NMDG
LEADING BEYOND S-PARAMETERS

Frequency-dependant Harmonic Phase Distortion of Amplifier Modules

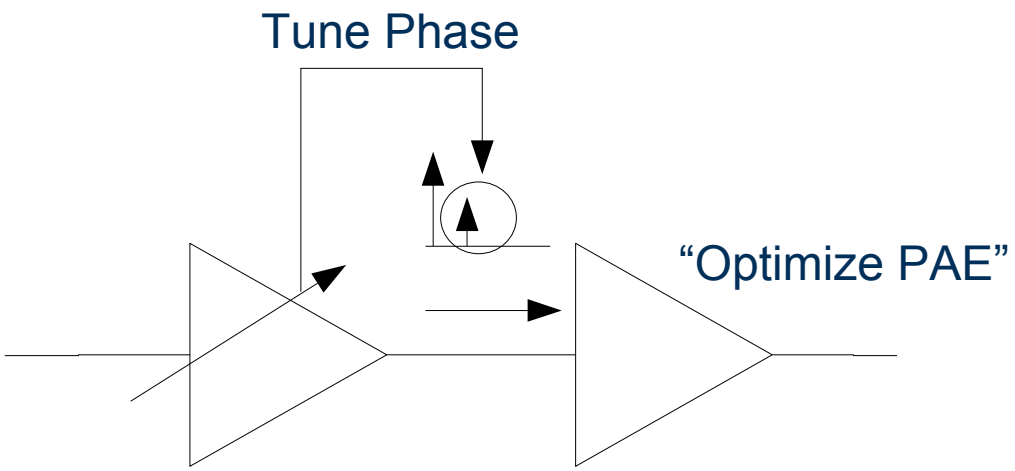
A Large-Signal Network Analyzer Application

Frequency-Dependent Harmonic Phase Distortion

- Goal: Measuring the phase dependency of a harmonic tone as function of the drive frequency at the output of a nonlinear component
- One-tone excitation, stepping across a given frequency range with a levelled input power at the device under test
- Measuring incident and reflected waves at excitation frequency and harmonics in amplitude and phase for each excitation frequency
- Normalizing the phase of a given harmonic of transmitted wave B_2 against the fundamental of the transmitted wave B_2
- An absolute calibration needs to be performed at the device under test
- De-embedding can move the calibration planes further
- When the source generates harmonics itself, the measurement is distorted
  - A filter can be used before the couplers to eliminate the harmonics
  - Or the impact of the harmonics from the source can be eliminated by an additional calibration

Application: Waveform Shaping to optimize PAE of Amplifier

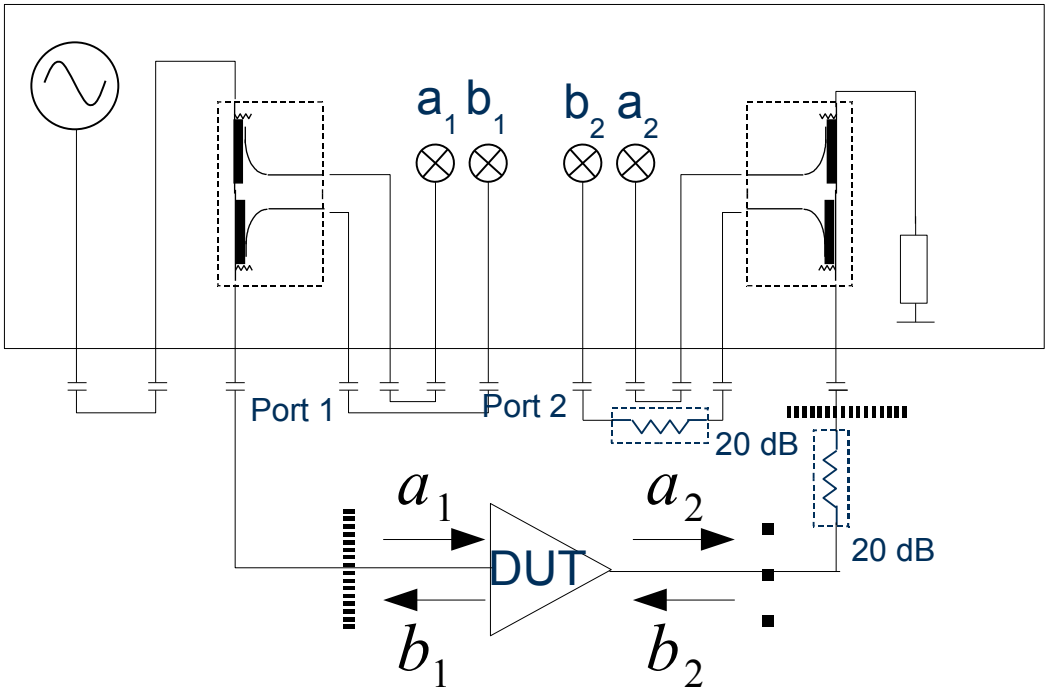
- Cascading amplifiers, it is possible to optimize the PAE of the second stage by injecting a second harmonic into the second stage from the first stage with proper phase (*)
- The first amplifier needs to be tuned such that the second harmonic has the proper phase
- The tool allows to monitor the phase behaviour while tuning

