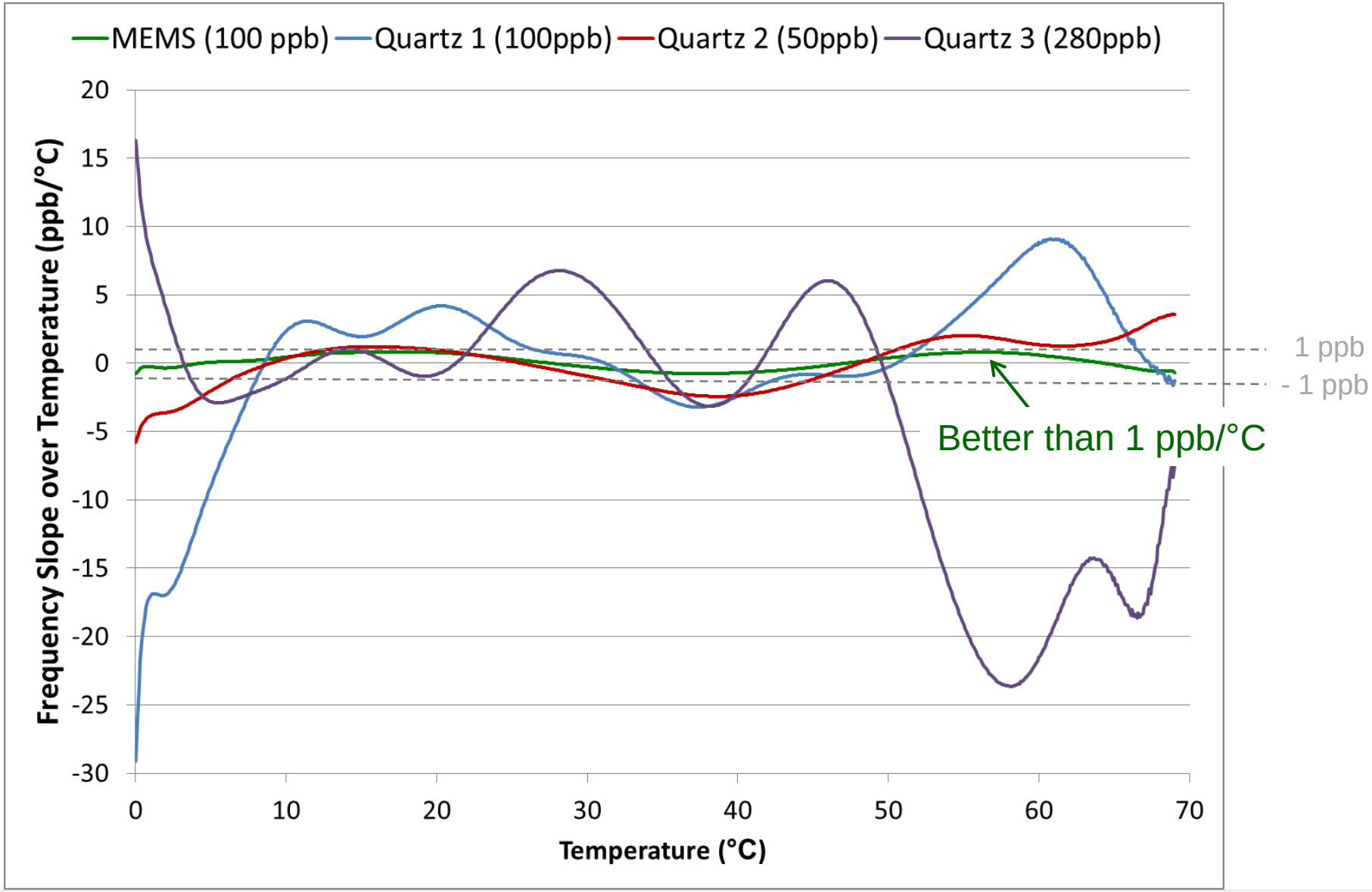
Frequency-over-Temperature Slope, dF/dT

- Frequency-over-temperature slope measures the frequency change due to temperature change by 1°C and is expressed in ppb/°C

