Impact of Data Quality on Synchro-Waveform Data Analytics

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Outline

- Start with the end in mind
- Synchro waveforms application analytics types
- Data quality issues
- Examples

Synchro waveforms application analytics

Still very young

- Edge Applications
  - Operating on data locally at the grid edge
  - Can be the same as regular (non-synchro) waveform applications
  - Focus on measurement quality as opposed to data communications issues
- Distributed and Central Applications
  - Realtime and non-real-time applications
  - Relies on data communications infrastructure
  - Waveform resolution categories
    - 1-100/s Slow: synchrophasors (e.g., 25-120 per second)
    - 1k-10k/s Medium: harmonics power flow, high-impedance fault detection (1k to 20k per second)
    - 100k-1M+/s Fast: transients and travelling wave (100k – 1M per second)

Data quality issues

Different Types

- Measurement errors (inaccuracies)
  - Measurand errors (voltage, current, …)
  - Time errors (timestamp errors)
  - Quality information (e.g., status info)
  - Trust level
- Data loss
  - Measurement instrument/sensor issues
  - Data transport issues
    - Data latency issues
  - Data storage issues

Data quality issues

Different Types

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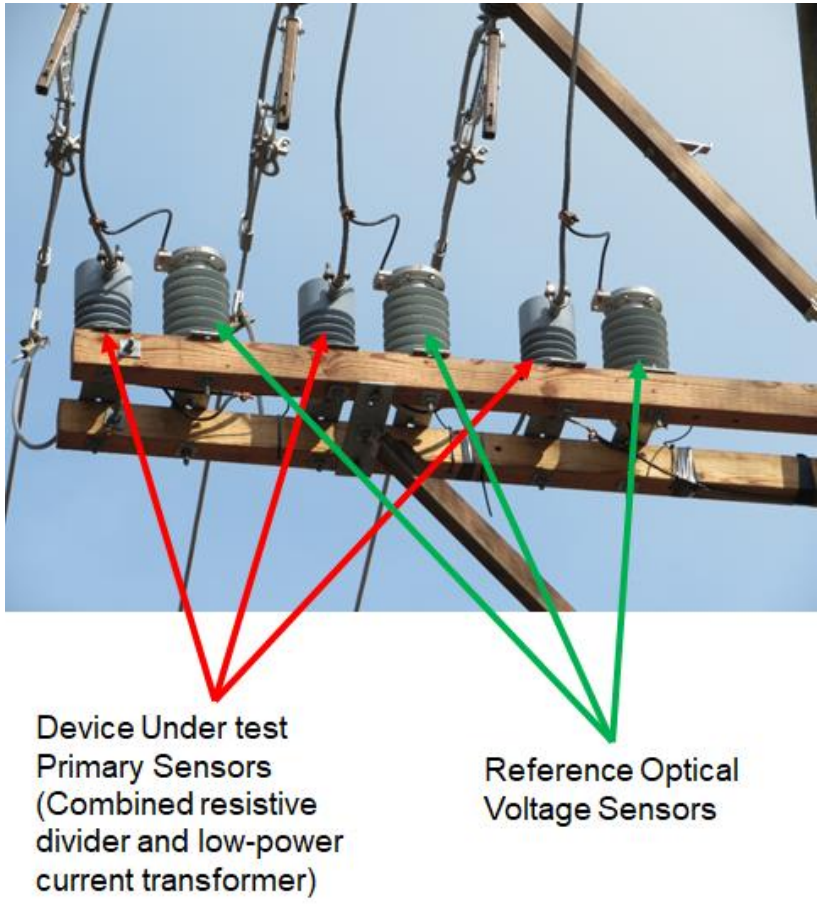
  - Data transport issues
  - Data storage issues

