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Utilities Presentation

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Presentation to Utility Companies

A Power Signaling Based DG Anti-islanding Protection Scheme

Presented
by

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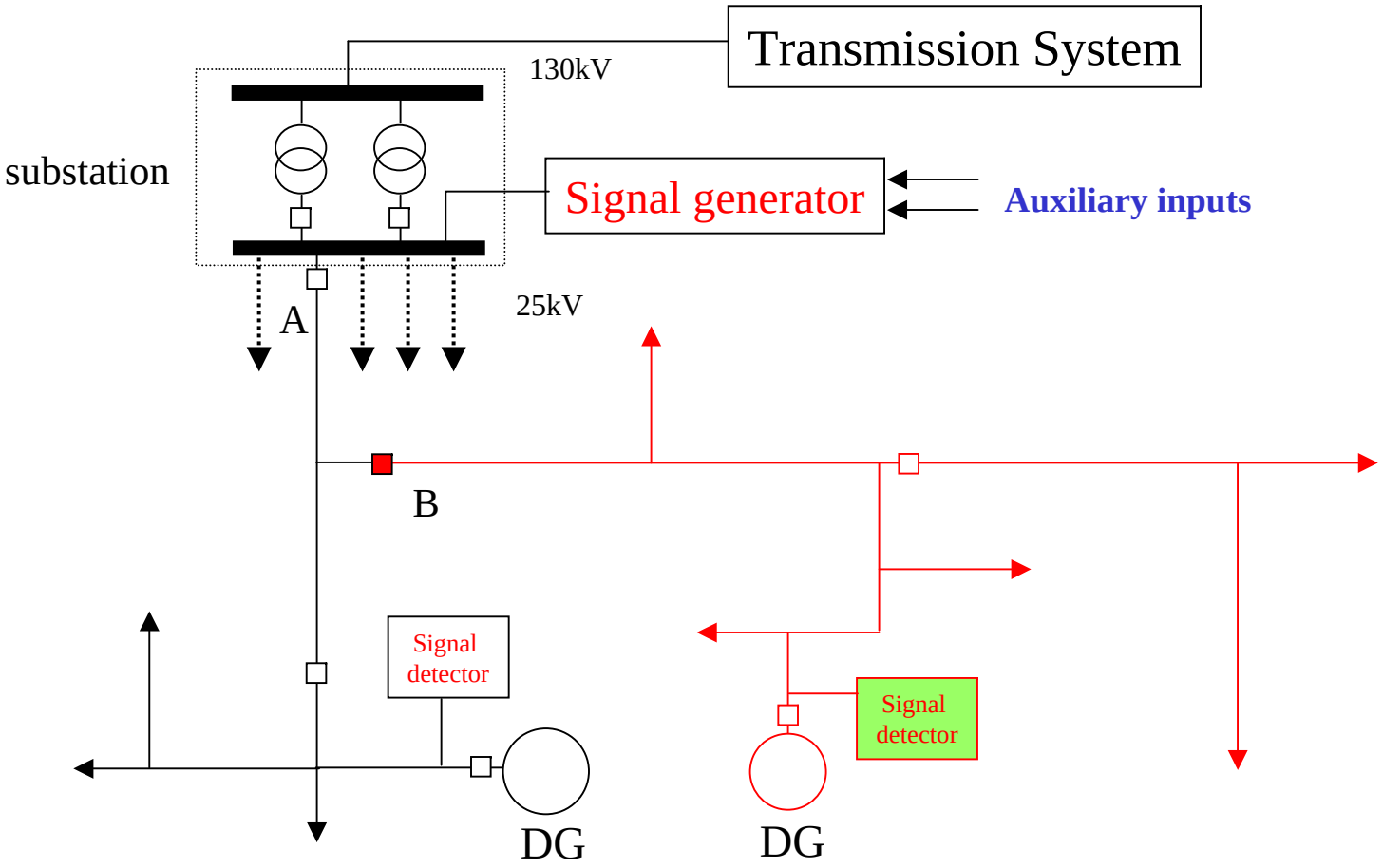
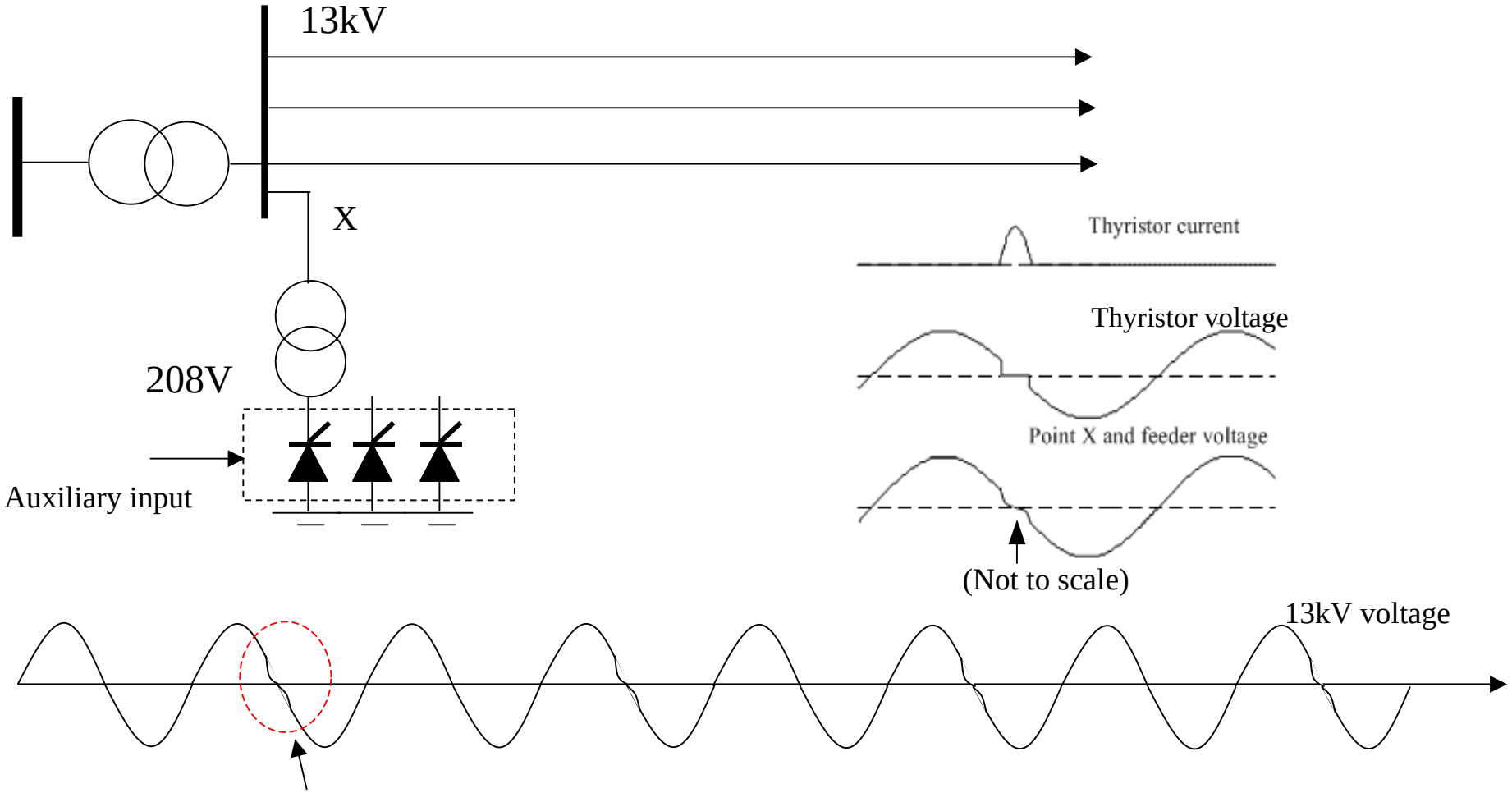
The Main Idea



