

Advanced Synchro - Waveform Grid Monitoring & Control System

By CT LAB

Presentation Outline

- Introduce Synchro - Waveforms
- Introduce CT LAB's latest Synchro - Waveform Technology
- Present AEMO R2 Generator Model Verification Programme as example of extensive use of Synchro – Waveform data
 - (Relevant to the Southern African Market)





WAVEFORMS

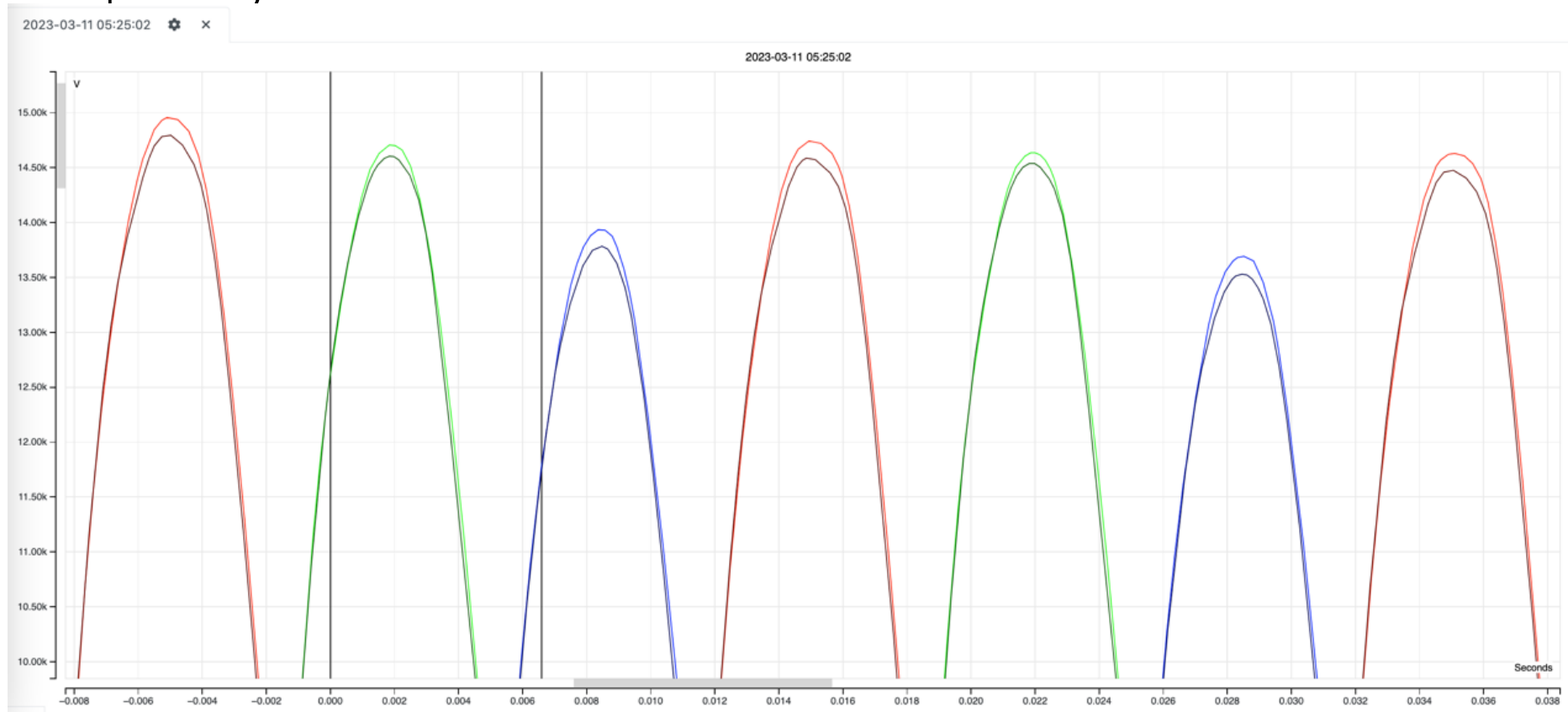
Are the most granular and authentic representation of voltage and current in power systems

SYNCHRO – WAVEFORMS

New frontier to advance power system and equipment monitoring and control

What is: Synchro-Waveforms?

