

Time-Domain System to Characterize UWB Emissions

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Time-Domain Free-Field Metrology

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Objectives & Rationale

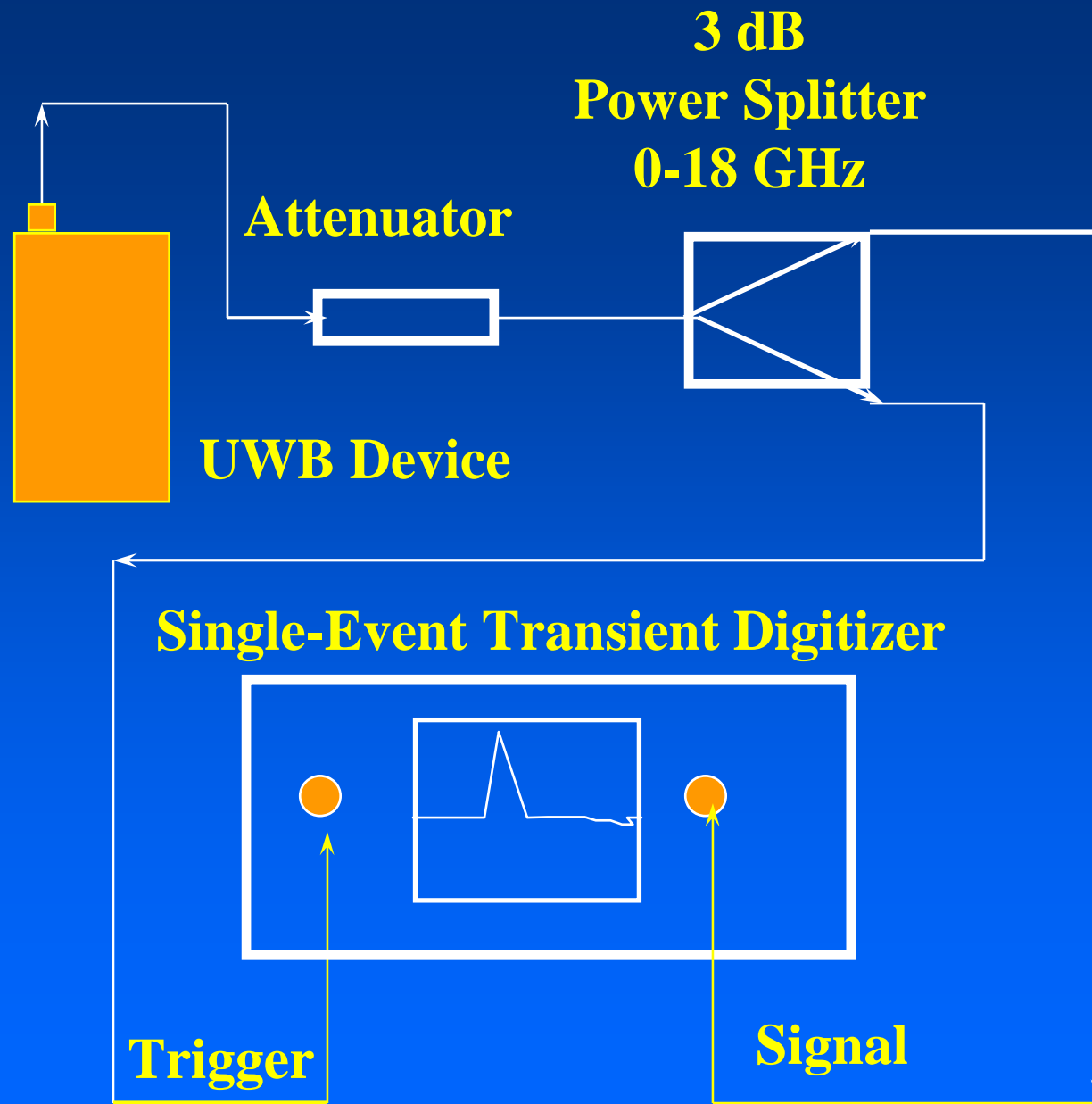
- Metrology-Grade UWB measurements have been performed at NIST since the early 70's
- High-fidelity measurements of nanosecond duration baseband pulses using real-time measurements
- During the past decade UWB devices have been introduced for various applications- communications, radars, intrusion detectors, stud finders, toilet deoderizers,...