Two components:

- Signal generator at substation
- Signal detectors at DG locations

Operating principle

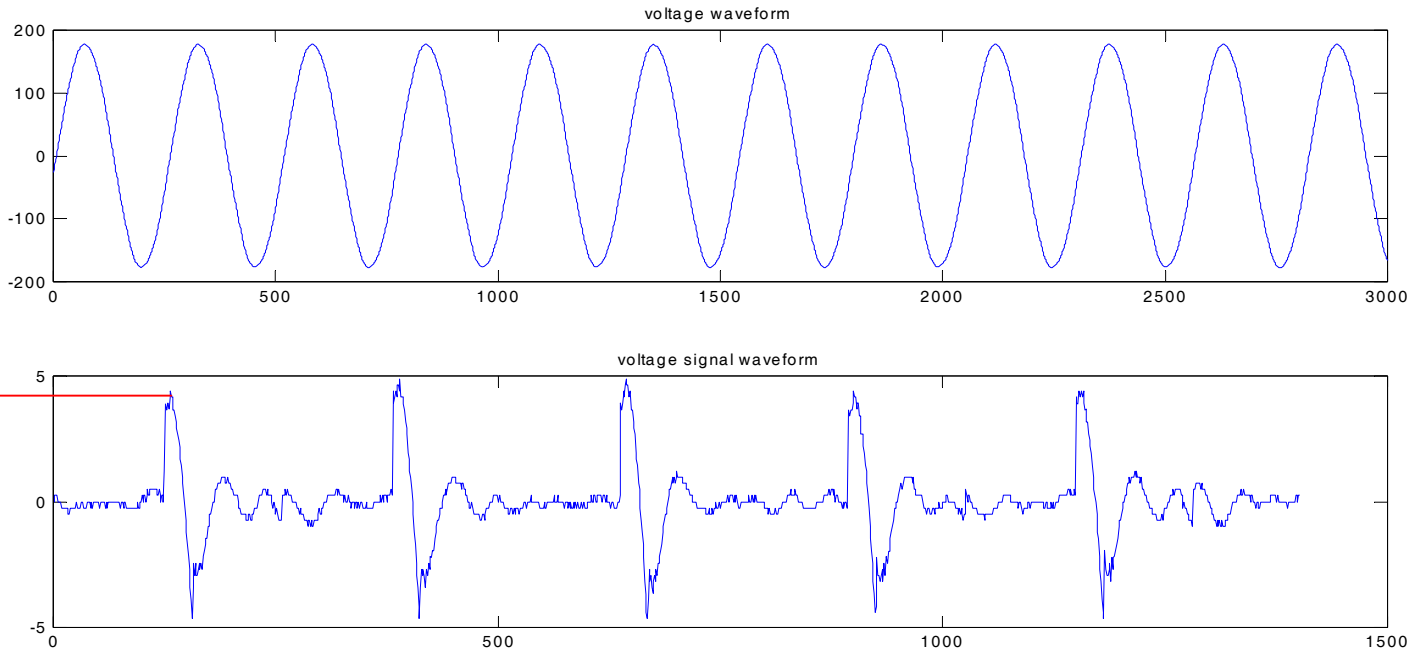


The thyristor conducts for a short period around the zero crossing point.
The resulting voltage distortion is the signal.

Sample signals

Sample field measurements

$$k = \frac{Signal\ Peak}{V_{peak}} = 2.9\%$$



The signals are obtained by subtracting two cycles of voltage waveform where one cycle contains the voltage sag and the other does not. The result of subtraction is the voltage signal. Furthermore, the harmonic distortions are subtracted out, leading to a signaling scheme immune to harmonics

The signal detection algorithm can be implemented into existing programmable relays

About signal propagation

- The signaling scheme was invented more than 20 years ago at Emerson Electric. It is called TWACS (Two Way Automatic Communication System) Technology