- High Resolution Broadband Digitized Voltage & Current Waveforms
- Each sample is synchronised to absolute time



[illegible]

VECTO System

Waveform synchronised multifunction monitoring & control system for electrical networks

VECTO 3

- Linux Based Multifunction Devices
- Permanently GPS Time Synchronised ($\pm 100\text{ns}$)
- 500kHz Sampling rate w 50kHz synchronised Waveform capturing



VECTO 3

VECTO Grid OS

- Cloud Based Big Data Platform
- Supporting tens of thousands of devices
- Data accessible in near real-time



FM637314



VECTO GRID OS

Device Compliance

- IEC61000-4-30 ED3.0 Class-A (Power Quality Measurement)
 - Certified by NMI – Netherlands
 - According IEC62586-2 Test Protocol
 - Certified @ 120V and 1A nominal
- IEC61000-4-7 Class I (Harmonic Emission Measurement)
- IEC61000-4-15 Class F1 (Flicker Emission Measurement)
- IEC62053-22 Class 0.2S (Billing)
- PMU - IEEE C37.118

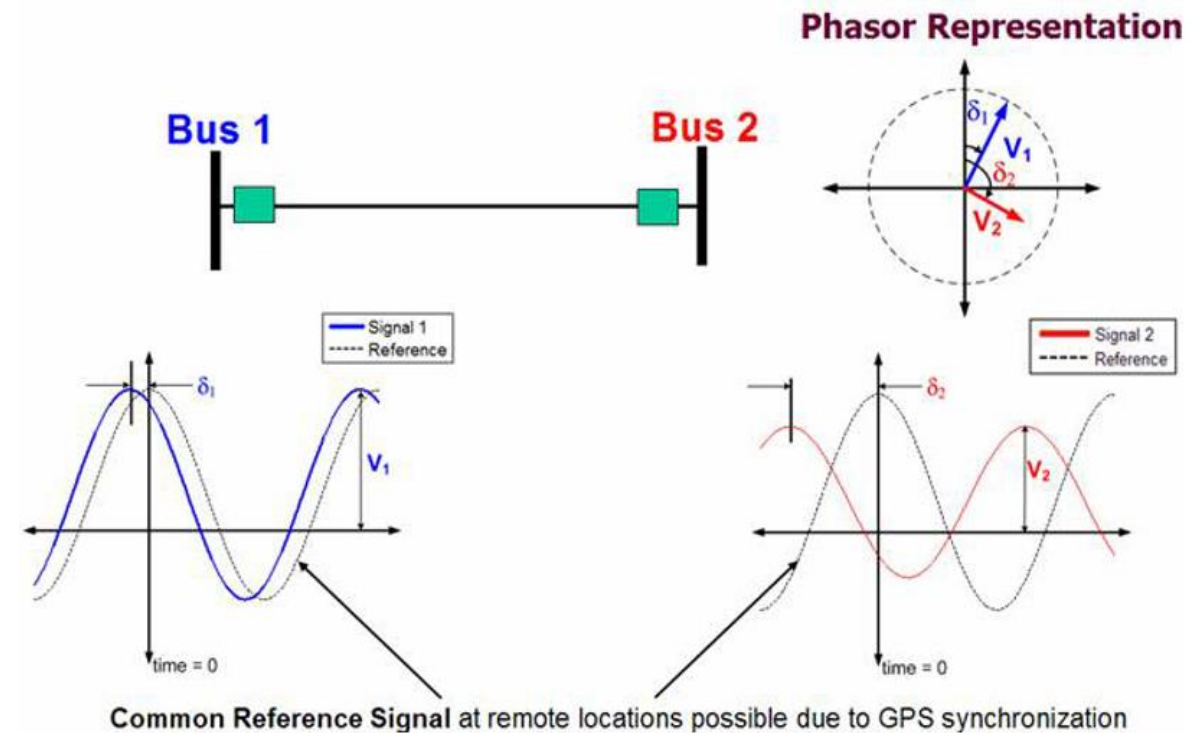
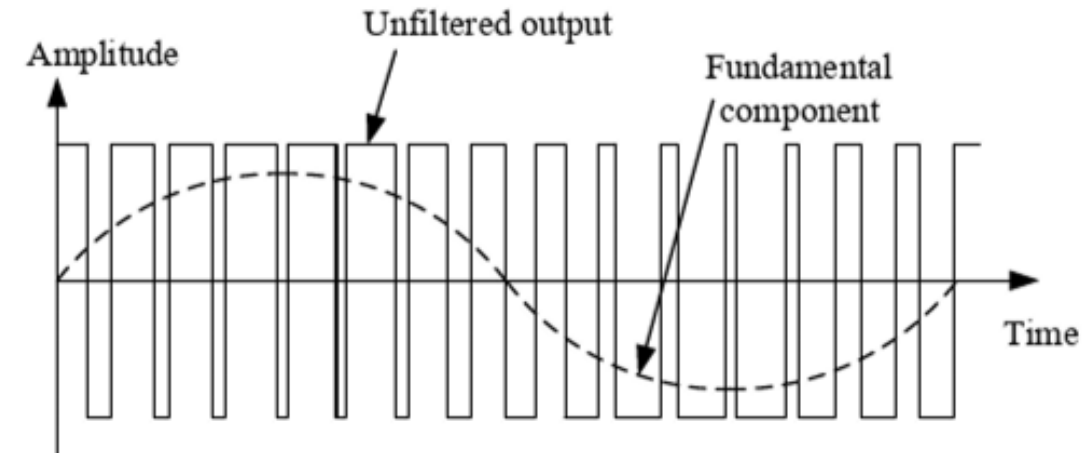


