New Energy Horizons
Opportunities and Challenges

Update on IEEE PC37.242

Guide for Synchronization, Calibration, Testing, and Installation of Phasor Measurement Units (PMU) for Power System Protection and Control

Farnoosh Rahmatian
Quanta Technology

IEEE PC37.242

IEEE Power & Energy Society
2012 San Diego,CA
New Energy Horizons
Opportunities and Challenges

Title: Guide for Synchronization, Calibration, Testing, and Installation of Phasor Measurement Units (PMU) for Power System Protection and Control

PAR Approved on 9/30/2010

Scope:

- The document provides guidance for synchronization, calibration, testing, and installation of Phasor Measurement Units (PMU) applied in power system protection and control. The following are addressed in this guide:
  a) Considerations for the installation of PMU devices based on application requirements and typical bus configurations.
  b) Techniques focusing on the overall accuracy and availability of the time synchronization system.
  c) Test and calibration procedures for PMUs for laboratory and field applications.
  d) Communication testing for connecting PMUs to other devices including Phasor Data Concentrators (PDC).

Purpose:

- This guide is intended to be used by power system protection professionals for PMU installation and covers the requirements for synchronization of field devices and connection to other devices including PDCs.

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Background

- NASPI PSTT has developed three guides that are the base for the PC37.242 Guide for Synchronization, Calibration, Testing, and Installation of Phasor Measurement Units (PMU) for Power System Protection and Control
  - Several meetings at NASPI for official agreement within NASPI to transfer the Guides to IEEE
  - Formal process because of potential patents or other reasons
  - NASPI / DOE agreements that the industry benefits by IEEE standards
- September 2009 PSRC NASPI Performance Standards Task Team (PSTT) request on behalf of the DOE and NIST
  - PSTT provided the background material and related PSTT Guides to PSRC
- IEEE PSRC leadership discussions leading to
  - "C" Subcommittee Task Force to establish task force and evaluate merits
  - "C" Subcommittee members voted to proceed with forming a WG C5
    - To accomplish within timeline, facilitate double sessions
    - Much of the work within the WG through conference calls and other IEEE Events
  - IEEE SA support is key

Summary

- **January 2010 – September 2011** – PSRC meetings and WG conference calls
- **December 2011** – WG internal balloting
- **January 2012** – PSRC approved to proceed with balloting
- **February 17, 2012** – Ballot Group formed
- **March 9 – April 8, 2012** – IEEE Sponsor Ballot
  - 115 registered to vote, and 95 people voted (82% participation, met IEEE-SA's 75% requirement).
  - 91% affirmative votes, 7 negative votes, 470 formal comments (533 total comments)
- **April – July 2012** – WG C5 has been going through comments in several conference calls and at the PSRC on May 15, 2012
  - Have gone through about all comments (533) and have edited the Draft accordingly – a few action items still to be completed.
  - Expect to complete comment resolution in a few weeks
- **August 2012** – Recirculation of the revised draft through IEEE Sponsor Balloting System.

IEEE PC37.242 Content

Contents

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Calibration and Data Quality

- Accuracy
  - Accuracy is a key quality metric for synchrophasor data
- What accuracy levels do we need?
  - Very much application dependent