Examples

Example: Comparative Verification of Accuracy

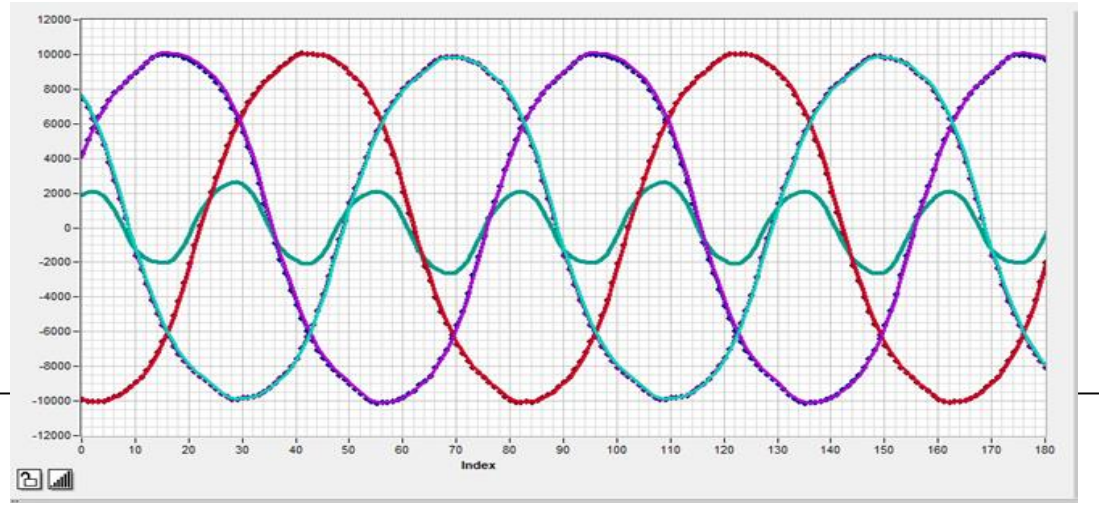
12 kV Digitized Resistive-Divider Voltage System

