Loran Tim

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IIA – 36th Convention and Technical Sympo

Outli

- iming and Frequency use
- eveloping High-end Loran-C timing quipment (recap)
- eveloping Low-end Loran-C timing quipment
  - Low-cost oscillator characterizaton
  - Received signal
  - Combining the two
- onclusions

Outli

Frequency

Receiver outputs:
- 10 MHz
- 2.048 MHz
- 1.544 MHz

Necessary input:
- eLoran/Loran-C signal

Time and Frequency

Receiver outputs:
Frequency outputs, plus:
- 1 PPS (aligned to UTC)
- 10 PPS
- 100 PPS
- Serial output for Time of Day message

Necessary inputs:
- eLoran signal
- Data channel for UTC information

Relevant measurements:

MTIE

Maximum Time Interval Error (MTIE): The maximu peak-to-peak delay variation of a given timing signal with respect to an ideal timing signal within an observation time ($\tau = n\tau_0$) for all observation times o that length within the measurement period (™).

TDEV

Time Deviation (TDEV or $\sigma_x(\tau)$): A measure of the expected time variation of a signal as a function of integration time. TDEV can also provide information about the spectral content of the phase (or time) nois a signal. TDEV is in units of time.

ETSI EN 300 462-3

00 462-3-1 V1.1.1

sion and
ng (TM);
equirements for
ization networks;
The control of
wander within
ization networks

7.2.1 Network limits for wander at PRC outputs

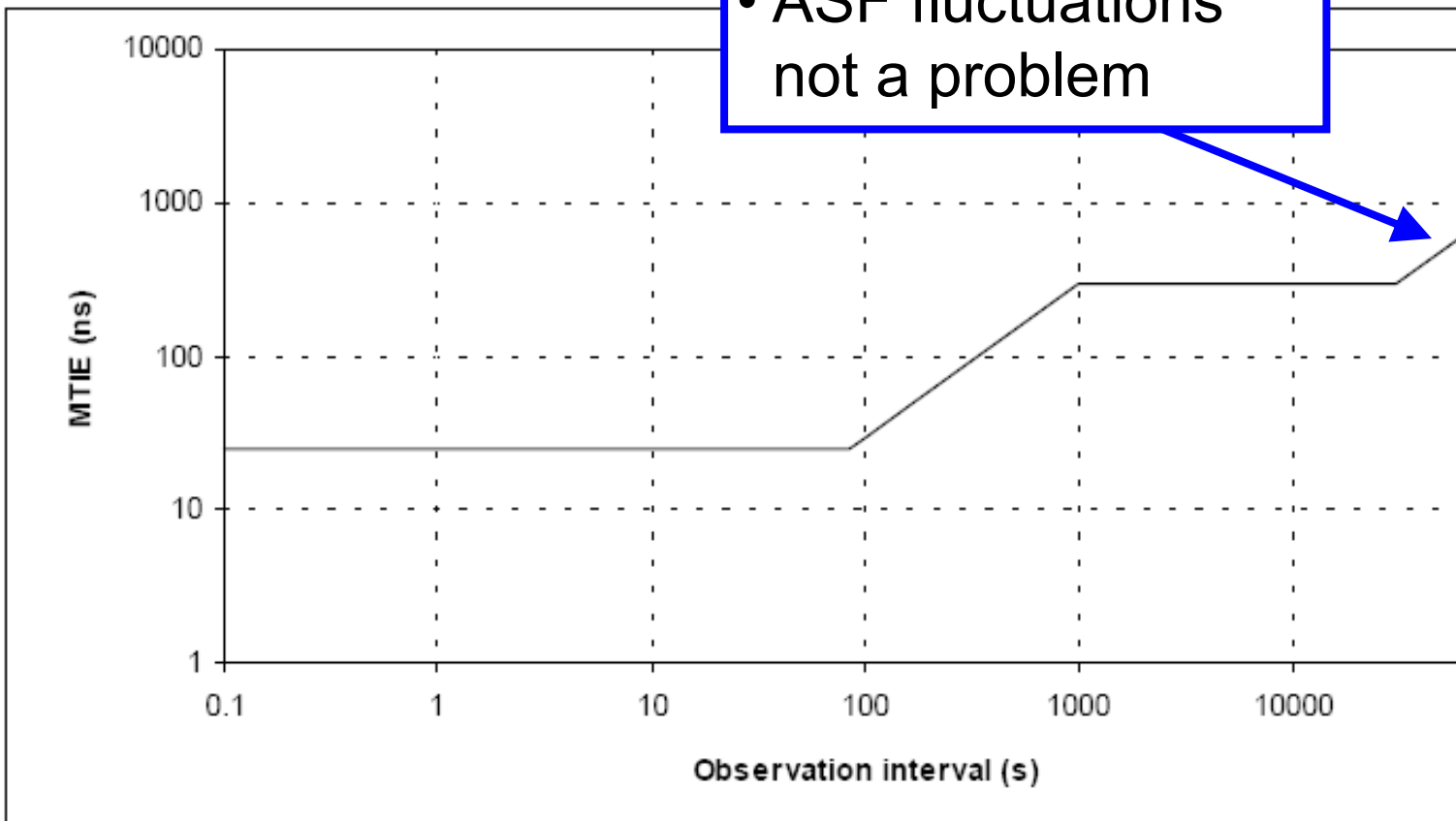
The maximum wander that may be generated at the output of a PRC, expressed in MTIE shall not exceed t
given in table 2.