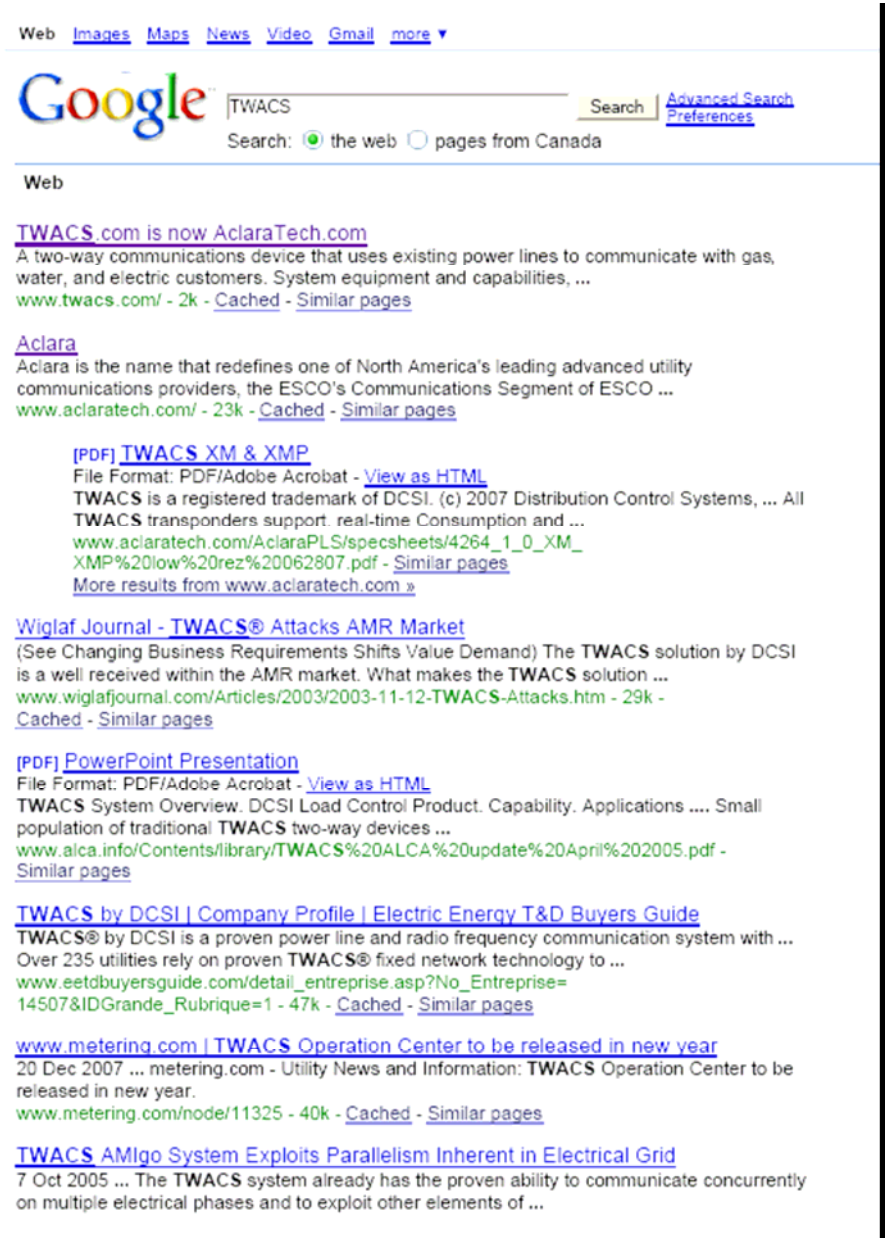
- At present, TWACS is the most widely used PLC (power line communication) technique for MV distribution systems with applications include AMR, load control and so on

- The technology is currently marketed by Aclara (formally DCSI), whose most recent customer is PG&E which has more than 5 million metering points

- The widely deployed AMR applications have shown that signal attenuation is not a concern for power distribution systems

About signal propagation – TWACS experience

TWACS Technology



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TWACS.com is now AclaraTech.com
A two-way communications device that uses existing power lines to communicate with gas, water, and electric customers. System equipment and capabilities, ...
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Aclara
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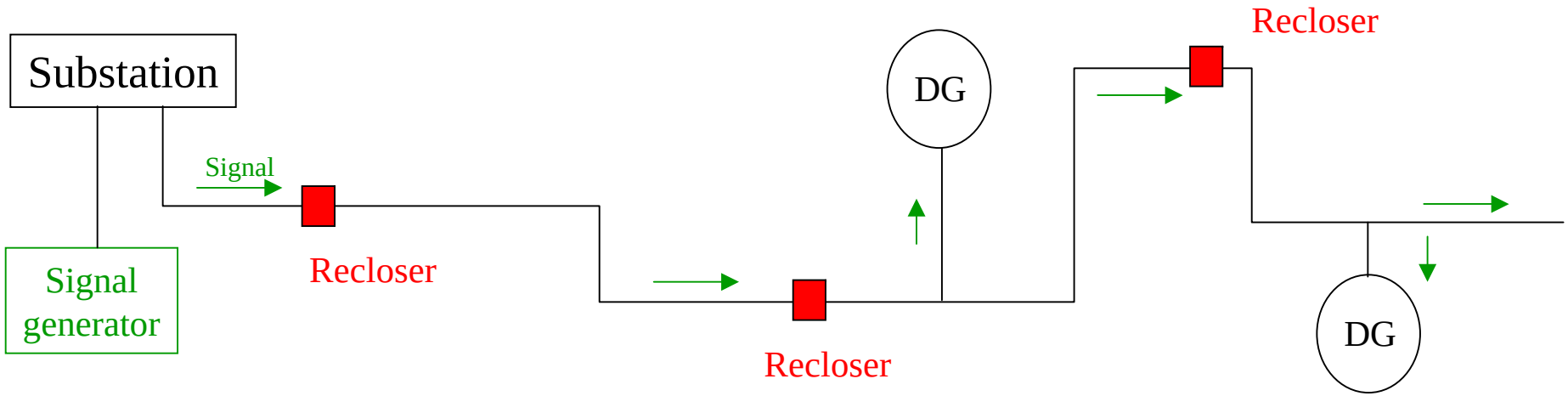
TWACS AMIgo System Exploits Parallelism Inherent in Electrical Grid
7 Oct 2005 ... The TWACS system already has the proven ability to communicate concurrently on multiple electrical phases and to exploit other elements of ...

