RF Group (Daresbury)

CM44 (30th March to 1st April) 2016

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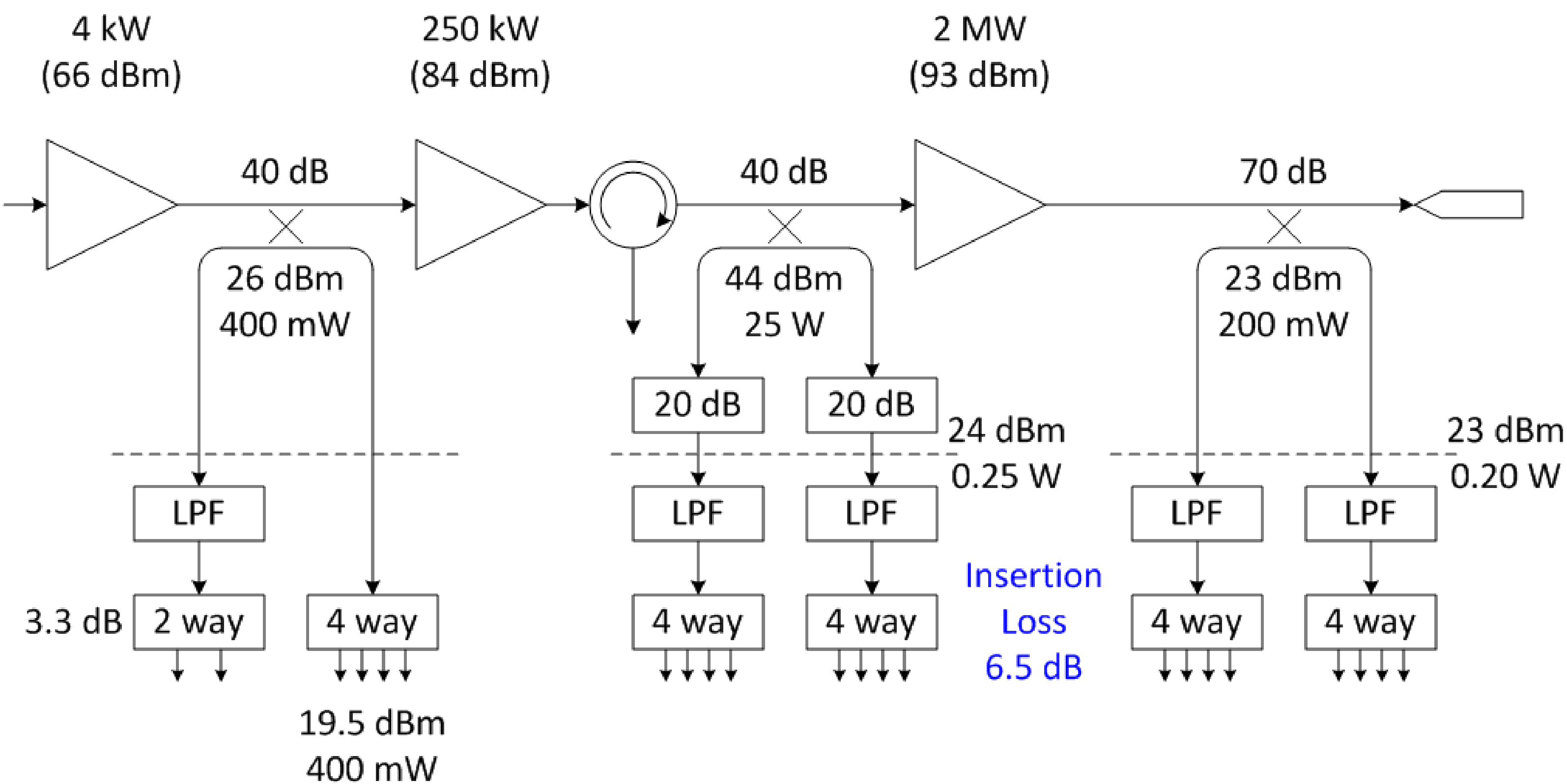
Aim

- To consider some of the principles of MICE RF monitoring

- Objectives
  - Look at the scalability of the system
    - Cost consideration and simultaneous acquisition
  - Look at the technique for phase measurement
    - Consider the wide dynamic range of input signals
  - (Today: check we are going in the right direction)

RF Monitoring (1/4)