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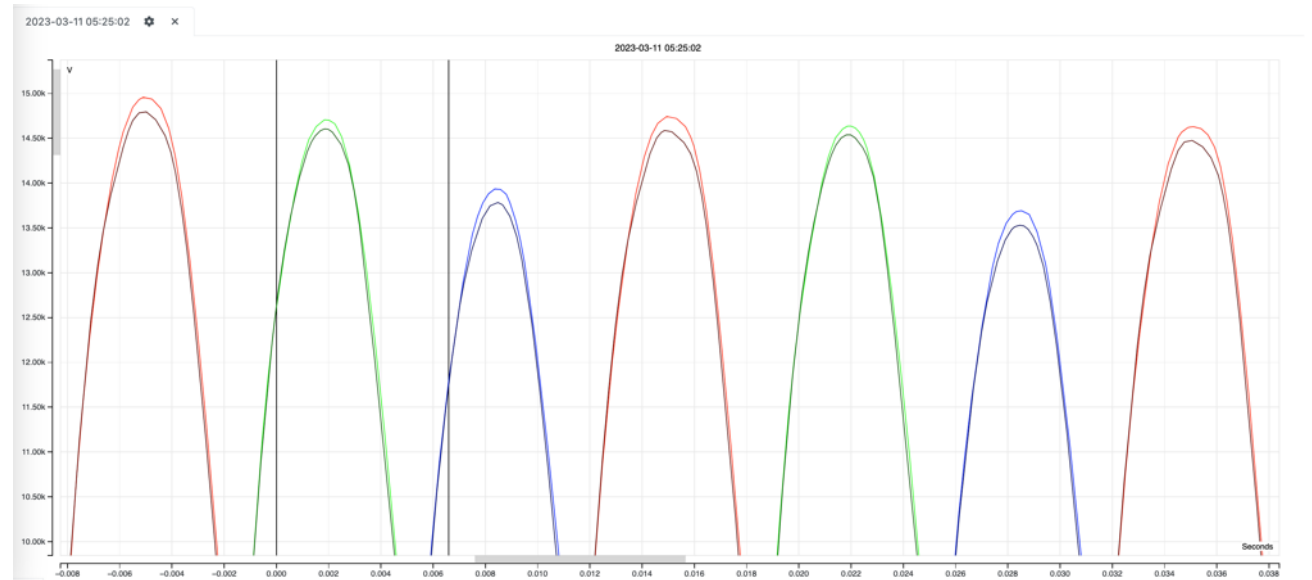
Latest Enhancements