Example from --- NASPI.org

L - Low: > 5°,

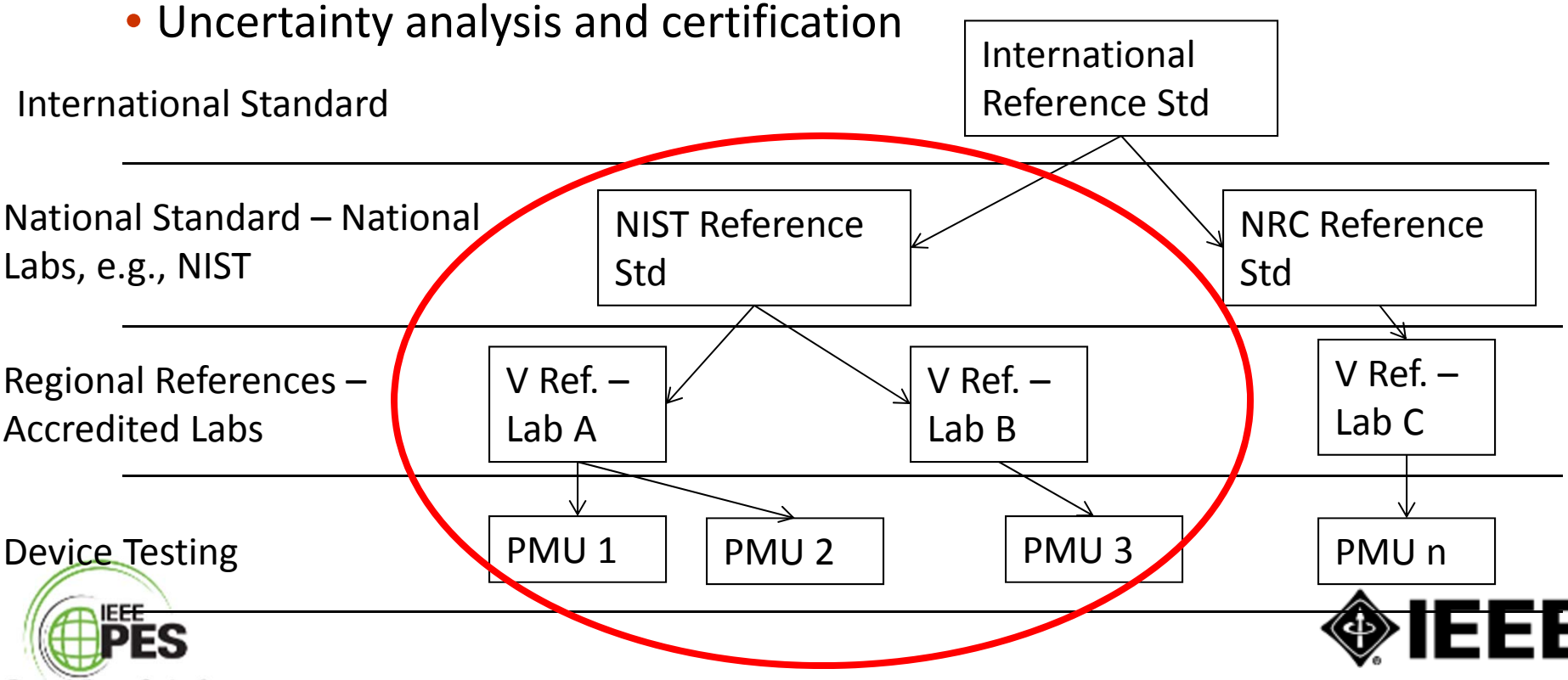
M - Medium: 1-5°,

H - High: < 1 °

Function	Angular Accuracy Requirements
Post-disturbance Analysis	H
System Model Validation and Fine-Tuning	H
Situational Awareness/Visualization	L
Power System Restoration	M
State Estimation (SE)	H
Angular Stability Monitoring and Control	H
Overload Monitoring and Dynamic Rating	H
Voltage Stability Monitoring and Control	L
Congestion Management	H
Distributed Generation Control	M
Real-Time Automated Control	M
Adaptive Protection	H
System Integrity Protection Scheme	H