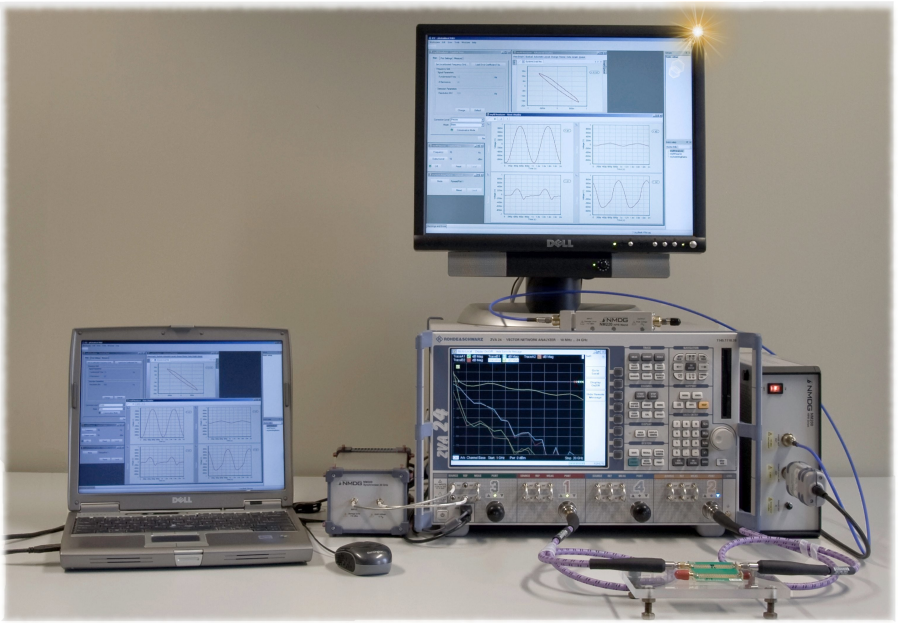


(*) See also:
"RF Power Amplifiers for Wireless Communications, Steve C. Cripps, Artech House", pag. 69