Objectives & Rationale cont'd

- What will be the impact of these devices be on conventional communications, navigation, and safety systems?
- High resolution measurements can be used to study interference potential of UWB radiating systems
- NIST results used in ITS/NTIA study of UWB devices

NIST Measurement System

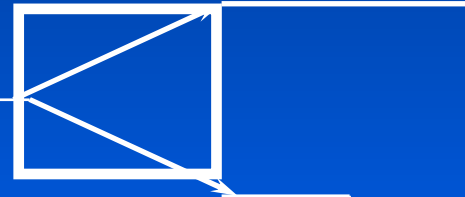
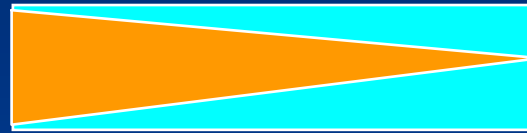
- Detects & digitizes single UWB pulses within asynchronous pulse trains
- Single-event time-domain measurement capability required
- NIST system based on single-event transient digitizer with 4.5 GHz bandwidth-can be extended to 15 GHz
- Conducted & radiated measurement capability



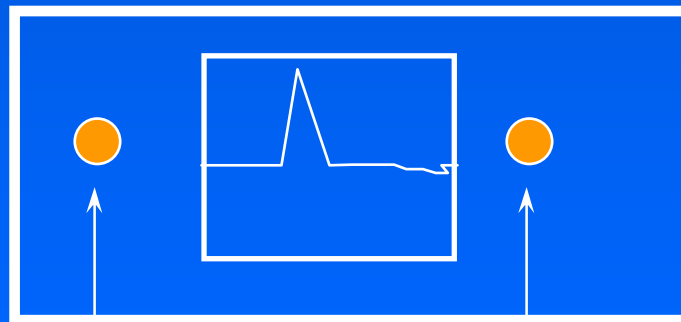
NIST TEM Horn

Attenuator

UWB Device

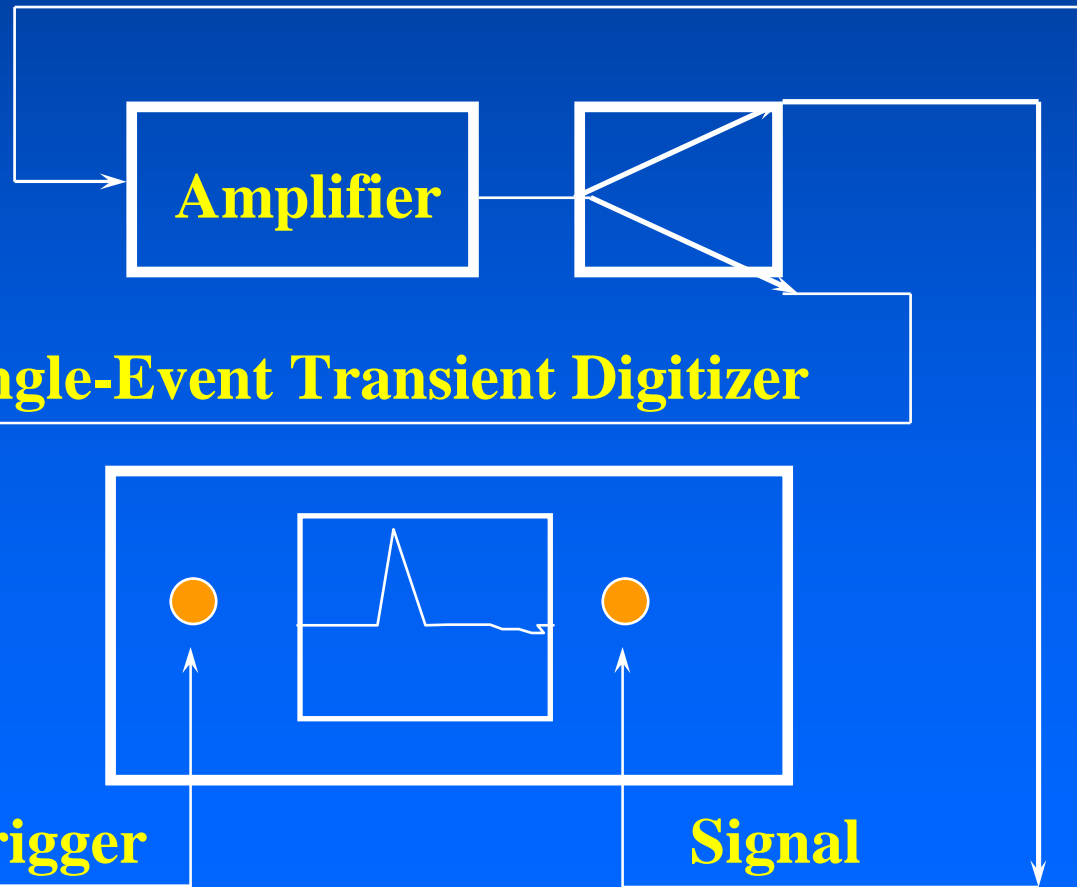


Single-Event Transient Digitizer



Trigger