Table 2: Network limit for wander at PRC outputs expressed in MTIE

MTIE	Observation Interval
25 ns	$0,1 < \tau \leq 83$ s
0,3 τ ns	$83 < \tau \leq 1\,000$ s
300 ns	$1\,000 < \tau \leq 30\,000$ s
0,01 τ ns	$\tau > 30\,000$ s

The resultant overall specification is illustrated in figu

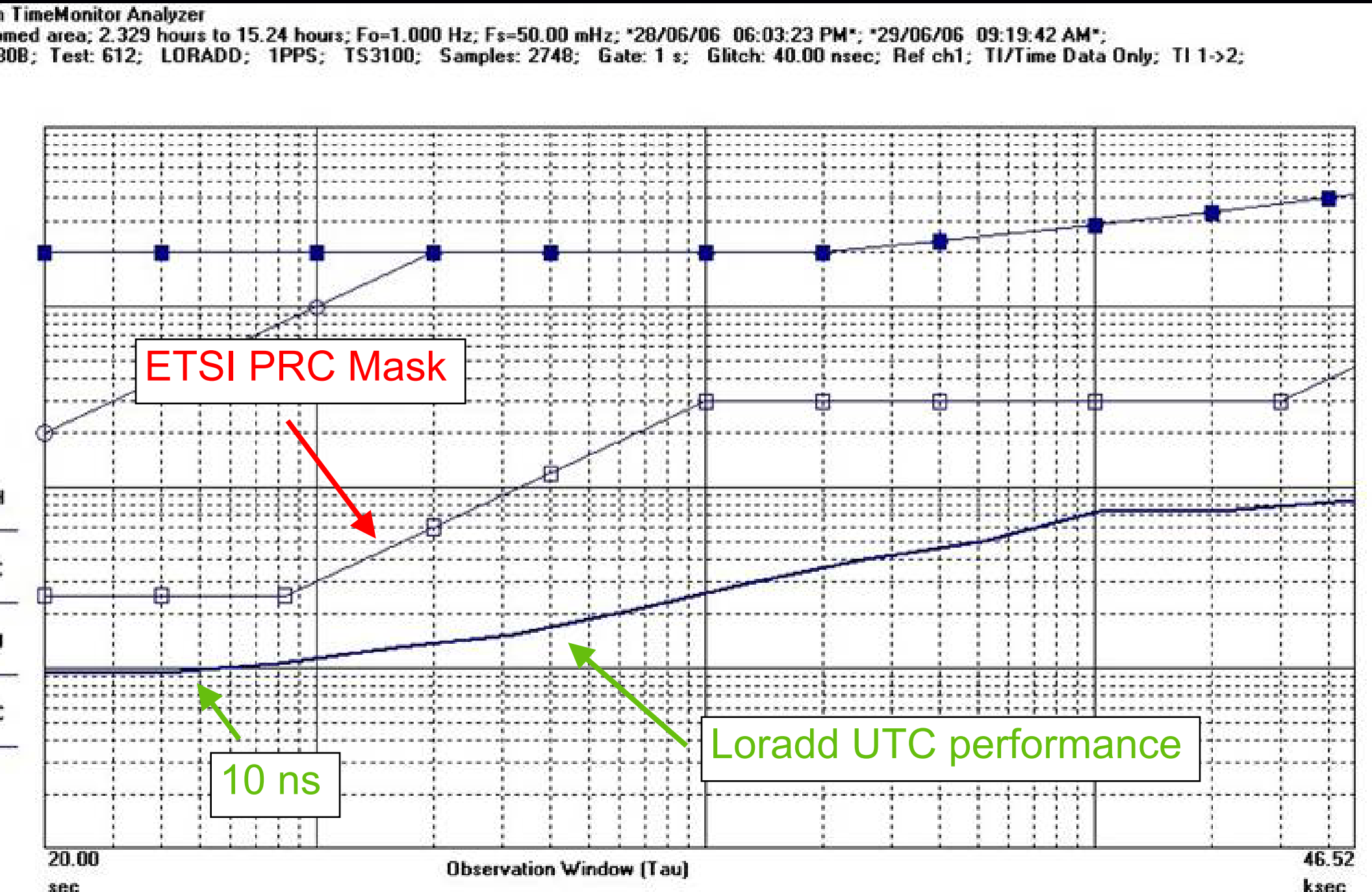
- 864 ns / day
- ASF fluctuations not a problem