- Best of Class Synchrophasor Performance
 - Simultaneous P & M Class
 - Stable under highly distorted waveforms
- IEEE C37.118 PMU Protocol
 - Certified
- International First: Oscillation Phase Monitoring
 - Trend & Event Recording



Synchro - Waveform Performance

- 500kHz Sampling Rate – Synchronised to $\pm 100\text{ns}$ from absolute time
- 50kHz Synchro – Waveform data stream
 - Derived by averaging 10 x 500kHz samples.
- Broadband signal (1,000 x fundamental)
 - 0.003% Amplitude resolution
 - 0.1% Phase angle resolution



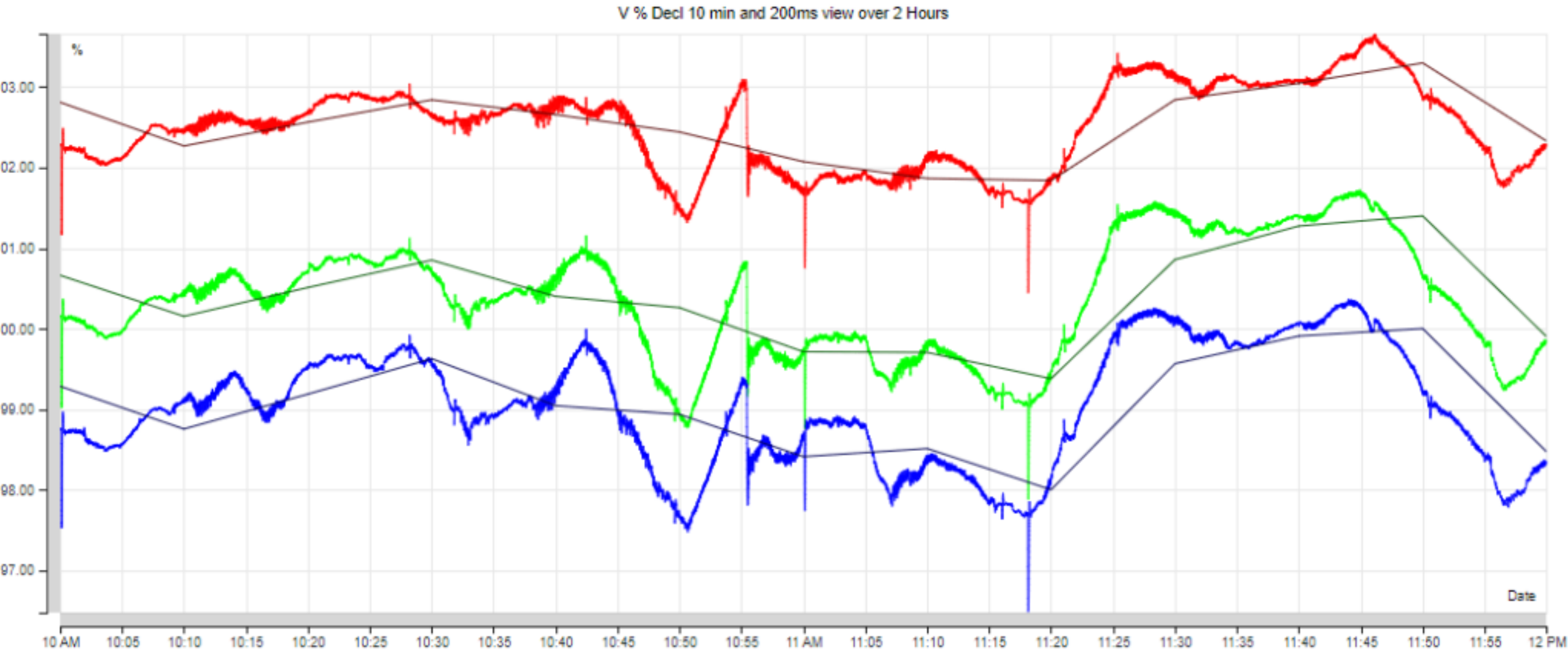
New VECTO Transient Device



- 5MHz Synchro - Waveform Capturing!
 - << 100ns Time Synchronisation
 - Programmable Gain
 - 1, 2, 4, 8, 16
 - GPS & PTP Sync Sources
 - SFP Gigabit Fiber
 - 128GB SSD Drive
 - MIMO Cellular & WiFi Antennae
-