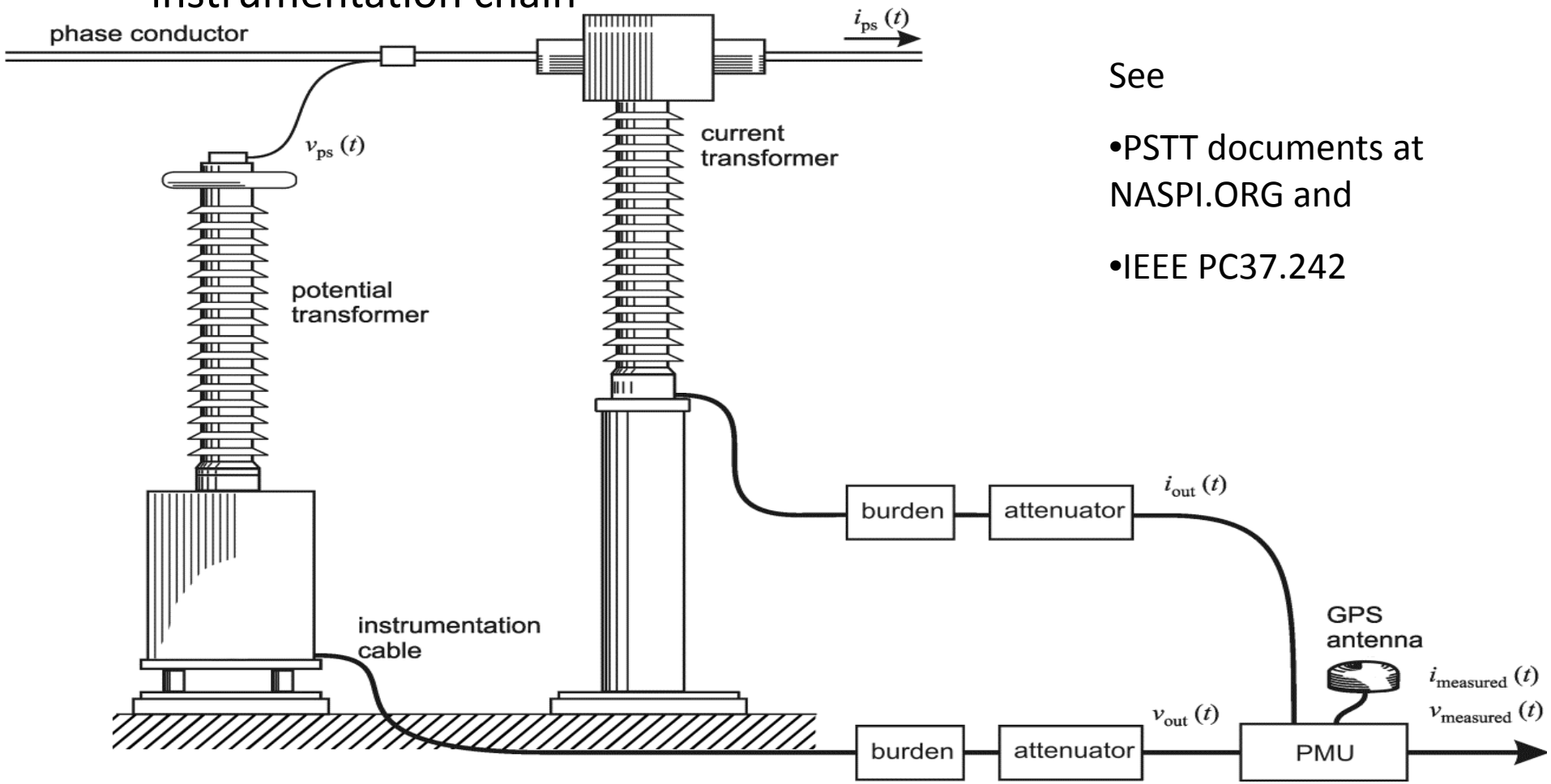
Calibration and Traceability

- Traceability is the basis for consistency
  - over time and geography
- Traceability
  - Unbroken Chain of Measurements Tracing Back to National and/or International Standards
  - Uncertainty analysis and certification



PMU Calibration vs. Synchrophasor Calibration

- The PMU is only part of the measurement chain
  - To achieve desired data accuracy requires calibrating the entire instrumentation chain



See

•PSTT documents at NASPI.ORG and

•IEEE PC37.242

Measurement Chain

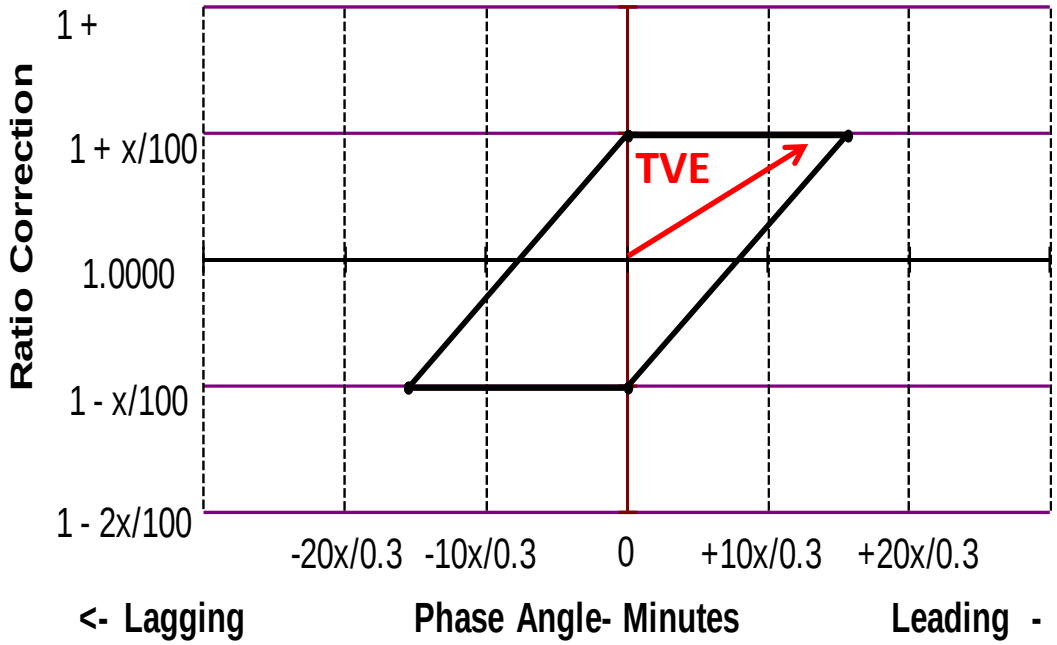
- PMU Accuracy – 1% TVE
- Instrument Transformer accuracy classes
  - Accuracy at operating point versus accuracy class
- Cabling and burdens