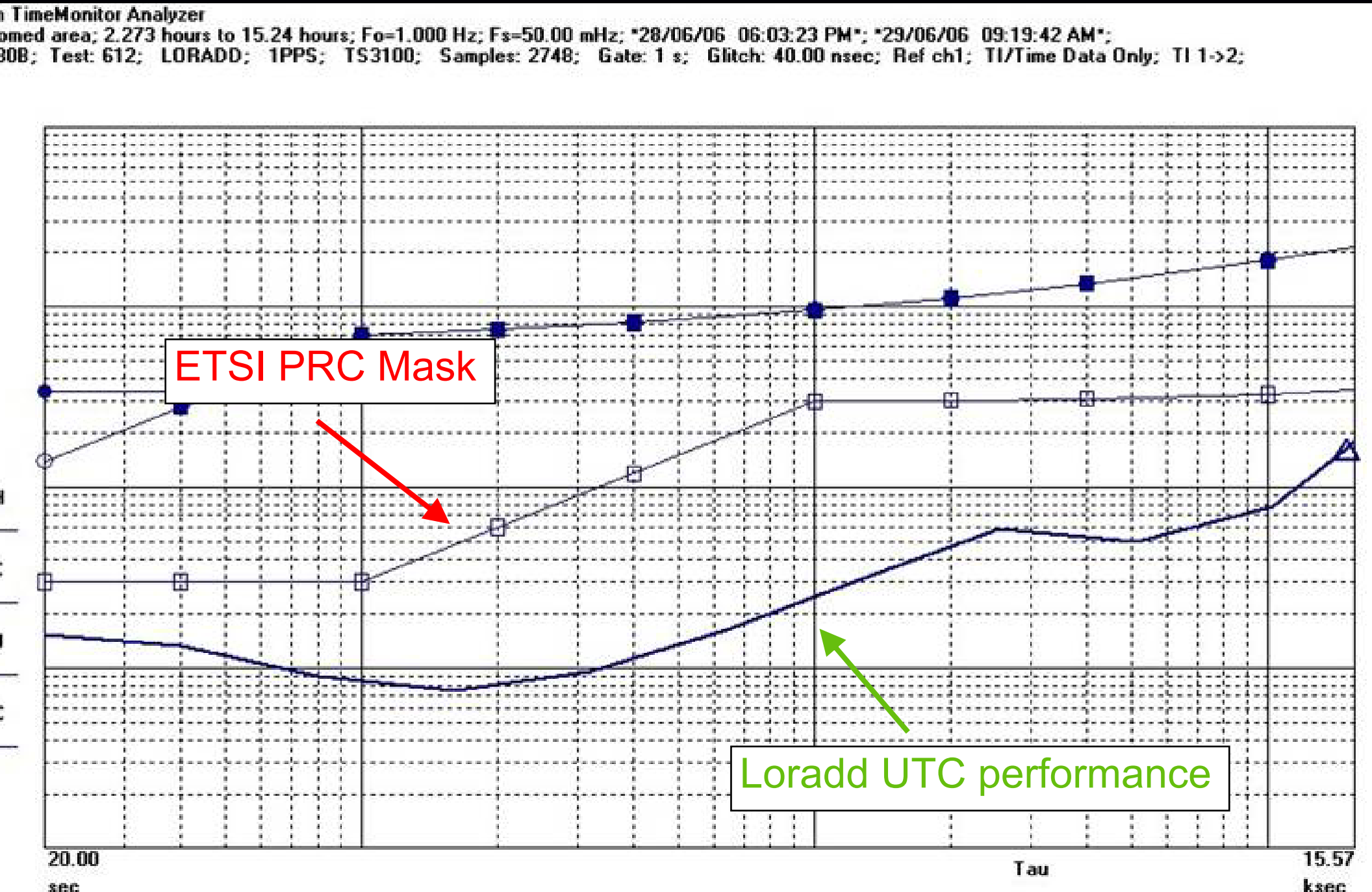
Loradd UTC set

unctionalities of a normal LORADD receiver
nized crystal for improved stability and hold-over (SRS SC10)
MHz, 2.048 MHz and 1.544 MHz outputs
PS (Loran-C derived) output
PS (GPS derived) output
n-C Timing Source Station selectable

Test results - MT



Test results - TDE



Low-co

- Market demand for low-cost frequency-on
receiver
- requency lock to a single Loran station
- lo hold-over required