VECTO Transient – Hyper-wave Data

5MHz vs 50kHz



AEMO R2 Programme

Generator Model Validation Monitoring Programme

Extensive use of Synchro – Waveform data
(Relevant to Southern African Region)



AEMO (Australian Grid Operator) R2 Programme

Generator Model Validation Monitoring Programme

The primary outcome from AEMO R2 testing:

- A completed and validated model and set of data
 - Including all control, protection and auxiliary systems.
- Covering
 - Factory Tests
 - Type Tests
 - Off-Site Testing
 - On-Site Testing
- Long-Term Monitoring Programme



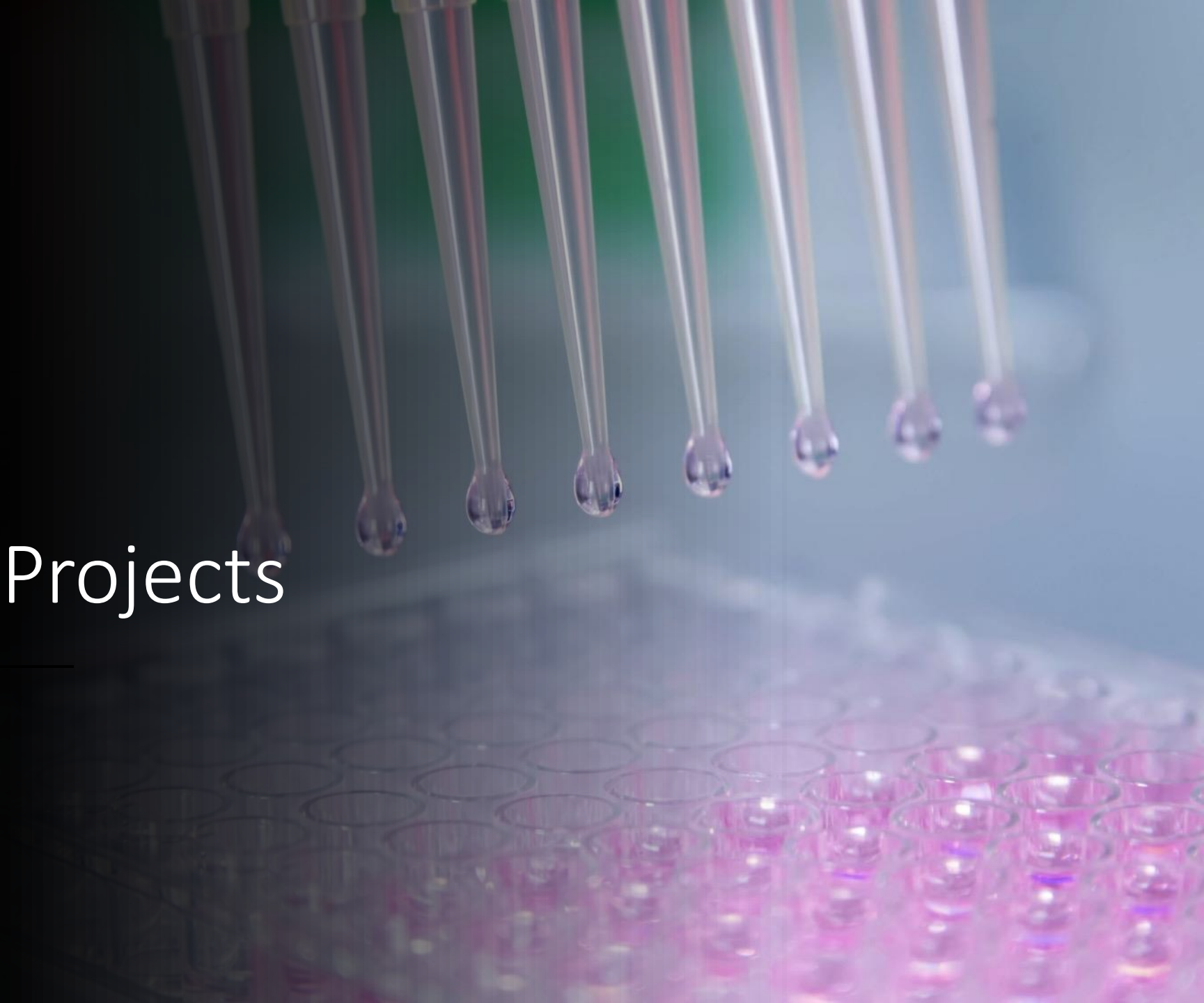
AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