Signal

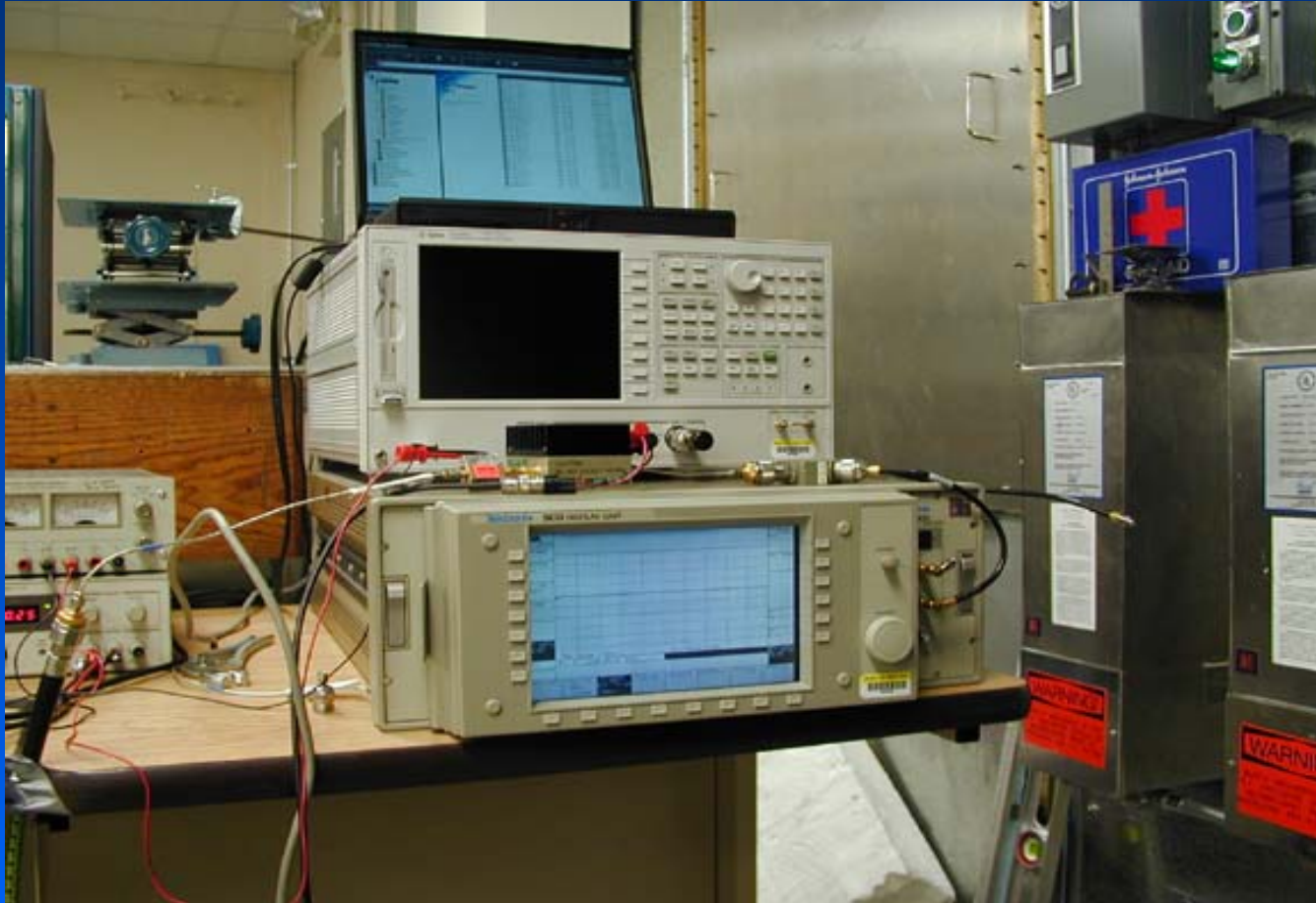




**Rx TEM Horn
100-4000 MHz**

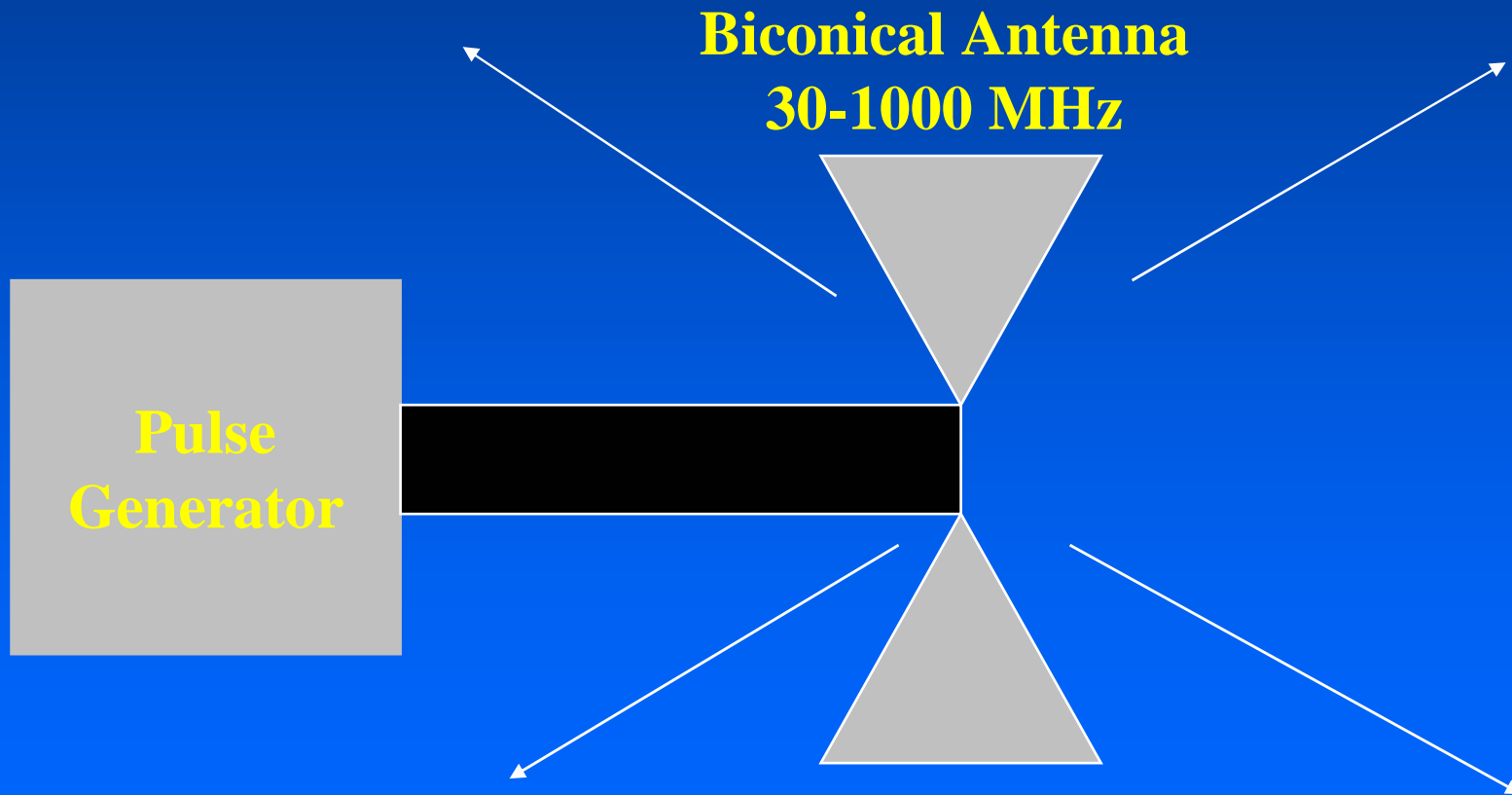
**UWB
Transmitter**

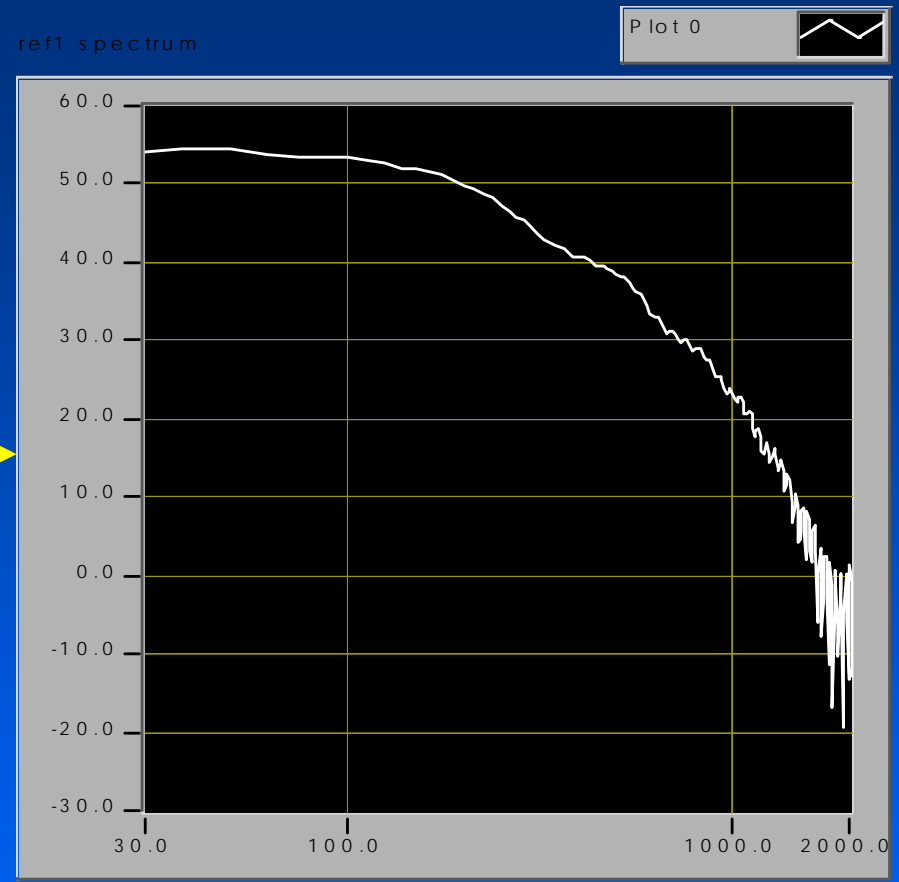
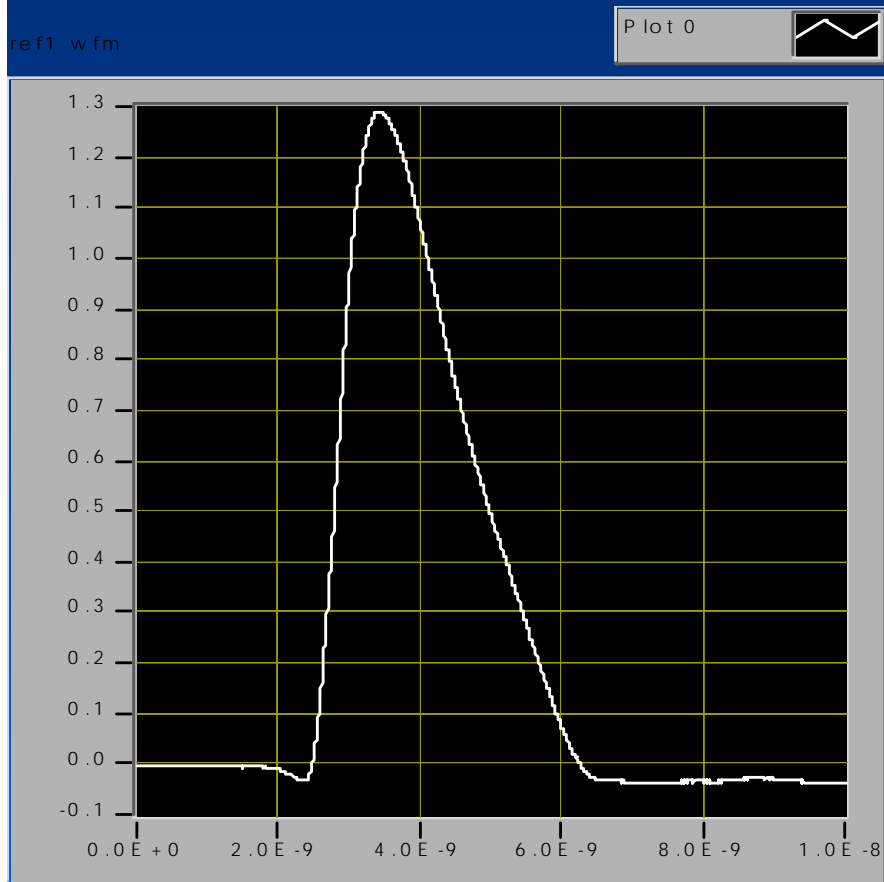
**UWB Radiated Test Under Test
in NIST Anechoic Chamber**