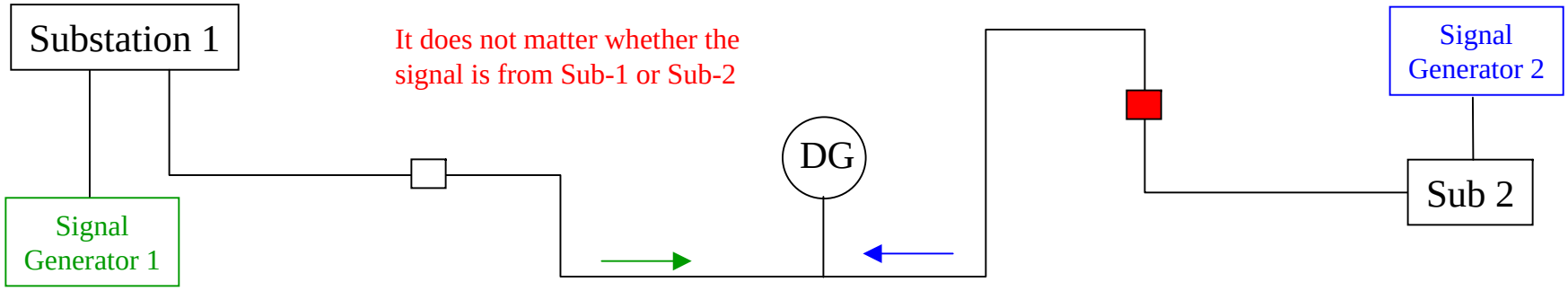
Main attractions - 1

- Anti-islanding detection becomes the detection of signal continuality from substation to the DG location
- This scheme can also be viewed as a transfer trip scheme. But the power line is used as the signal carrier
- As a result, the scheme works equally well for feeders with multiple reclosers, significantly simplifying the radio-based transfer trip scheme
- One signal generator is sufficient to cover all DGs served by a substation



Main attractions - 2

- The scheme is also immune to the impact of feeder reconfiguration



- The scheme is a fail-safe scheme and gives utilities a full control on DG trip

  It is impossible for noises, disturbances or DGs to create a waveform pattern that resembles the signals and “holds” the DG to the system after the DG is actually islanded

  On the other hand, the supply utility has a full control on DG connection – It can trip all DGs by simply stop broadcasting the signal using a substation SCADA commend