Example of Setup

2 GHz ... 4 GHz





Levelled Input power at -10 dBm
across input frequency range

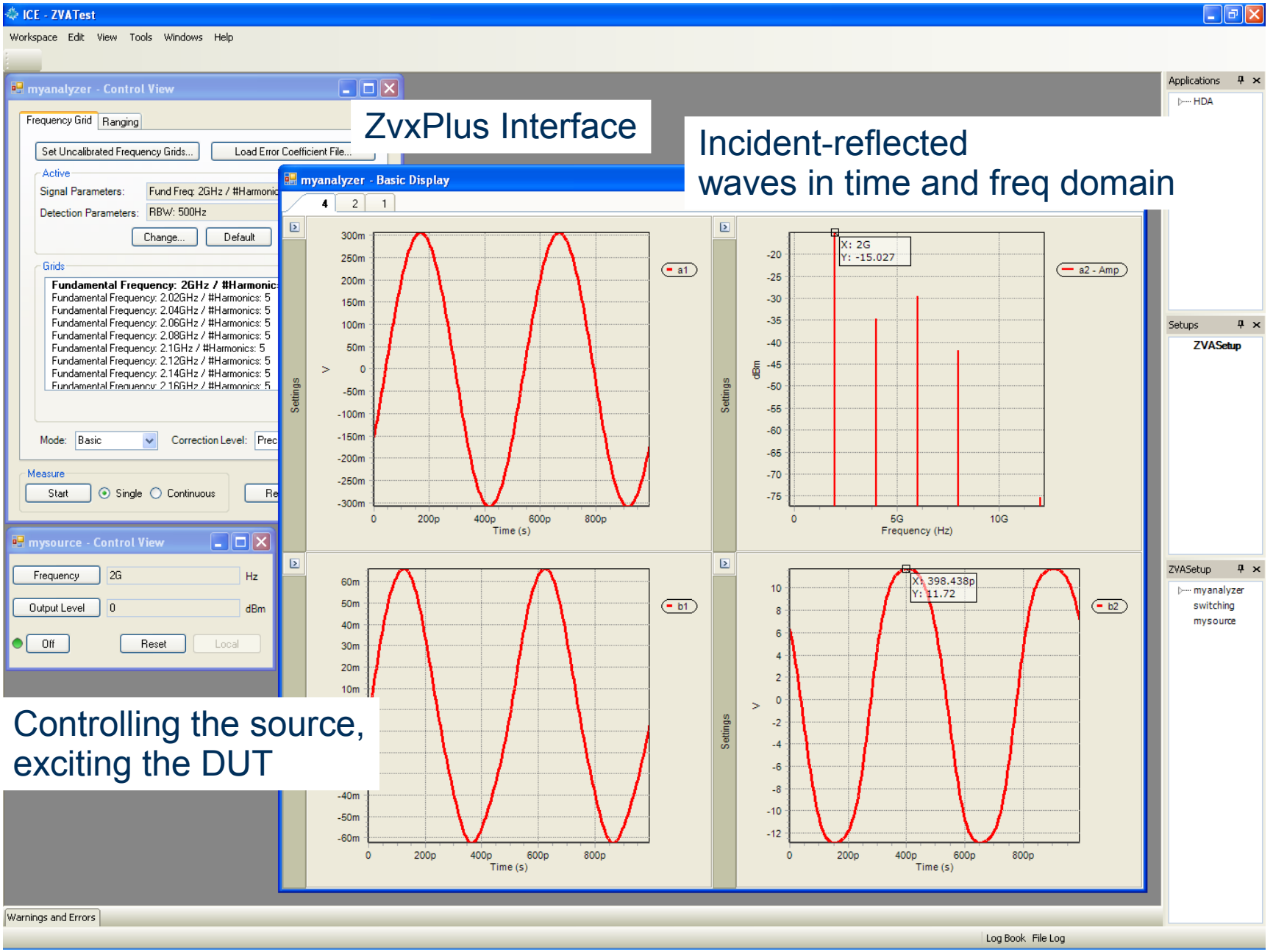
Output: appr. 25 dBm

Calibration Plane