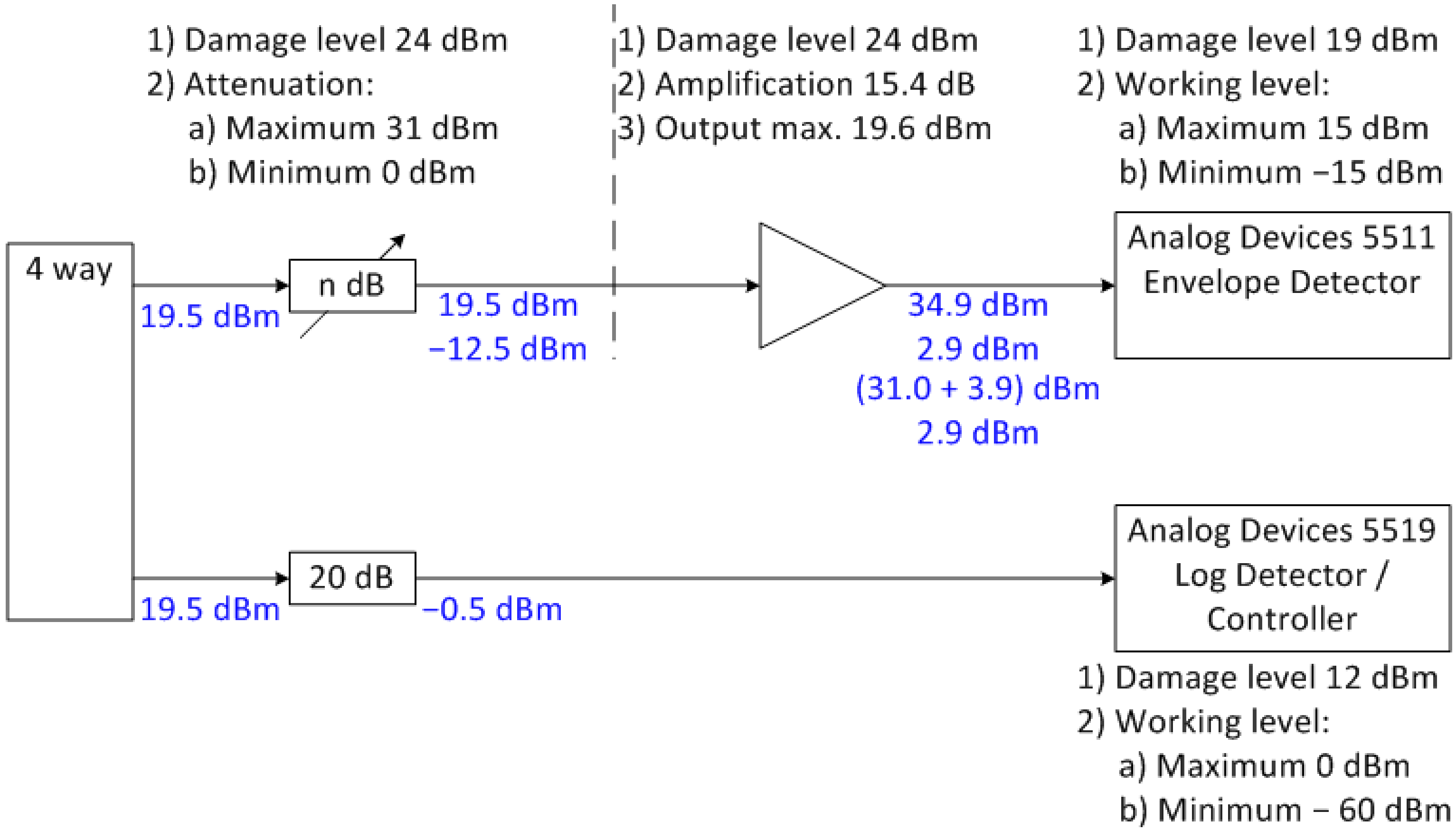
- The initial stages of the RF system are illustrated below



- It is possible to measure power at 12 points!