- ow-cost oscillator means shorter
ntegration of received Loran signals

oradd-F

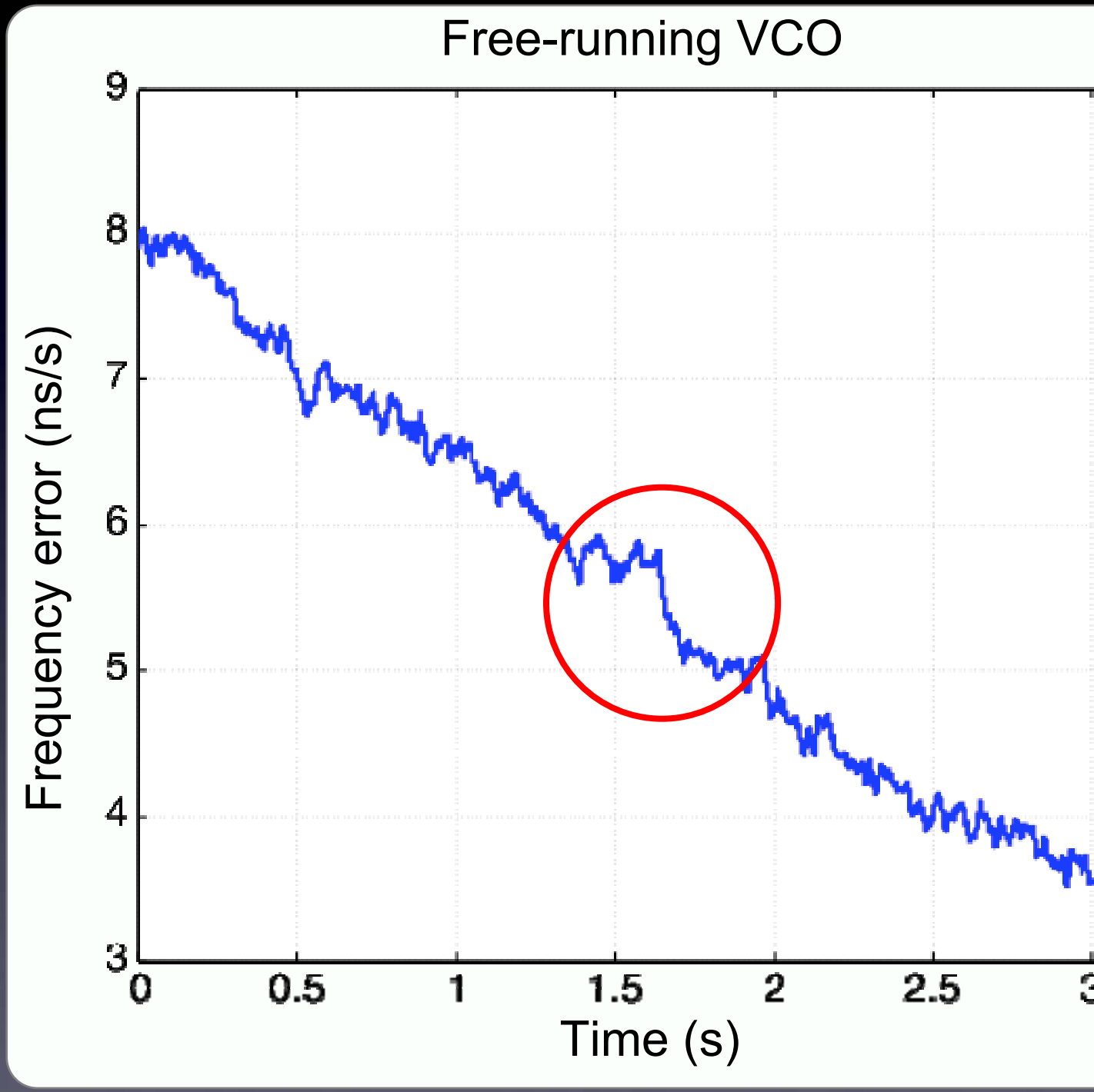
ow-cost VCO

lo GPS

0 MHz output via SMA

Low-cost oscillator characterizat

- oscillator frequency
- displays frequency vs
- er operating at room ature
- arming up for several
- kely still due to ature variations