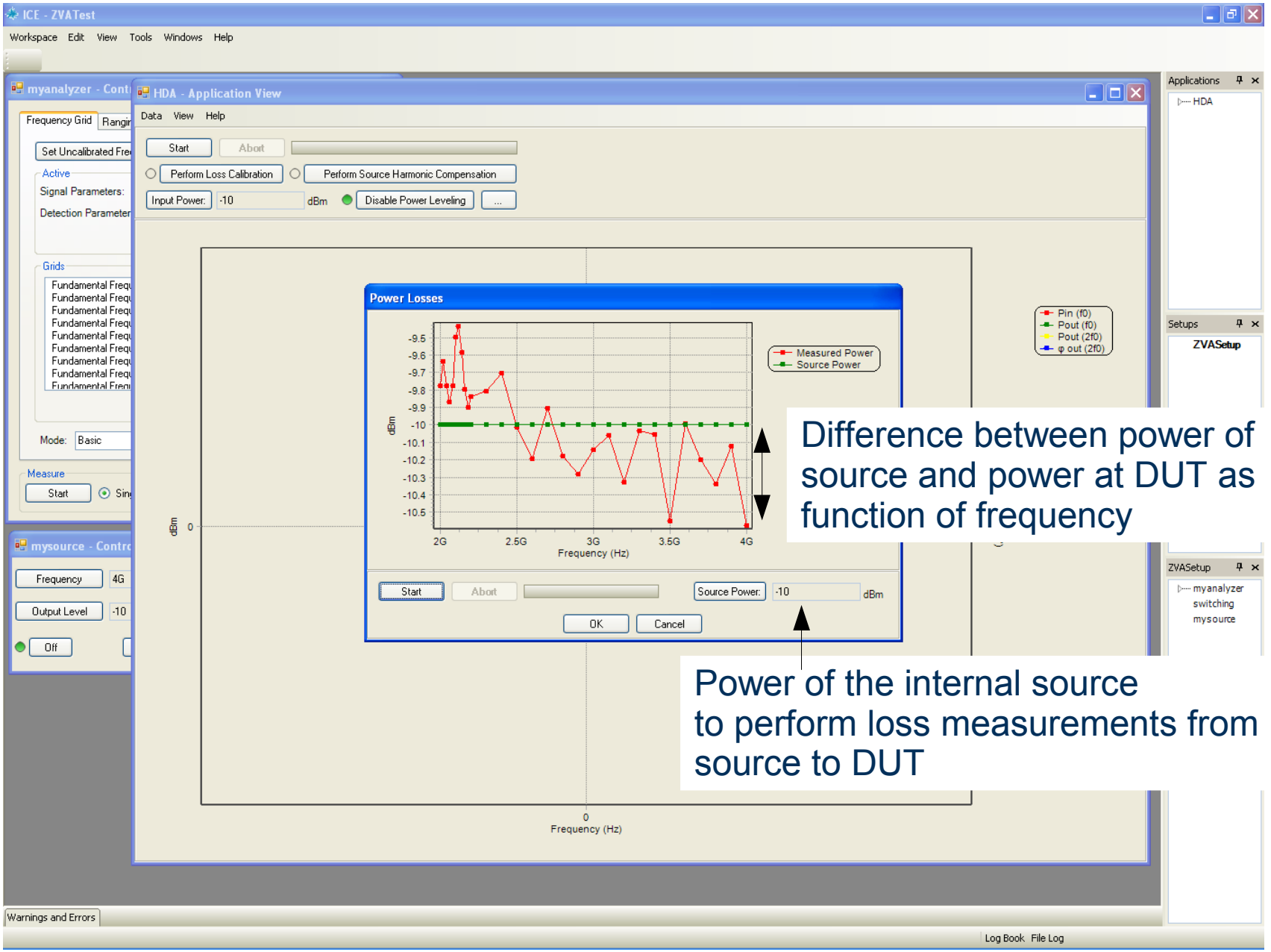
Deembedding Plane

The attenuators are required for proper power balancing

Verification of Operation of Component



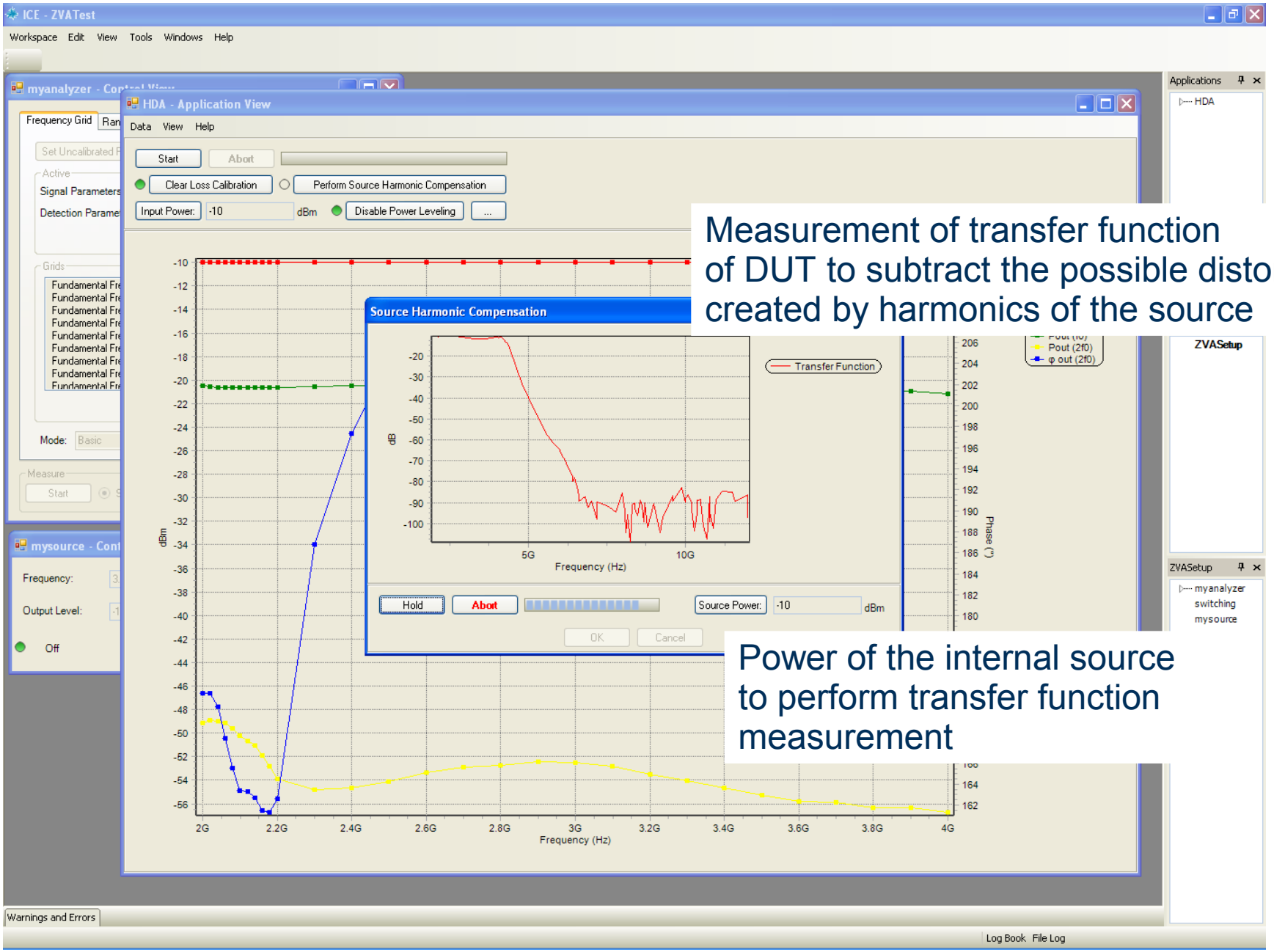
Performing Loss Calibration