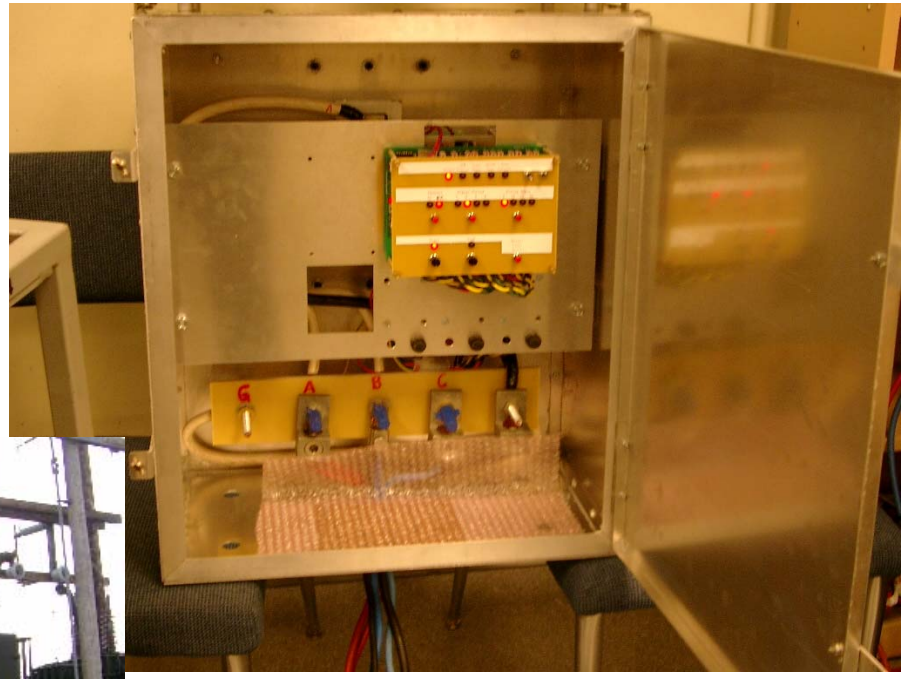
Main attractions - 3

- Speed of response
  - Two cycles are needed to carry one pulse
  - If missing one pulse is considered as islanding condition, the scheme can respond in 2 cycles
  - The above set up is too sensitive and are likely to cause excessive nuisance trips
  - Based on requirements of some utilities, our proposed set up is 1 pulse for every four cycles and missing 4 consecutive pulses constituting an islanded condition. So the response time is 16 cycles (or 277ms) plus breaker activation time.
- Trip DGs under single-phase lock out condition

  The package provided to utilities can send signals in three phases. If any one of the phases Misses the signal (i.e. 4 pulses), the signal detector will send a trip command
- The scheme can be tested without actually islanding the system
- It works on all types of DGs, independent of the natures of the DGs

Field experiences - ATCO

Test in ATCO Electric System (Completed)



Signal generator

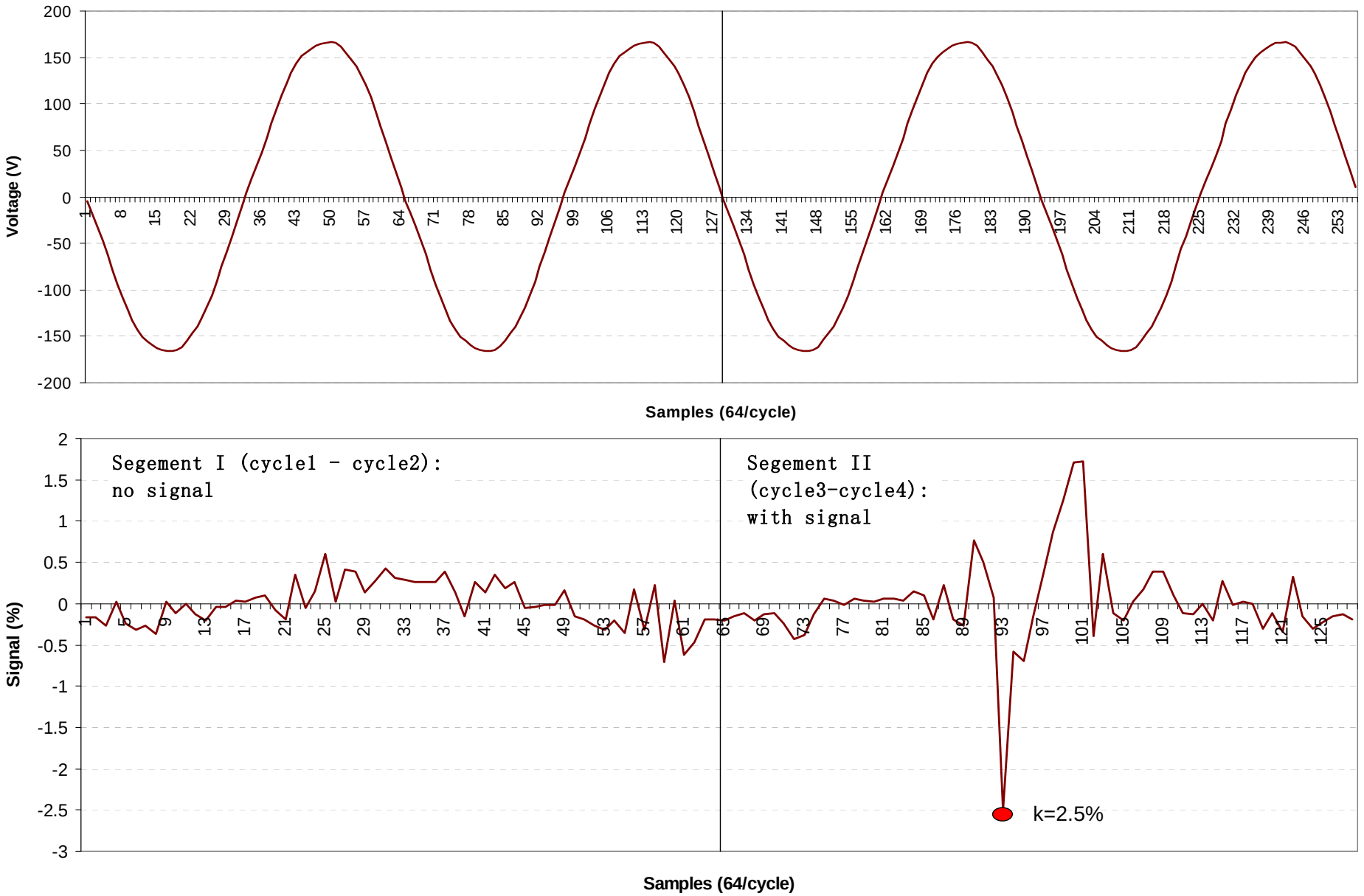
Field experiences - Manitoba

Test in Manitoba Hydro system (on-going)