RF Monitoring (2/4)

- 1) A wide dynamic range AD5519 Log Detector
- 2) Envelope Detector AD5511



RF Monitoring (3/4)

AD5519

- Linear-in-dB measurements are provided …

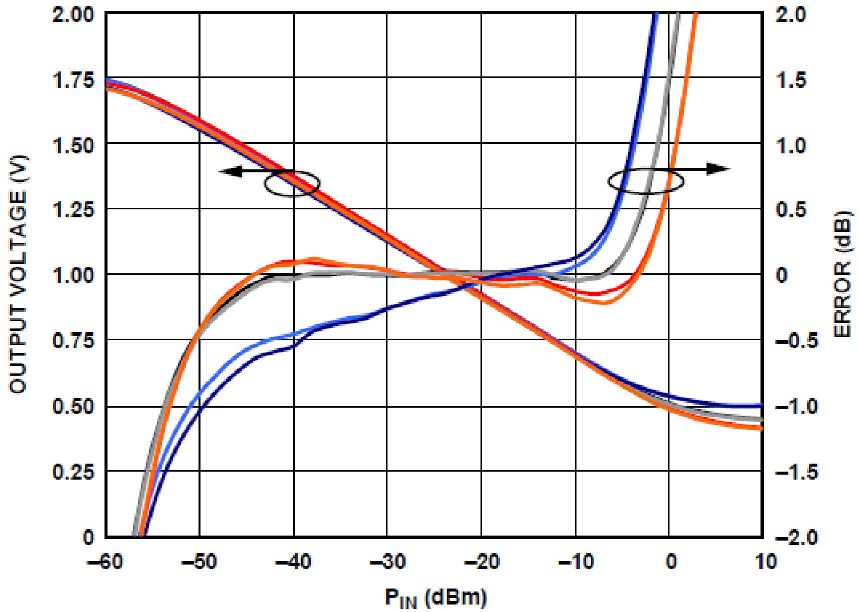


Figure 3. OUTA, OUTB Voltage and Log Conformance vs. Input Amplitud at 100 MHz, Typical Device, ADJA, ADJB = 0.65 V, 0.7 V, Sine Wave, Single-Ended Drive