Difference between power of source and power at DUT as function of frequency

Power of the internal source to perform loss measurements from source to DUT

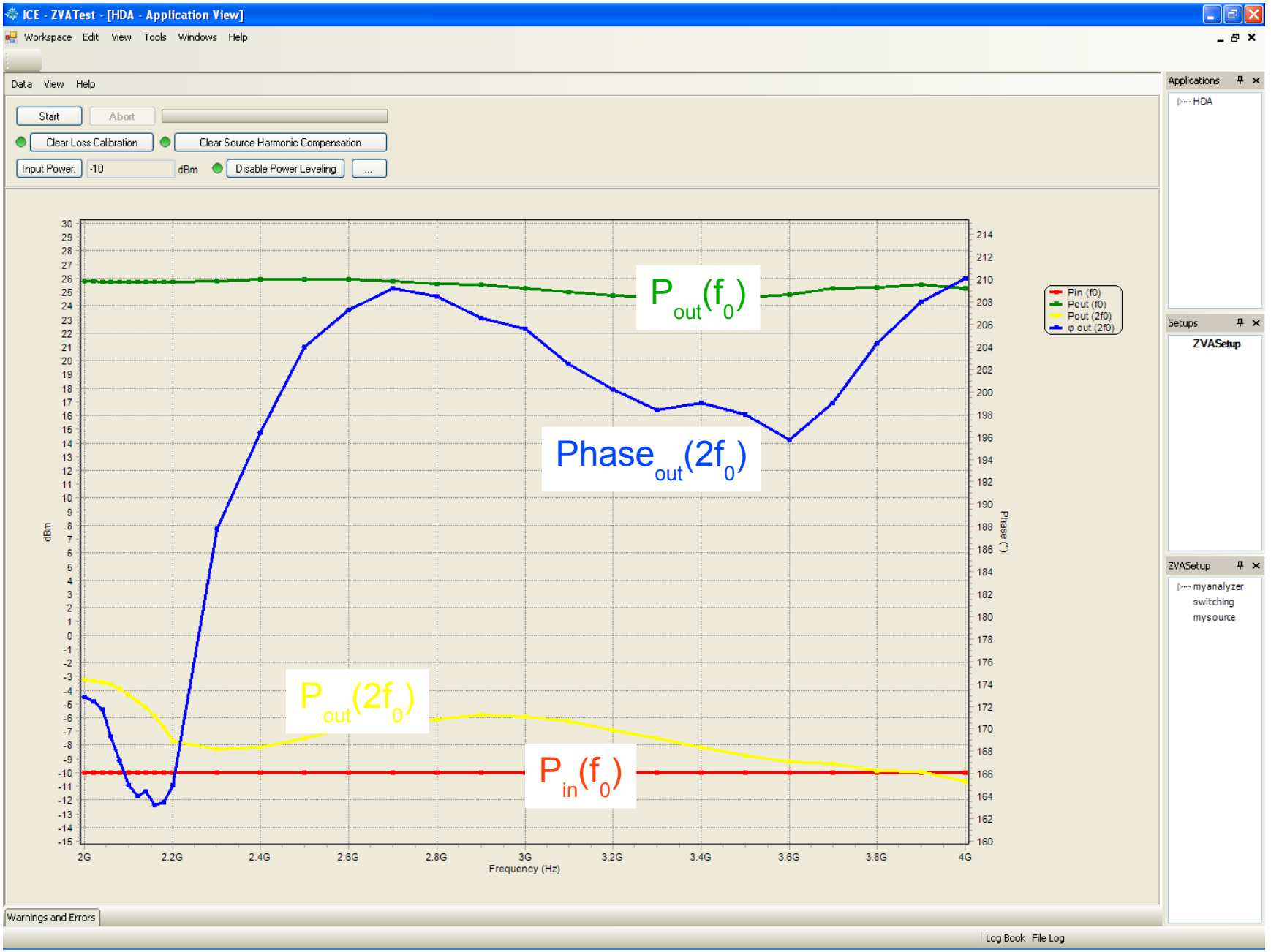