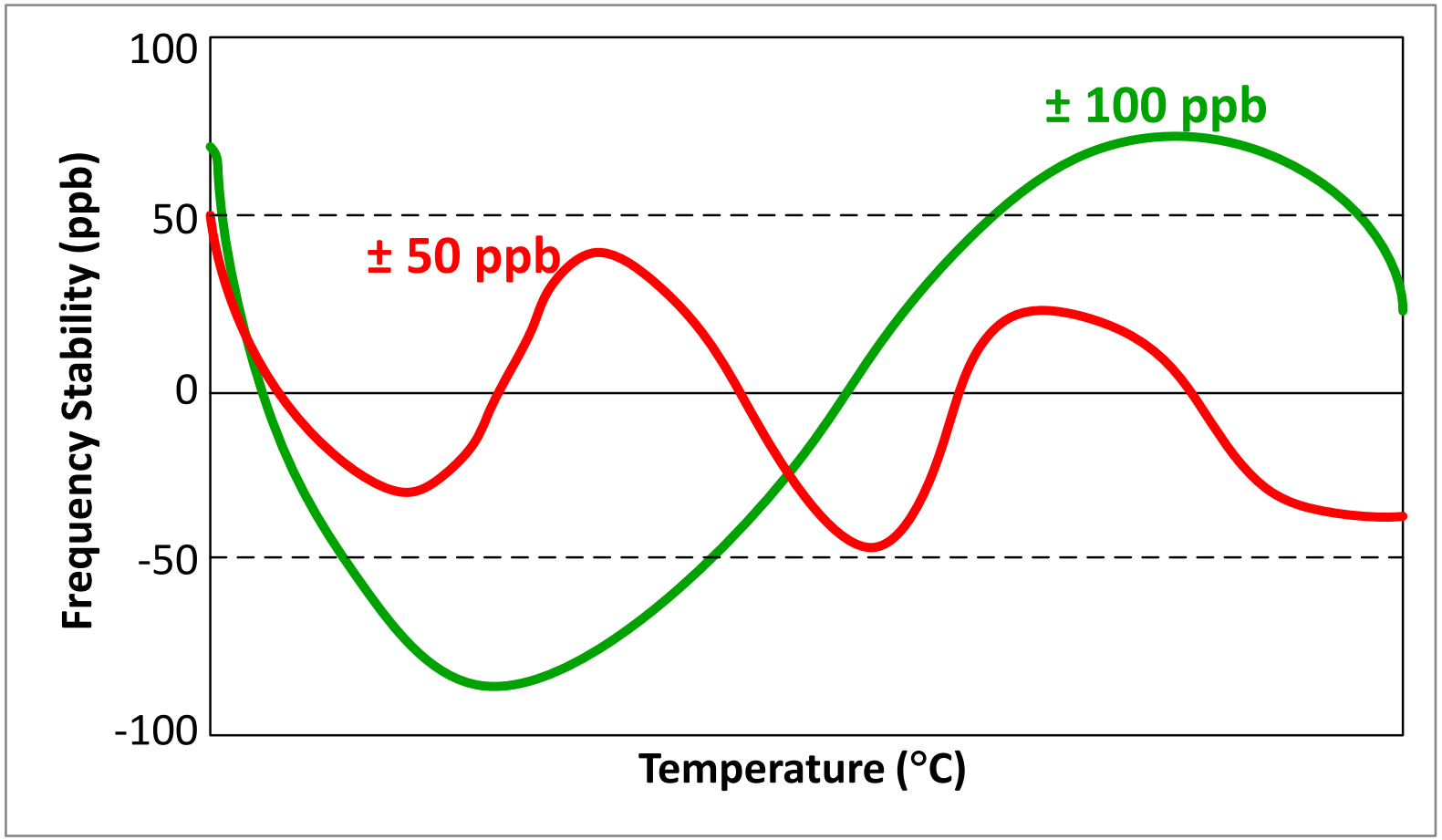


Measured MEMS TCXO Frequency Stability

MEMS vs Quartz TCXO dF/dT Performance



Which Part is Better for PTP Applications: 50 or 100 ppb?



What matters is low sensitivity to temperature changes (dF/dT), not lifetime peak-peak stability