AD5511

- rms output is a linear-in-V/V voltage …

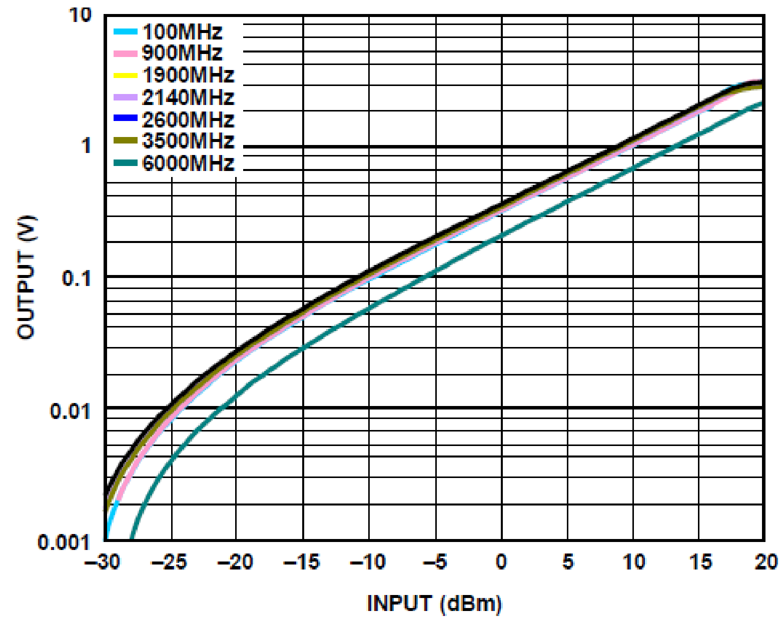


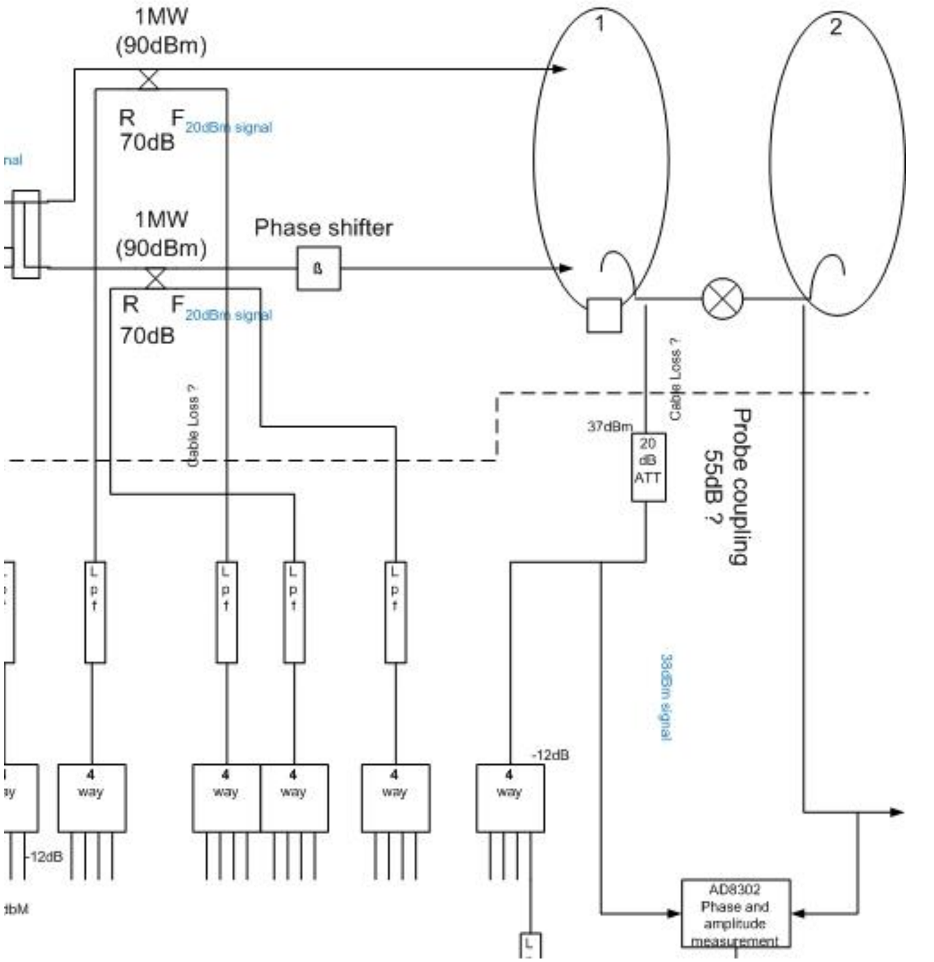
Figure 4. V_{ENV} Output vs. Input Level, at Various Frequencies at 25°(Supply 5 V

RF Monitoring (4/4)

- The voltages can be simultaneously read using NI and LabVIEW
  - PXI chassis PXIe-1073
  - NI PXIe-6358 DAQ – data acquisition and functionality for controlling step attenuator
    - 16 simultaneous channels, 1.25 MS/s, 16 bit resolution
    - Input range ±10 V, ±5 V, ±2 V, ±1 V
    - 48 digital I/O lines
  - NI PXIe-5105 Oscilloscope - higher sampling rate and wider dynamic range
    - 8 simultaneous channels, 60 MS/s, 12 bit resolution,
    - Input range (peak-to-peak) 50 mV to 30 V

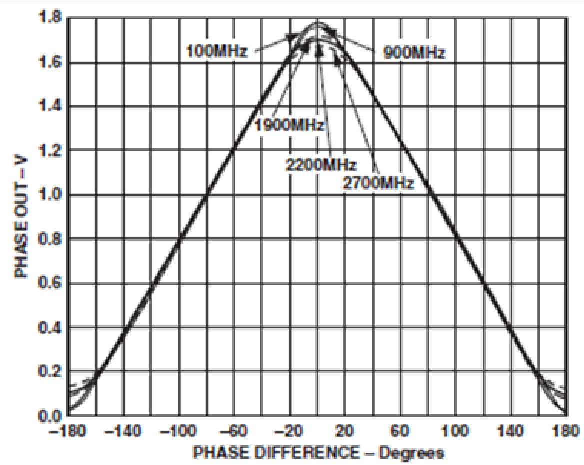
Phase Measurement (1/4)

- The final stage requires a phase measure

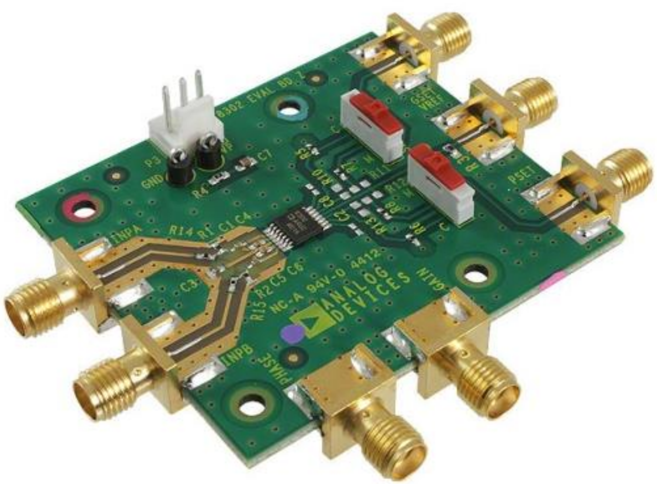


Phase Measurement (2/4)