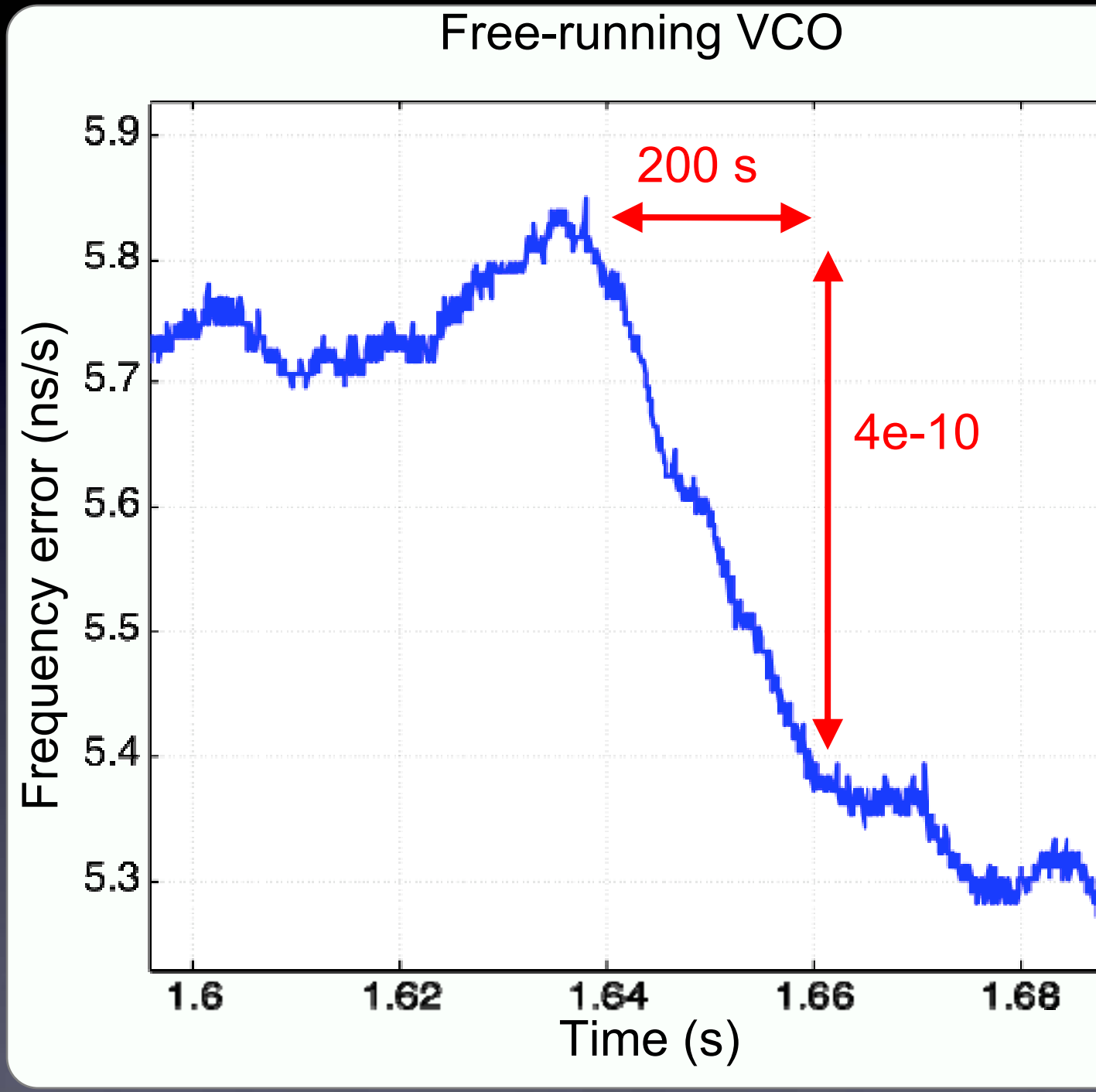


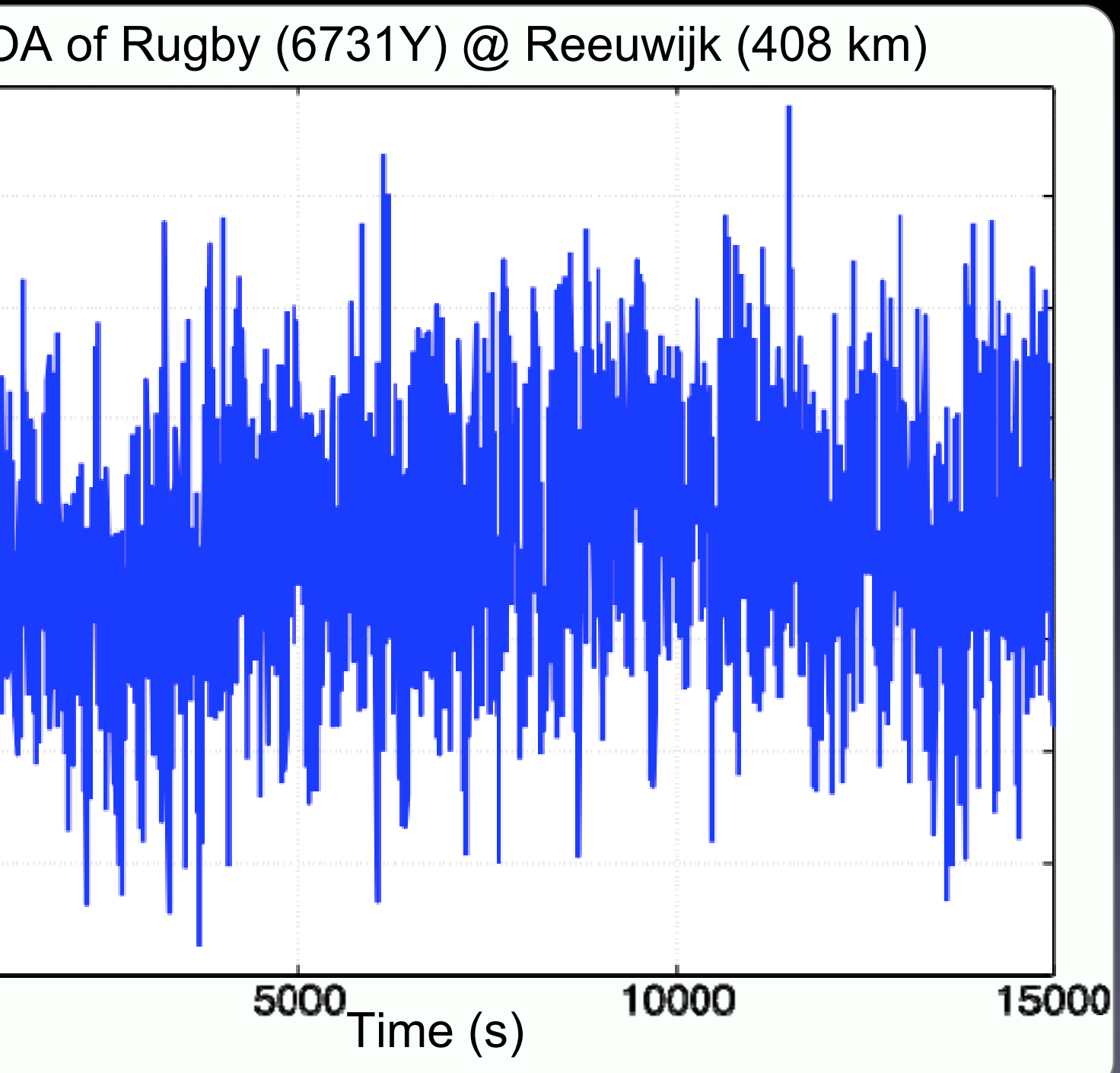
Low-cost oscillator characterizat

val: 200s
y error: 4e-10
or (over 200 s): 40 ns

k: 25 ns

uncorrected, MTIE
oken at this point.