CT Accuracy Class X

IEEE C57.13 or 1601

e.g.: Class 0.6 is equivalent to

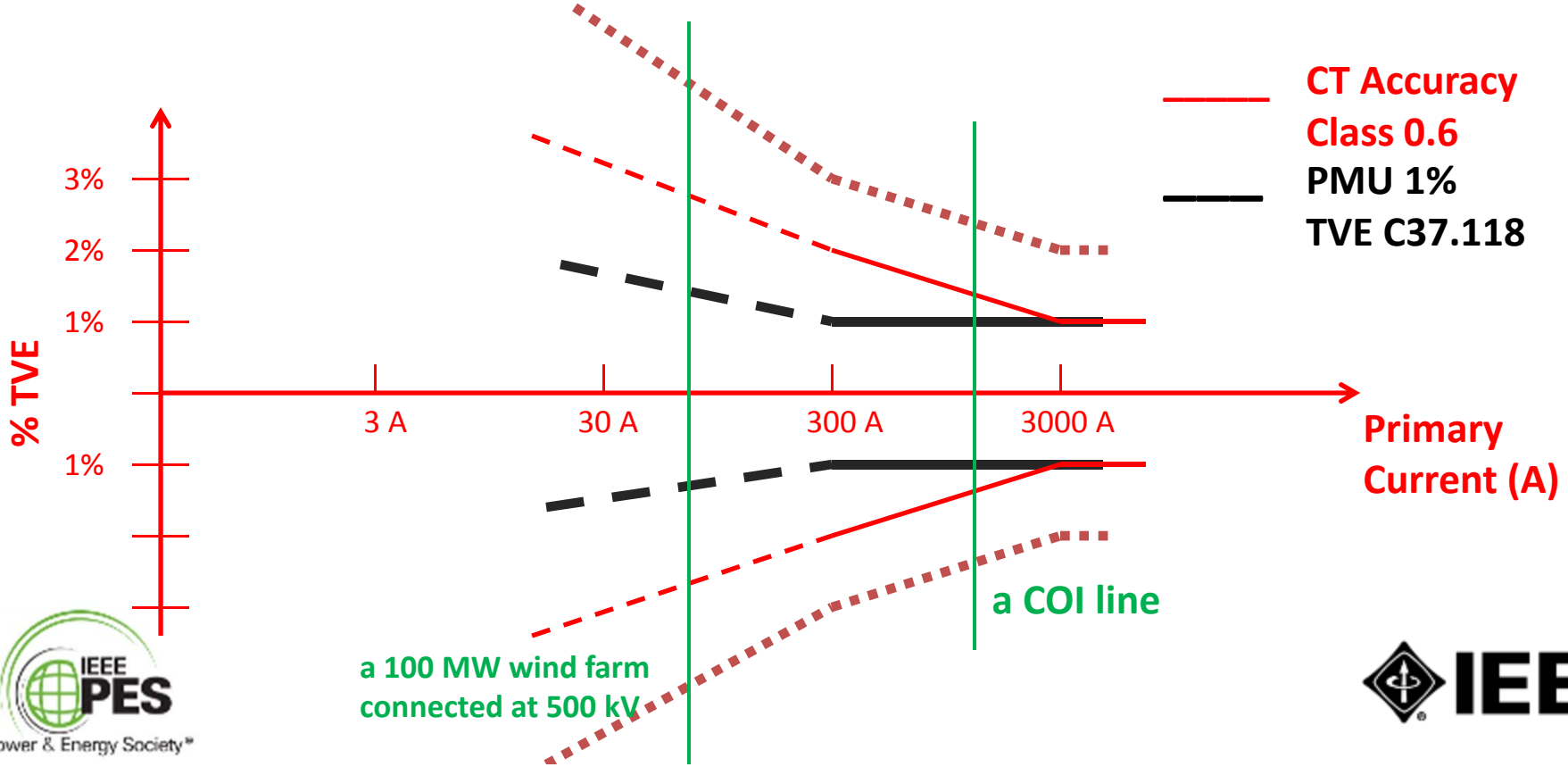
- 1% TVE at rated current
- 2% TVE at 10% of rated current
- possibly more than 2% TVE below 10% of rated current (no requirements)