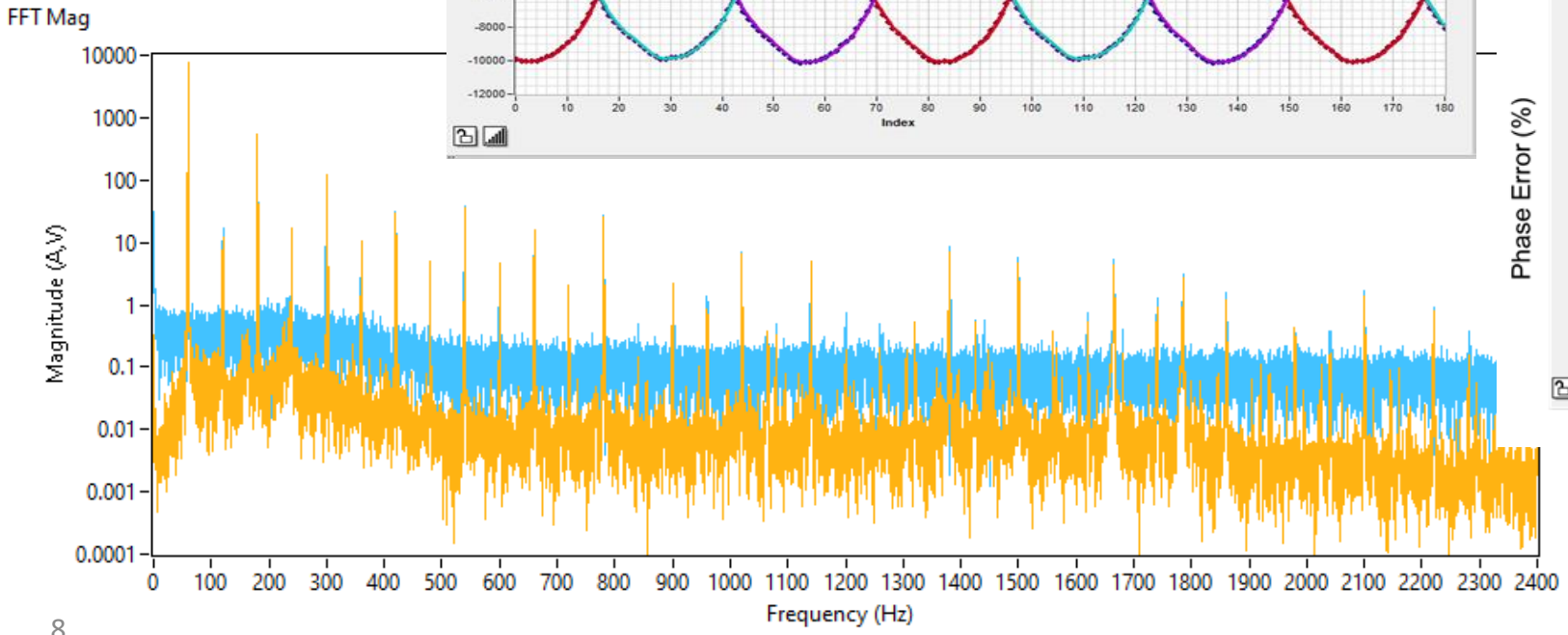


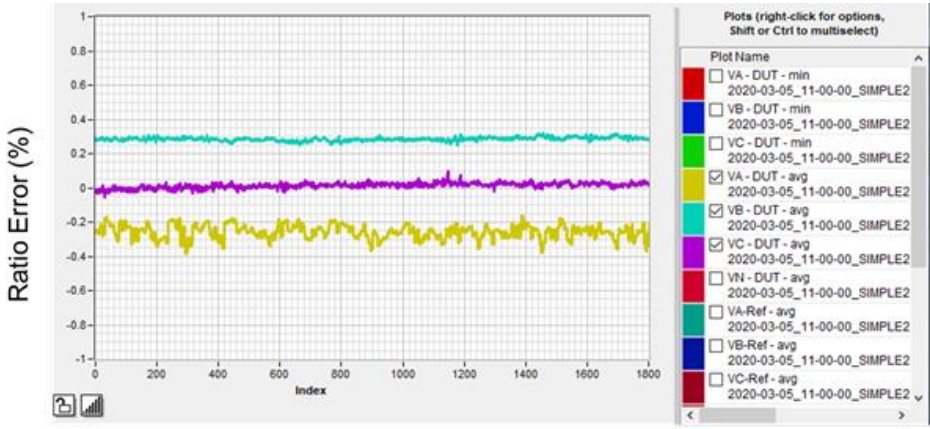
Example of Verification of Accuracy

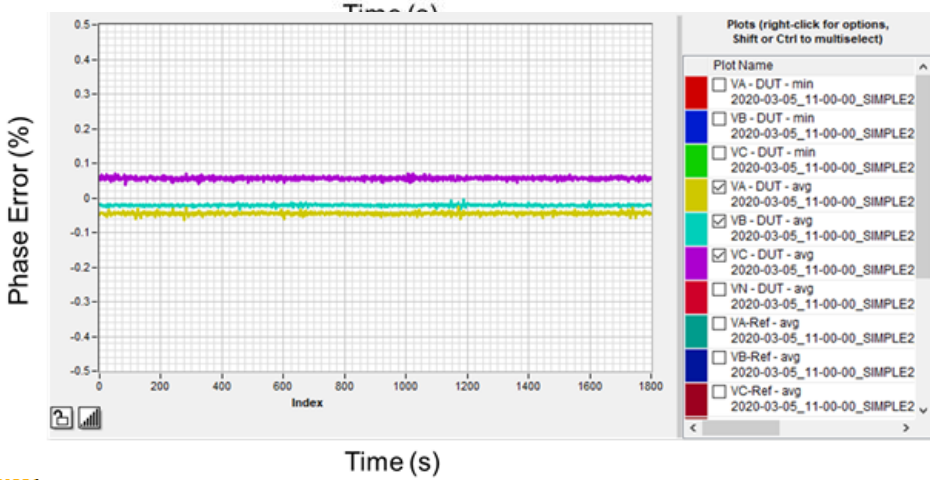
12kV – 60 Hz and Harmonics

4.8 kHz sampling rate









Time (s)