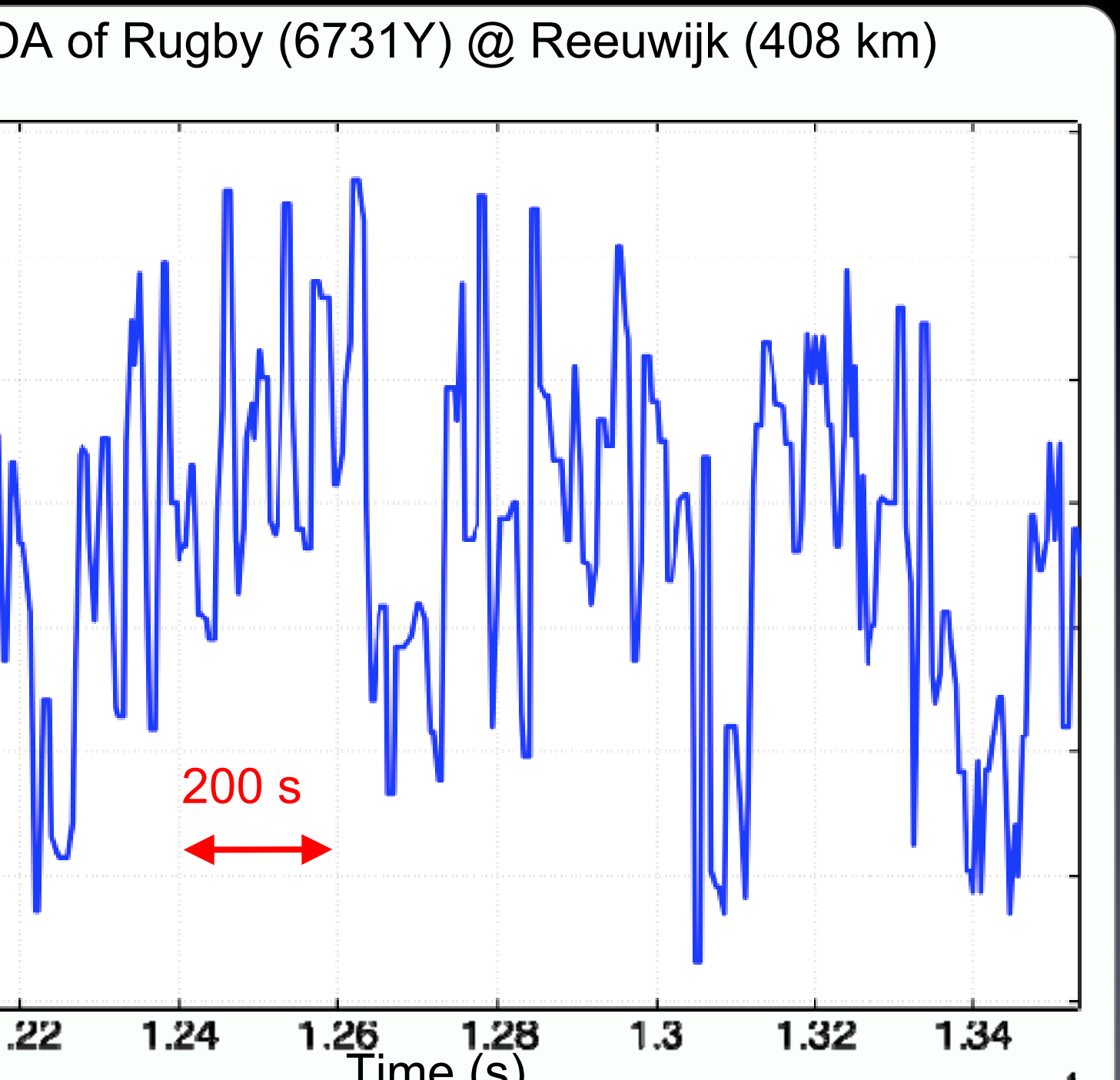




Rugby (6731Y)