Measurement Chain Alignment

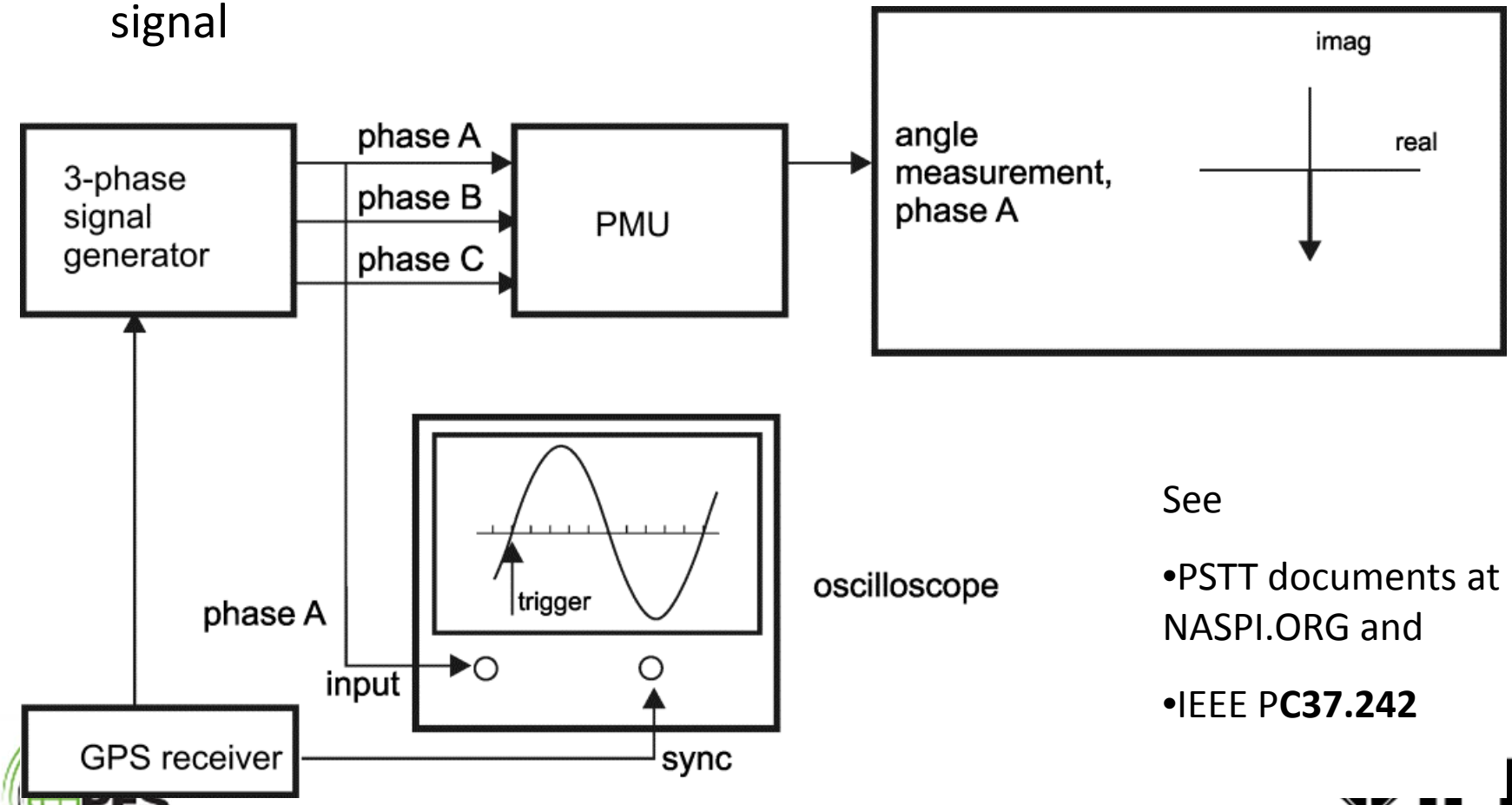
Example:

- PMU Accuracy – 1% TVE
- Instrument Transformer accuracy class 0.6, rated for protection application with rated primary current of 3000 A



Reference PMU calibration

- Using a reference PMU for calibrating other PMUs
  - Example – Phase Calibration of a reference PMU using 1 pps clock signal



See

- PSTT documents at NASPI.ORG and
- IEEE P**C37.242**

Questions

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