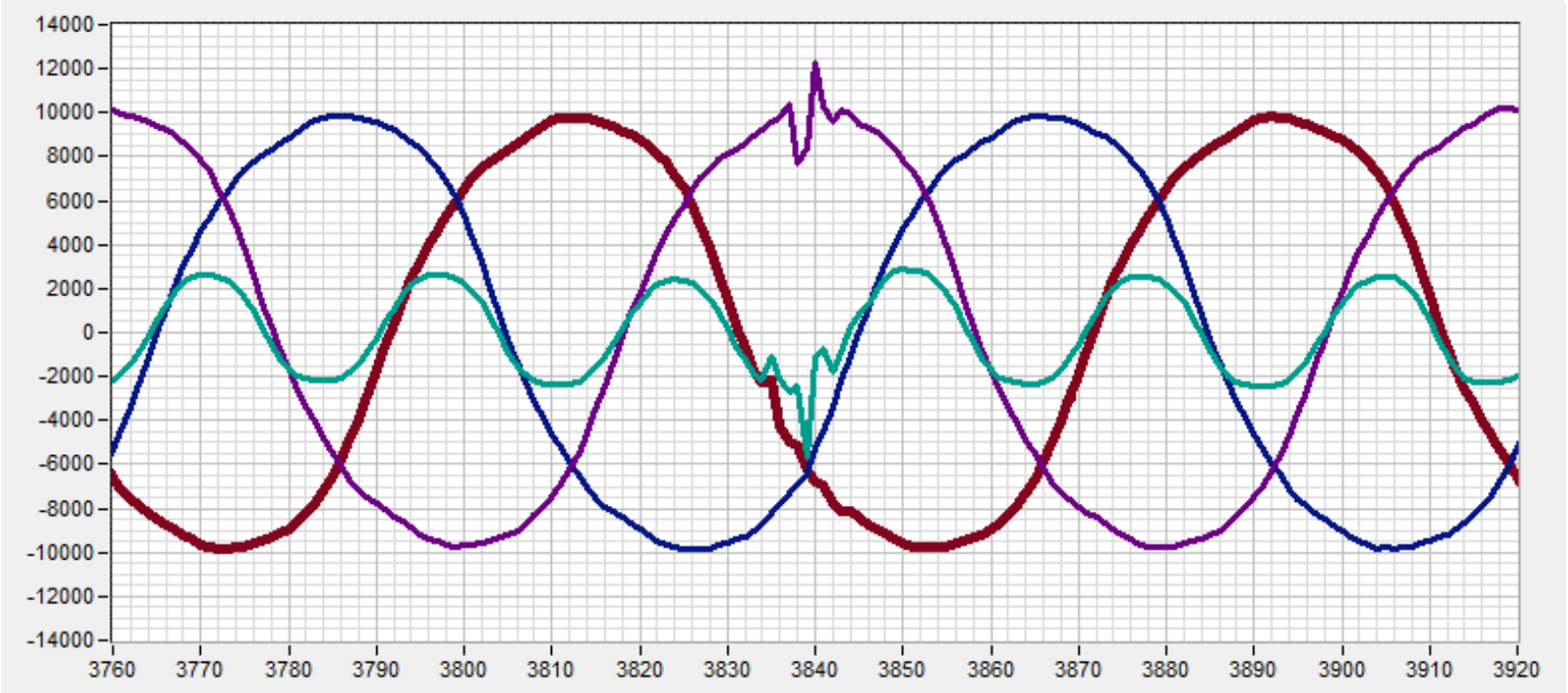
8

Example of Verification of Data Quality

12 kV Digitized Resistive-Divider Voltage System

Capacitor Switching & Slow Transients

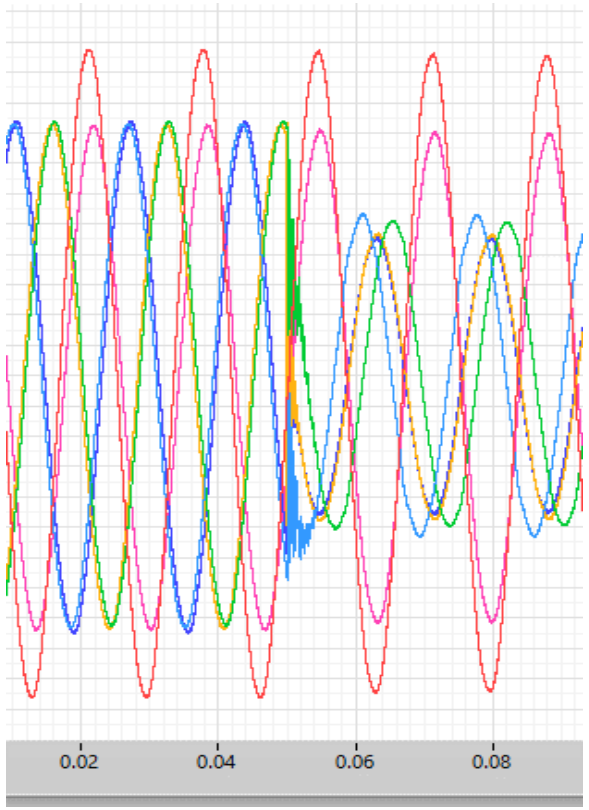
4.8 kHz sampling rate