5-second independe measurements

6731Y std=10.44 ns



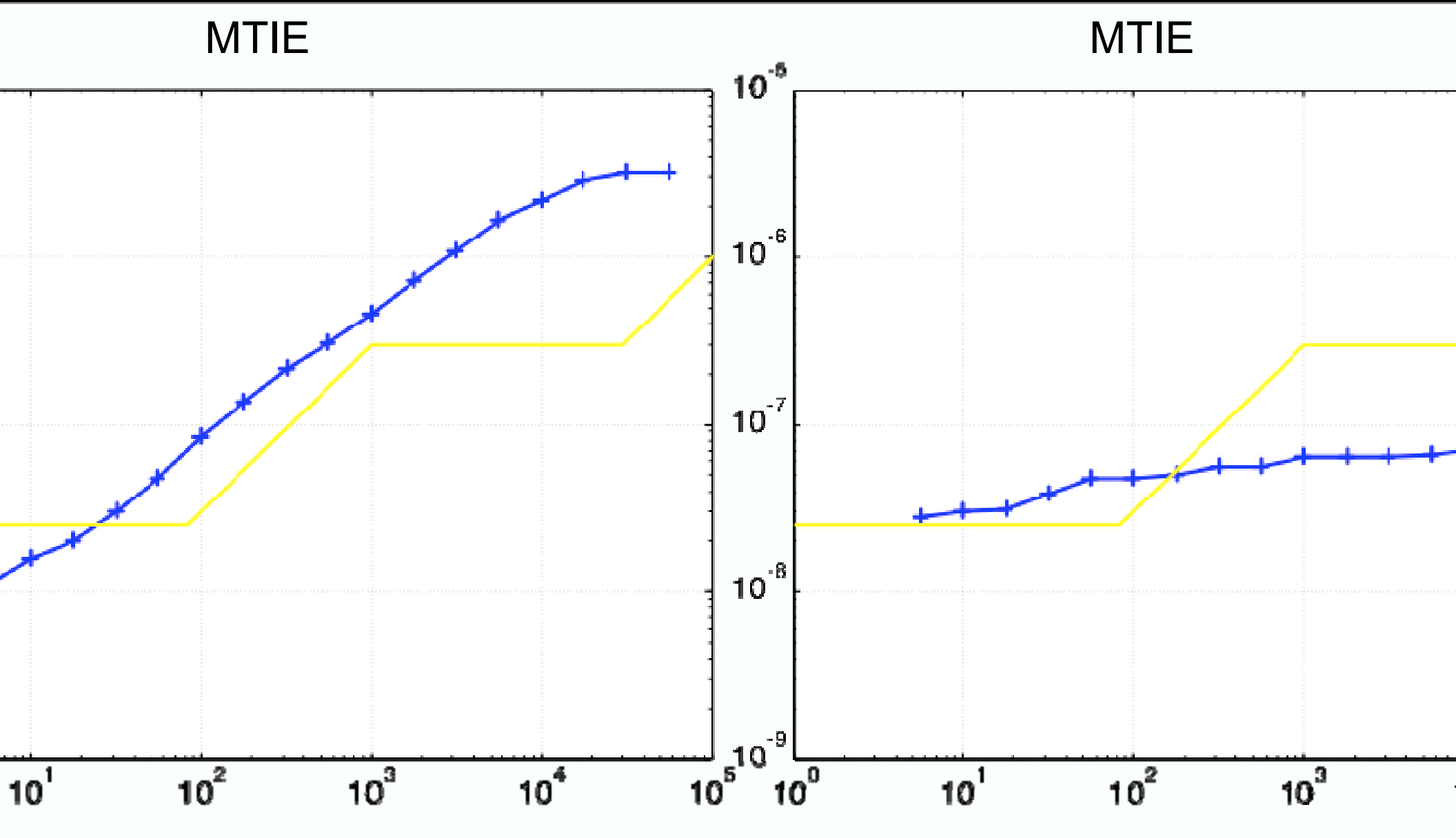
Rugby (6731Y)