Performing Source Harmonic Calibration



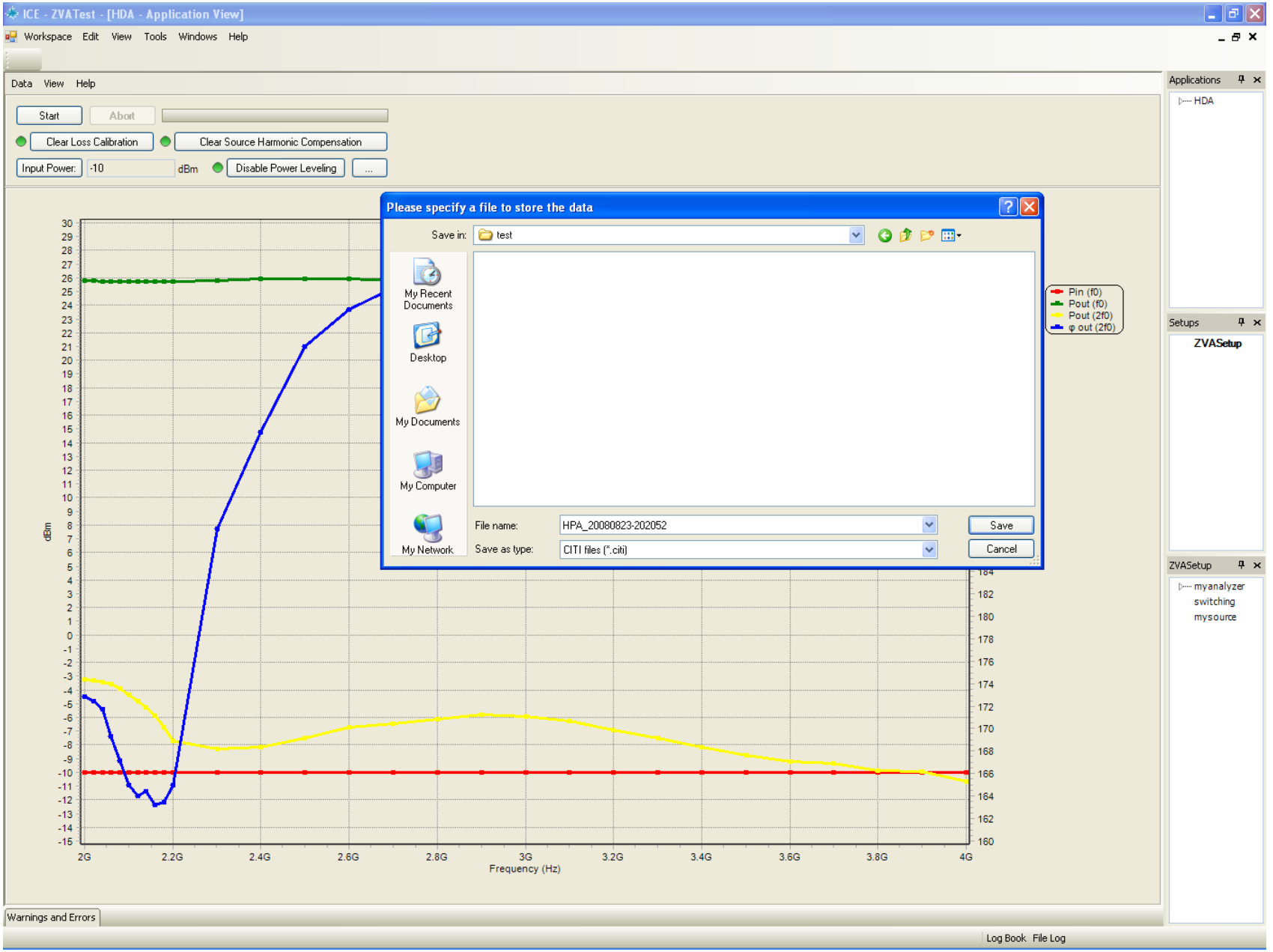
Measurement of transfer function of DUT to subtract the possible distortion created by harmonics of the source