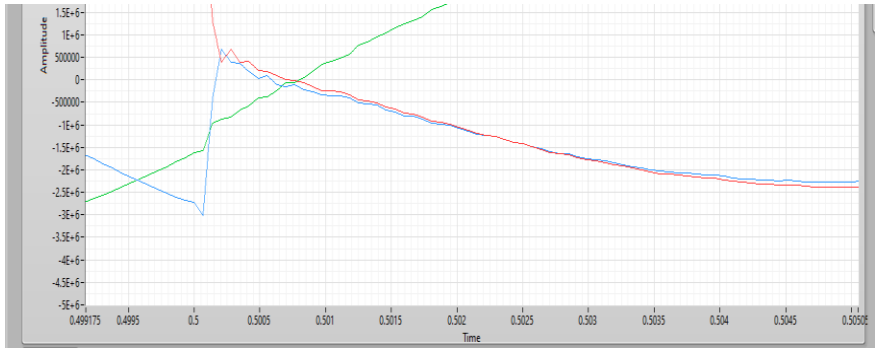
9

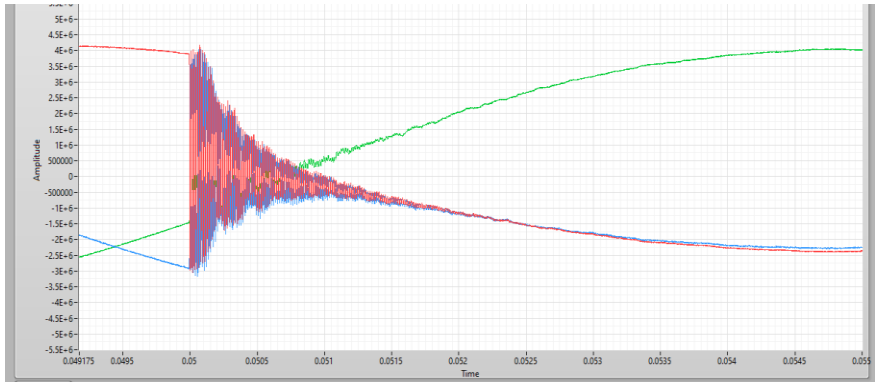
High-Frequency Example

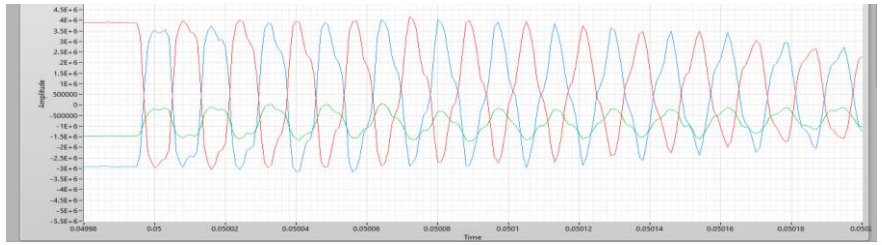
Impact of Data Rate



Fault Event







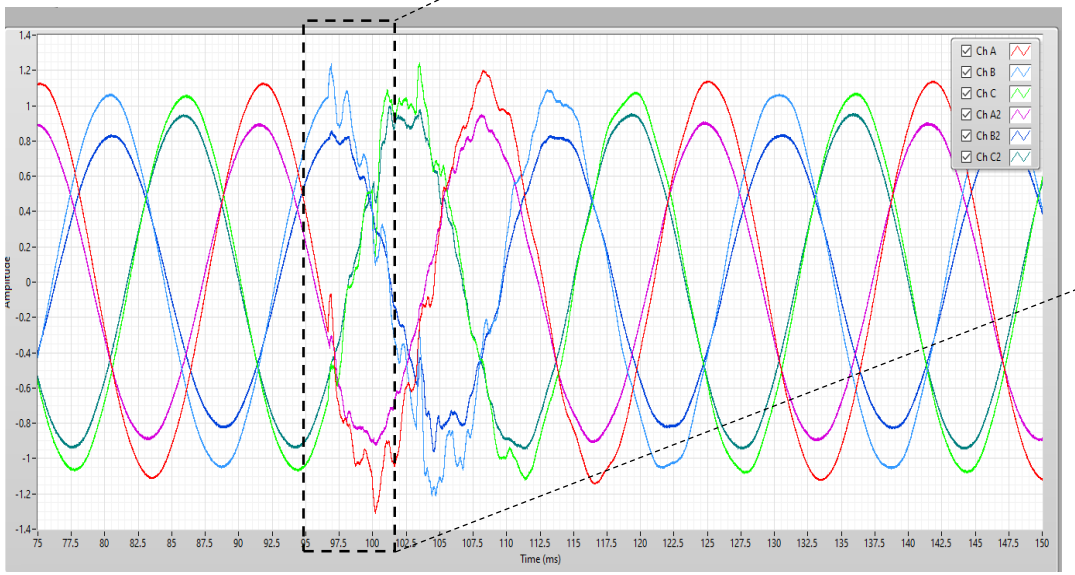