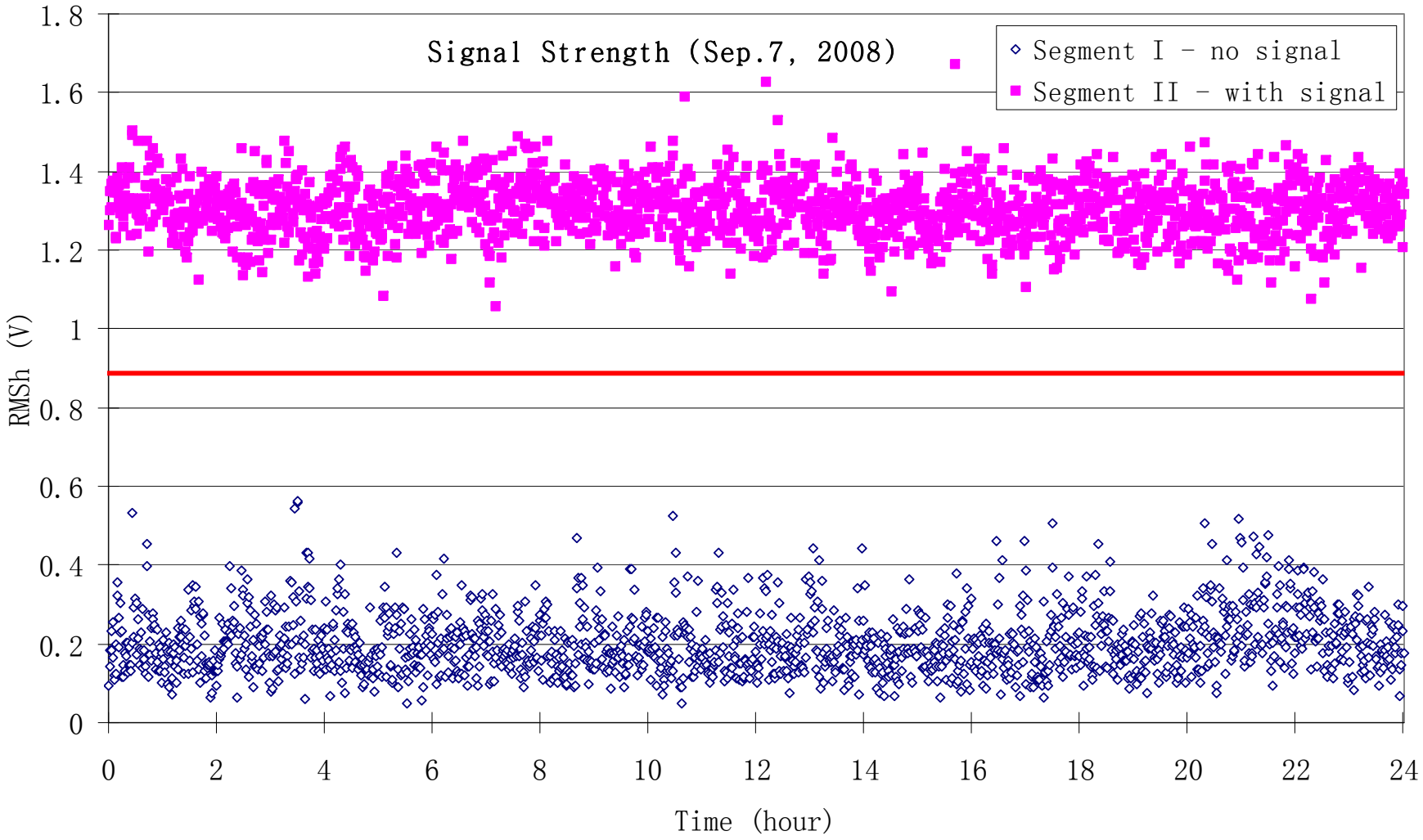
Signal transformer (standard distribution transformer)