Power of the internal source to perform transfer function measurement

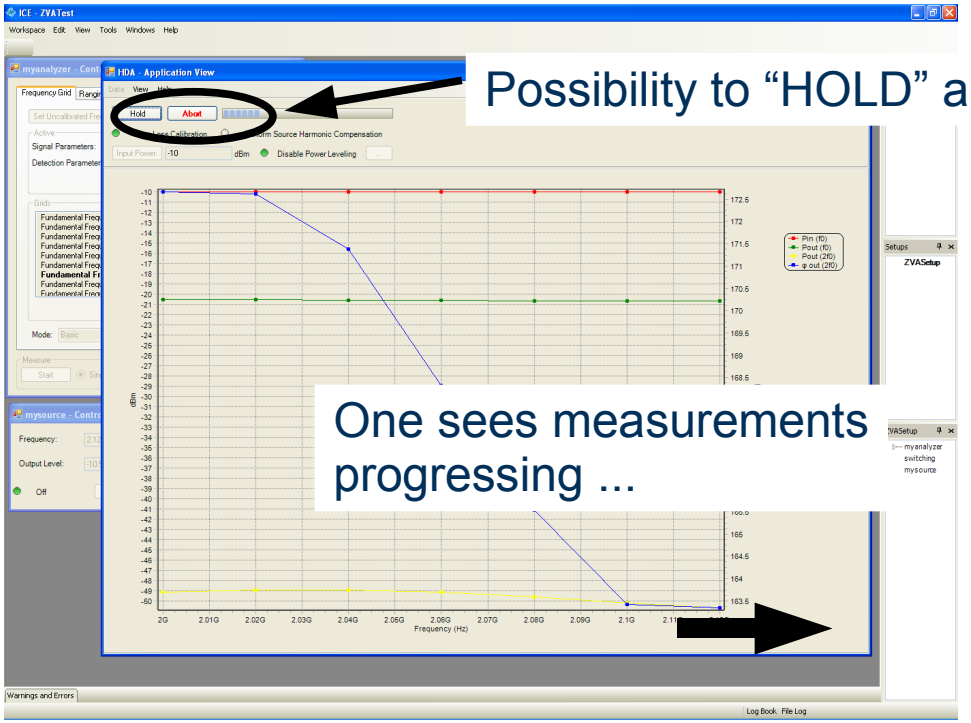
Frequency-Dependant Phase Distortion



Export Data



Two Measurement Modes



With live feedback: 1 sec per frequency point

NO live feedback: 0.4 sec per frequency point

Conclusion

- The ZvxPlus has been demonstrated in an application to characterize the “Frequency – Dependant Harmonic Phase Distortion” of an Amplifier

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