~ 6 ms window at the beginning of the event Anti-alias filtered and sampled at 14.4 kHz

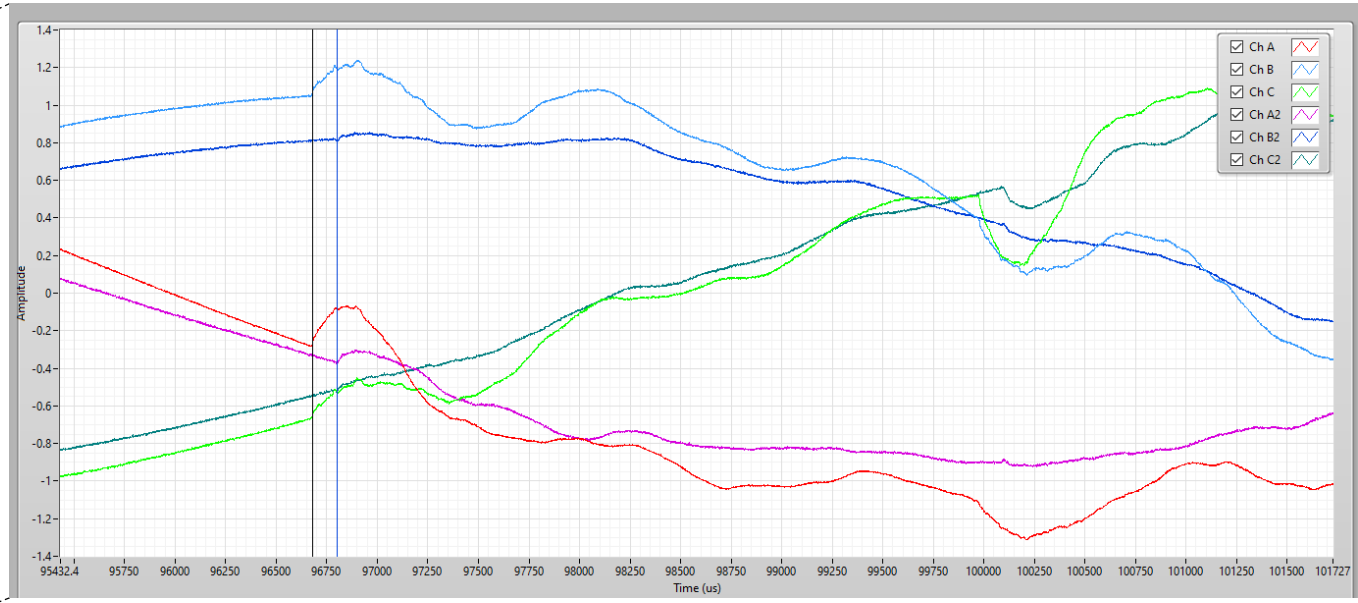
~ 6 ms window at the beginning of the event Anti-alias filtered and sampled at 1 MHz