Signal generator

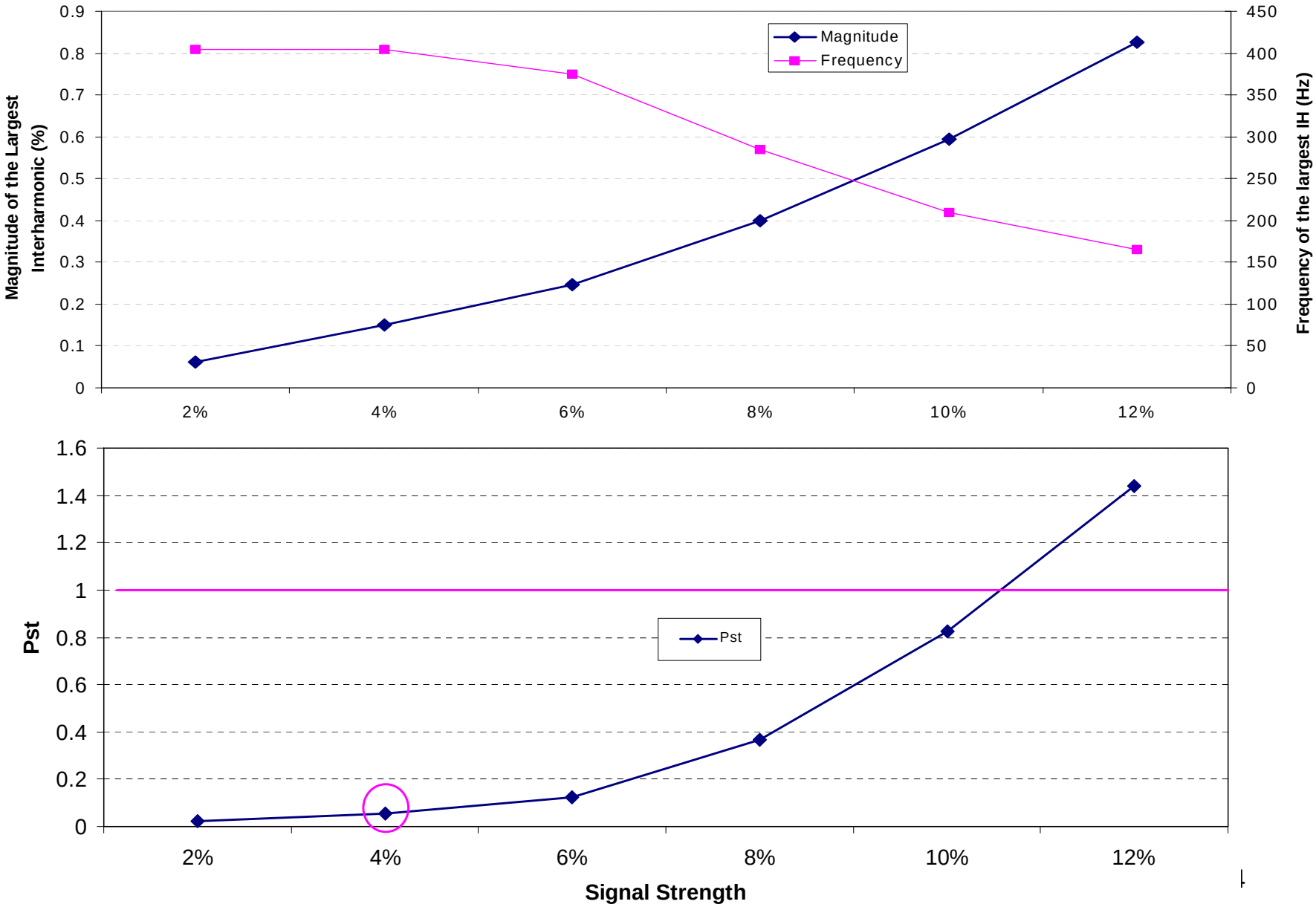
Field experiences - Manitoba



Field experiences - Manitoba



Power quality impact



A Component of Smart Grid

- The proposed scheme can be integrated into the TWACS AMR system, becoming one of the AMI features
- The scheme can also be developed independent of the TWACS to send information (not just signals) to DG for advanced DG control, such as asking DGs to output more reactive power
- The signal generator has the potential to monitor the substation grounding conditions, system fault levels and high-impedance faults, resulting in other “smart grid” applications
- Once utilities start to use the technology, more applications are likely to show up, which will support the smart grid vision of distribution utility companies.

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