5-second independe
measurements with 3
moving median filter

6731Y std=8.18 ns

**Transmitters a
currently broadcas
a 10ns "grid"**

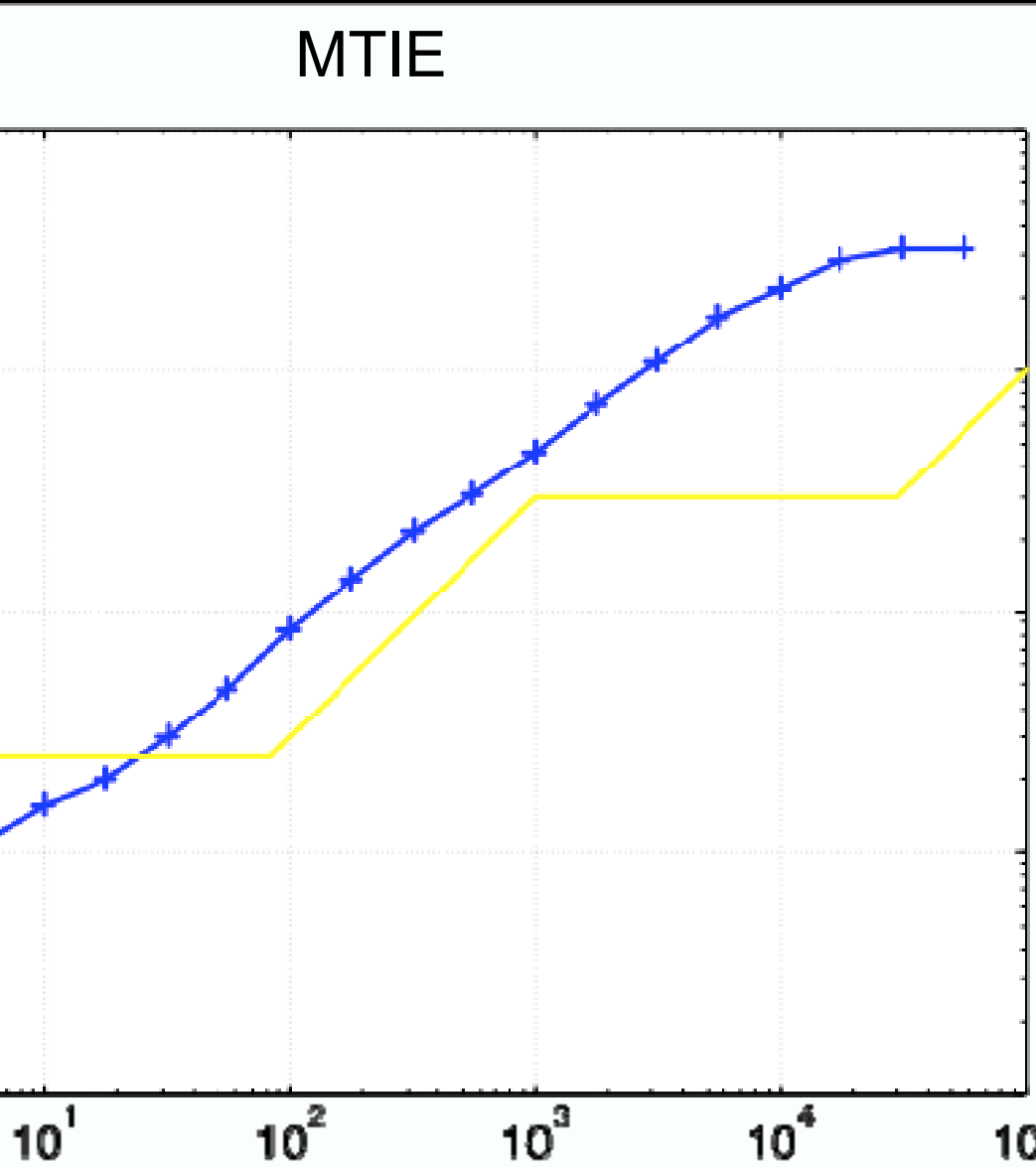
Combining the two



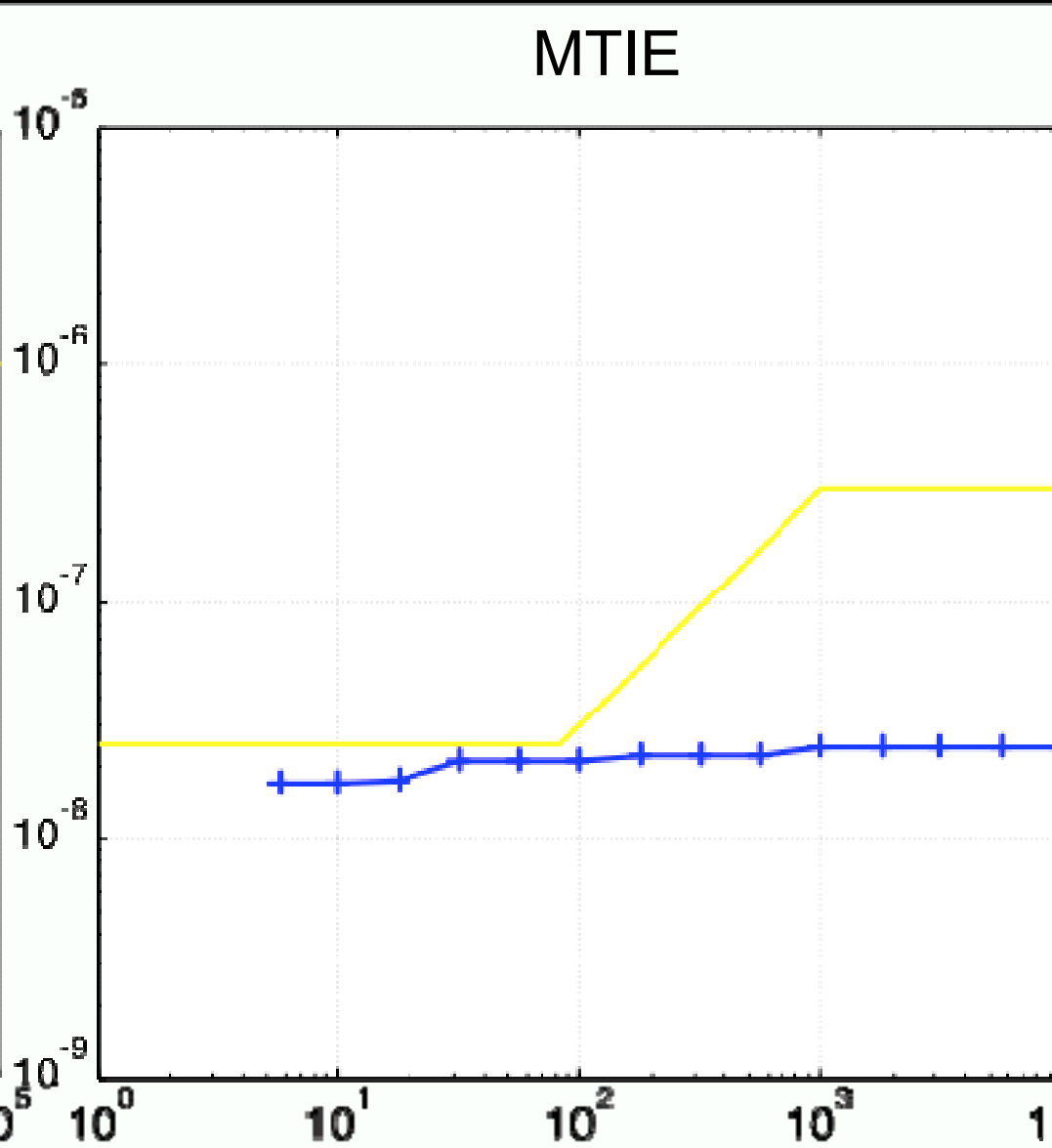
Low-quality VCO

Loran TOA

Combining the tw



Low-quality VCO



Simulated Loran TOA (σ=3.5
No timing steps

Conclusion

oradd UTC with high quality VCO fully
neets MTIE specification

oradd-F with low-quality VCO does not
et meet MTE spec at $25<\tau<110$ s

- Temperature controlled VCO
- Higher grade VCO

iming steps in transmitter need to be
nvestigated. Elimination will result in
educed cost receivers.