Zooming into the first 200 µs window of the event (sampled at 1 MHz)

High-Frequency Example

Event Comparison across the grid

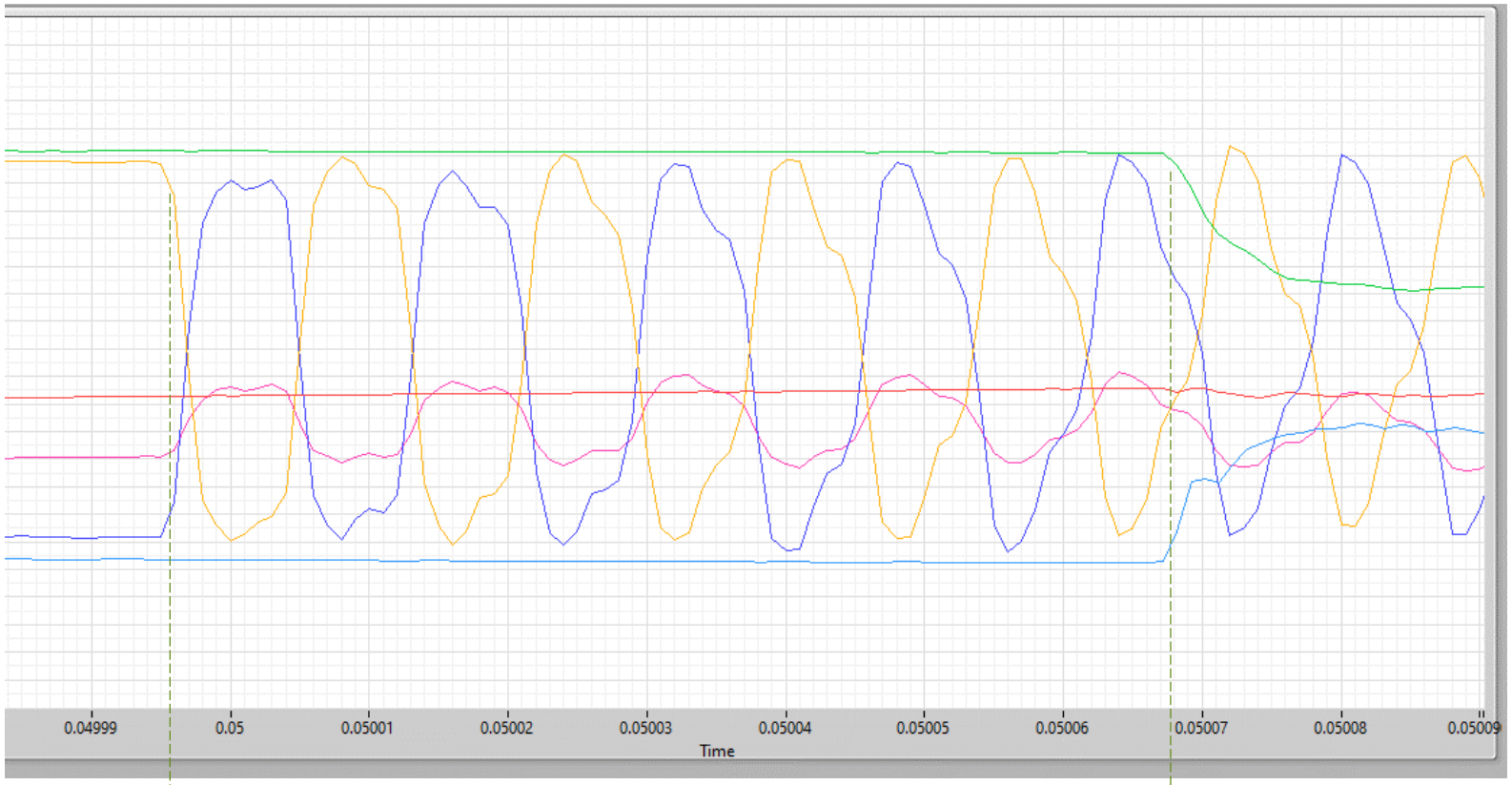




121 µs time difference
(Event propagation time)

High-Frequency Example

Event Travel Comparison and Data Rate



Questions?

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