- A suitable device for measuring phase is the AD8302
  - However, there are 2 problems
    - 1) not invertible
    - 2) significant errors at 0°and ±90°



TPC 25. Phase Output (VPHS) vs. Input Phase Difference, Input Levels –30 dBm, Frequencies 100 MHz, 900 MHz, 1900 MHz, 2200 MHz, Supply 5 V, 2700 MHz



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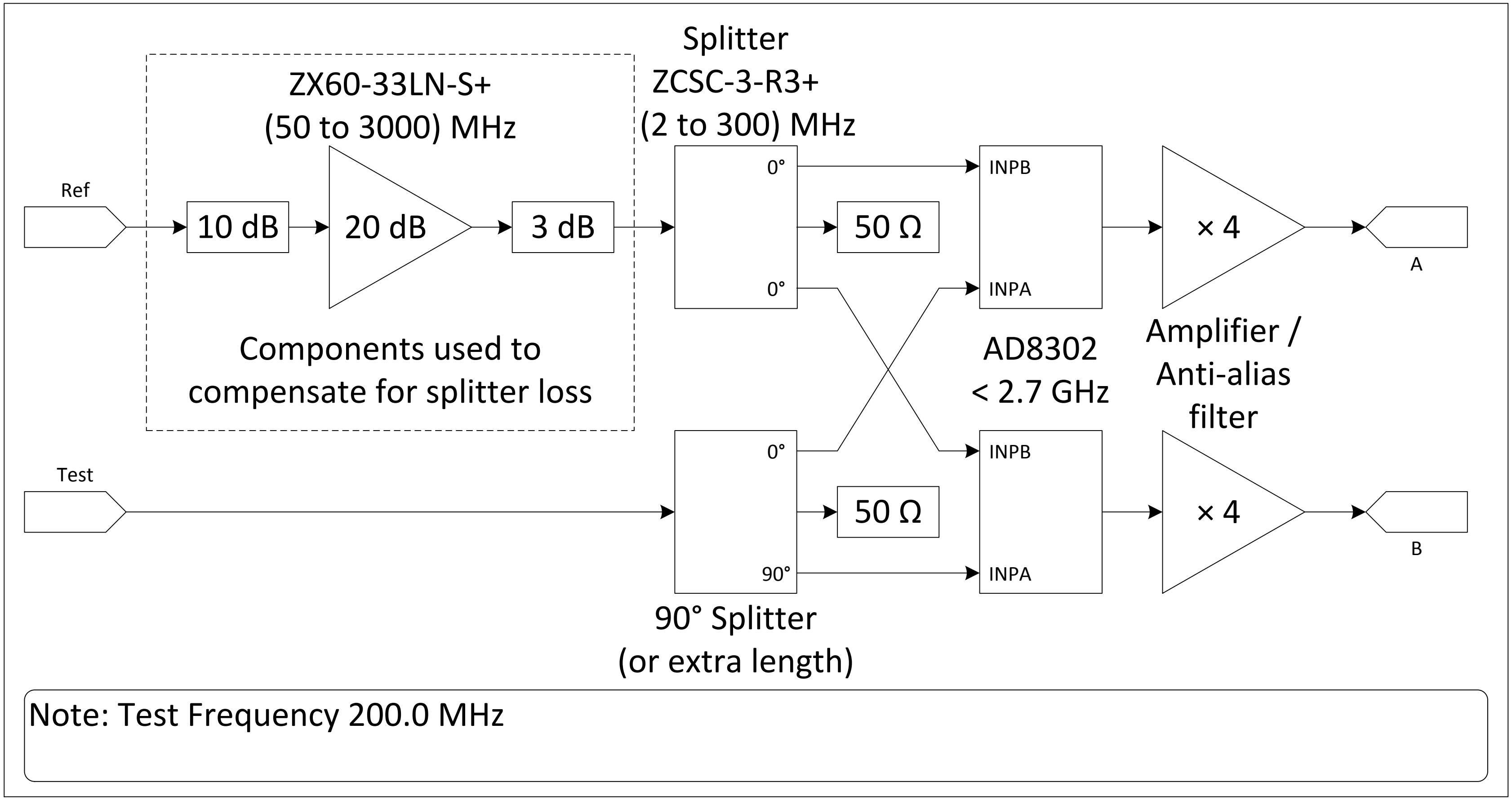
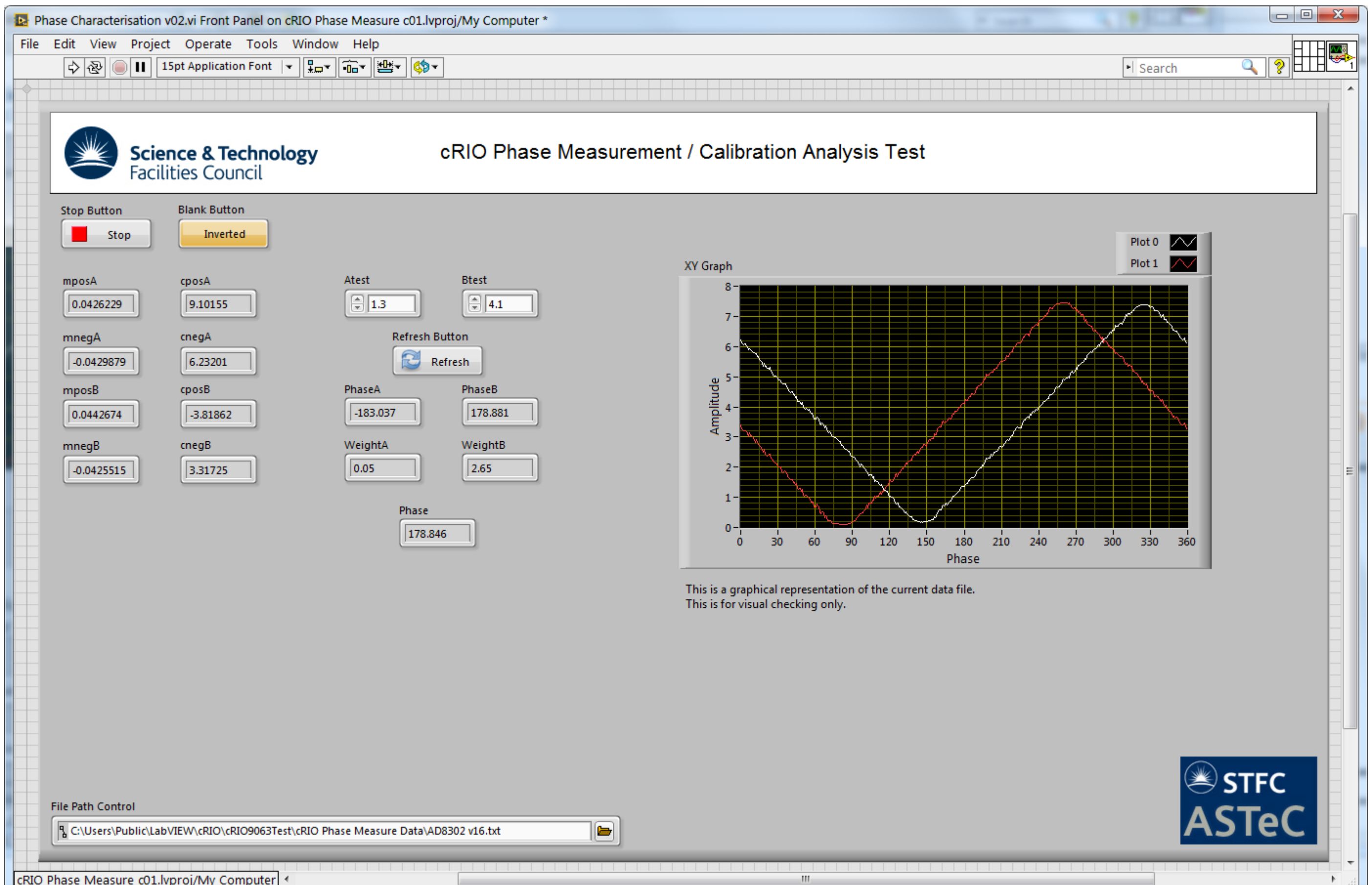
Phase Measurement (3/4)

- Proposed solution to use 2 devices
  - Second device has input phase shifted by 90°



Phase Measurement (4/4)

- Tested on NI (cRIO) to read in the two readings from the AD8302s and to determine the phase



Summary

- System under development to be
  - cost effective,
  - maximum simultaneous acquisition
  - Flexible
- Control possible under National Instruments LabVIEW
  - Compatible with EPICS using library functions

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Appendix

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