SYNCHROPHASOR 118 STANDARDS UPDATE

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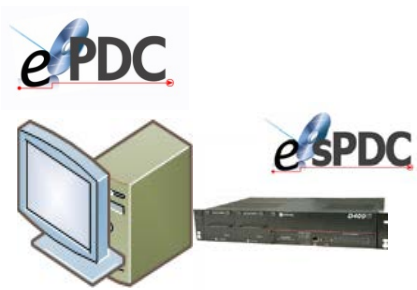
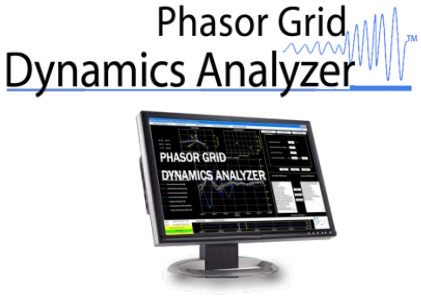


*e*nhanced PDC

Real Time Dynamics
Monitoring System Alarming



Phasor Grid
Dynamics Analyzer

Outline

- Standards overview
- IEEE synchrophasor standards
  - IEEE C37.118.1-2011
  - IEEE C37.118.2-2011
- IEC/IEEE synchrophasor standard
  - IEC/IEEE 60255-118-1

Synchrophasor Standard History

- First standard IEEE1344-1995
  - Time sync & sampling specified
- Second standard C37.118-2005
  - TVE test & error limits, steady-state phasor only
  - Comprehensive messaging for communication
- C37.118 split into 2 standards
  - C37.118.1-2011 for measurement
  - C37.118.2 -2011 for communication
- IEC 61850-90-5 communication
  - Synchrophasor communication adapted to 61850
- IEC 60255-118-1 synchrophasor measurement

Synchrophasor Measurement Standard IEEE C37.118.1-2011

- Retains existing steady-state requirements
- Adds measurement under dynamic conditions
  - Measurement bandwidth, tracking, and response time
- Standard covers all reported measurements
  - Phasor, frequency, & Rate of Change of Frequency (ROCOF)
- M & P performance classes
- Includes a latency test

Requirements presented in 10 tables

Example: Steady-state synchrophasor performance

Influence quantity	Reference condition	Minimum range of influence quantity over which PMU shall be within given TVE limit			
		Performance Class P		Performance Class M	
		Range	Max TVE (%)	Range	Max TVE (%)
Signal frequency range – f_{dev} (test applied nominal + deviation: $f_0 \pm f_{dev}$)	$F_{nominal}$ (f_0)	± 2.0 Hz Report rate independent	1	± 2.0 Hz for F_s<10 ± F_s/5 for 10 ≤ F_s < 25 ± 5.0 Hz for F_s ≥25 Keyed to report rate	1
The Signal Frequency range tests above are to be performed over the given ranges and meet the given requirements at 3 temperatures: T = nominal (~23º C), T = 0º C, and T = 50º C. Test over temperature					
Signal magnitude - Voltage	100% rated	80 – 120% rated	1	10 – 120% rated Separate V & I tests	1
Signal magnitude - Current	100% rated	10 – 200% rated	1	10 – 200% rated	1
Phase angle with $\lvert f_{in} - f_0 \rvert$ <0.25 Hz	Constant or slowly varying angle	±π radians	1	±π radians	1

Amendment to Standard IEEE C37.118.1

- Problems reported by developers & testing
  - Typos of significance
  - Wording with dual interpretations
  - Requirements difficult/impossible to meet
- Amendment completed in December 2013
  - Fixes all typos
  - Clarifies wording
  - Relaxes or suspends ROCOF (so it does not drive designs)
  - Improves model in annex – now meets all requirements
  - Fixes Ramp & Latency tests
  - Small changes in a few performance requirements

Synchrophasor Data Transfer Standard IEEE PC37.118.2 – 2011

- Backward compatible with C37.118-2005
  - New features extend for current developments
- Only specifies messaging
  - Describes messaging structure and contents
  - Can use any communication protocol or hardware
- Implementation has established communication
  - RS232 serial
  - Networks using IP protocol
- No changes have been needed

IEC/IEEE 60255-118-1

- Joint IEC/IEEE development
  - IEC-TC95 measuring relays (WG1)
  - IEEE Relay committee (WG H11)
- Covers synchrophasor measurements
  - Based on IEEE C37.118.1
  - Will generally follow same methods & requirements
- Intended to update/replace C37.118.1
- Expect completion in 2016
  - First meeting January 2014

Summary for C37.118 standard series

- PMU standards started with IEEE 1344-1995
- IEEE C37.118-2005 widely used, very successful
- IEEE C37.118.1-2011: measurements
  - IEEE C37.118.1a -2014 amendment corrects issues
- IEEE C37.118.2-2011: data communication
- IEC/IEEE 60255-118-1: synchrophasor measurement standard under development

Thank You!

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Dynamic Performance Tests

- Amplitude and phase angle modulation
  - Determines the bandwidth of the measurement
  - Emulates a system oscillation
- Constant ramp in frequency
  - Determines measurement tracking system
  - Emulates a system separation: power-load imbalance
- Step change of amplitude or phase
  - Determines response time measurement
  - Emulates a switch action