For Wind & Solar Connections

- Requires High-speed time synchronised meters
- At the following locations:
 - The closest wind turbine/solar panel from the collection grid.
 - The furthest wind turbine/solar panel from the collection grid.
 - Medium voltage side of each network transformer.
 - Point of common coupling.
 - Central park level controller (if applicable).
 - One meter for each reactive plant feeder.
 - Inside the wind turbine nacelle
 - Generating unit LV terminals (for all wind turbine and solar panel technologies)
 - Generator rotor terminals (for type 2 and 3 wind turbines only)
 - Grid-side converter (for type 3 wind turbines only)
 - One meter for each particular type of the dynamic reactive support, i.e., STATCOM, synchronous condenser, etc

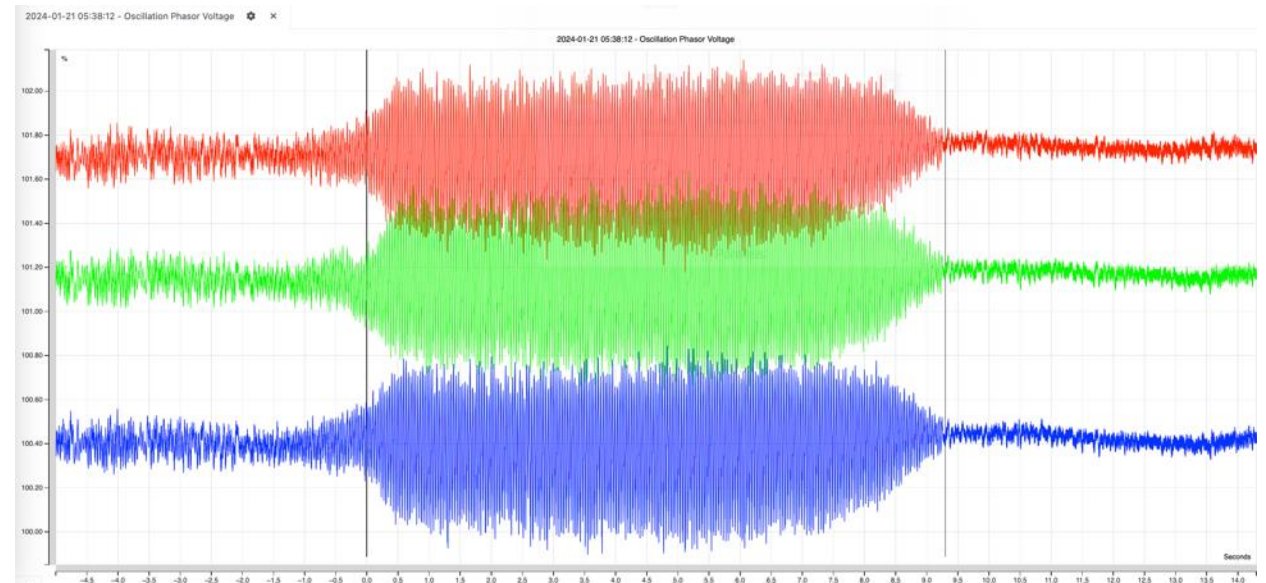


Other CT LAB Projects

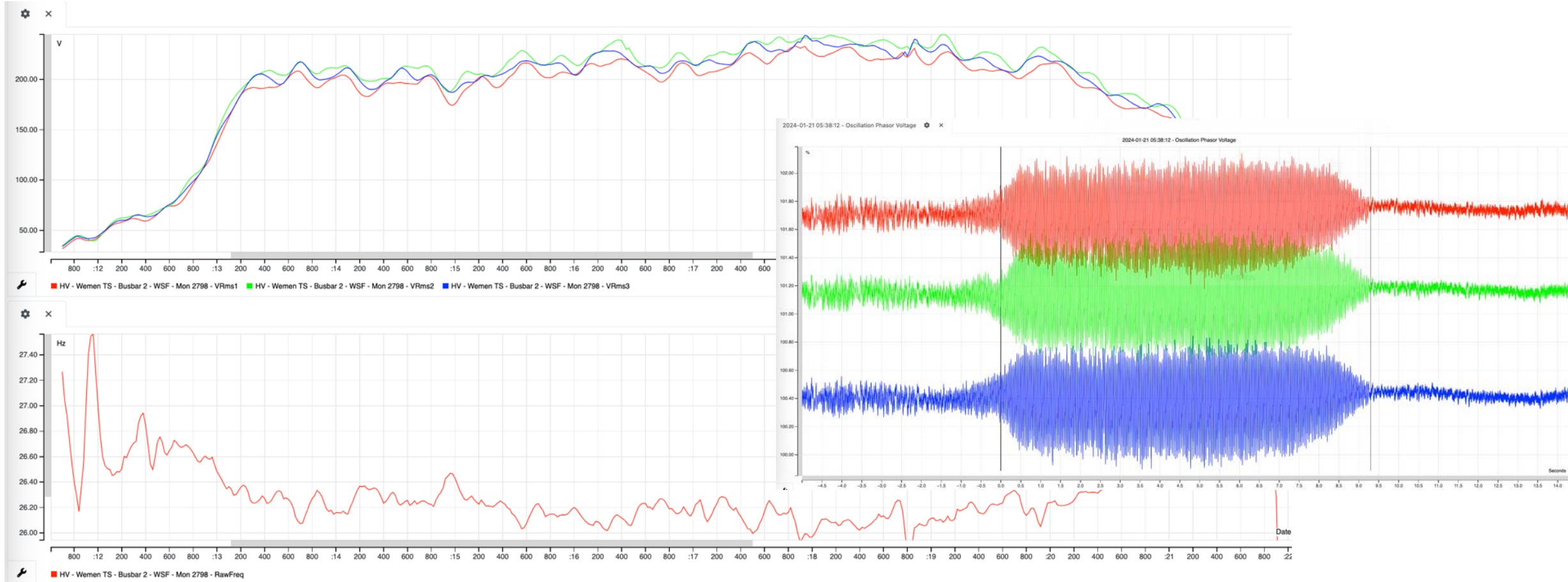


Grid Stability Monitoring – Wemen AU

- Oscillation @ $\pm 26\text{Hz}$
 - Almost impossible to detect it using conventional PMU devices
 - CT LAB Developed new Oscillation Phasor Monitoring Module
 - Works on same principle as classic Synchrophasor estimation
 - Profile the complete Oscillation Phasor
 - Frequency & ROCOF
 - Amplitude
 - Phase angle



Oscillation Phasor Amplitude & Frequency




The VECTO System is built on Synchro - Waves.

The system supports the complete spectrum of grid monitoring, grid stability, automation & control applications.

With more than a decade of experience in synchronised recording, VECTO System is pioneering the way towards a stable transformed grid.



A wooden-framed chalkboard with the words "Thank You" written in white chalk. The chalkboard is set against a rustic wooden background. To the left of the chalkboard is a vintage orange rotary telephone. To the right is a green plant. The entire scene is set on a wooden surface.

Thank
You

Synchro-Phasor

- Describes the fundamental magnitude & phase angle of electrical signals
- Enables synchronized real-time measurements of multiple remote points on the grid.
- 1 sample per cycle
- Typically streamed to control room in real-time.
- Also available offline to analyse

Mainly used to analyse and control power flow and stability within grids.