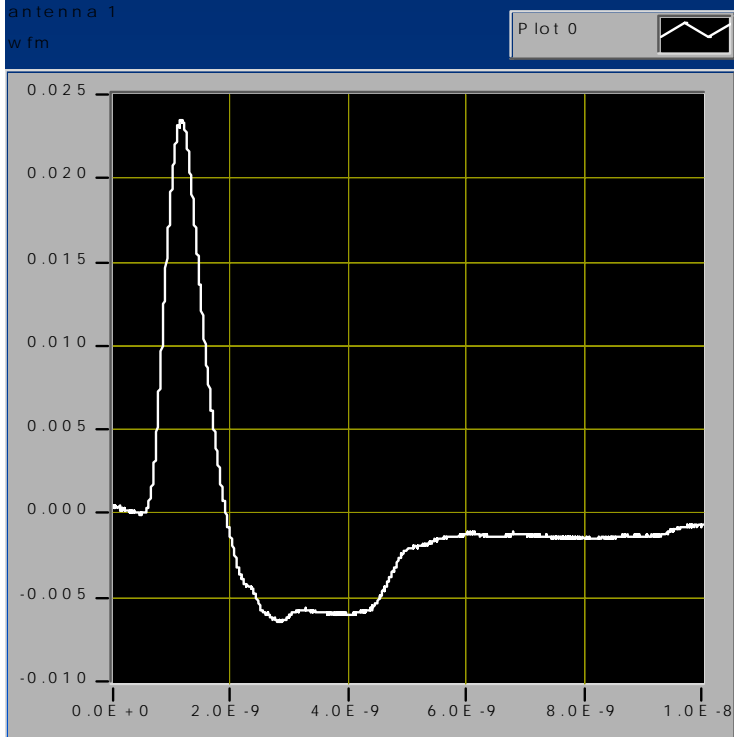
Measuring Equipment

EMI Reference Radiator used for EMI Facilities Intercomparisons

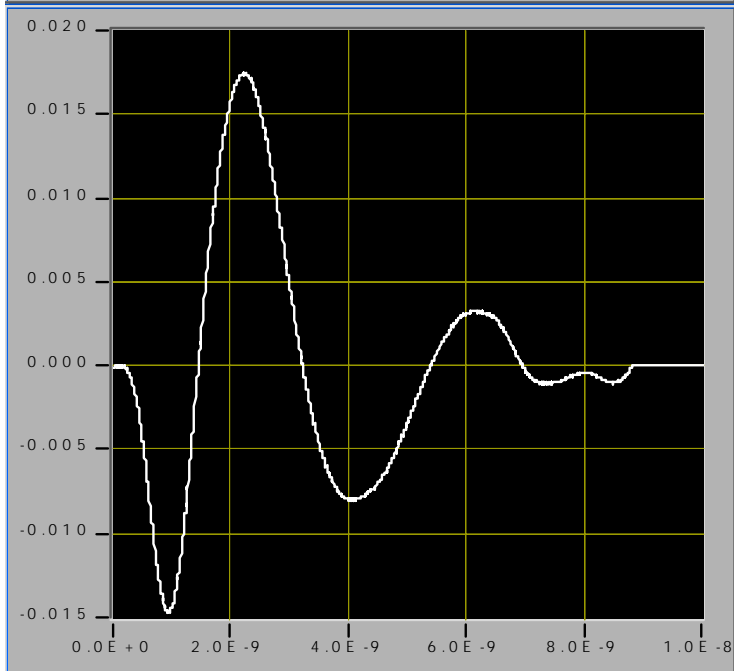
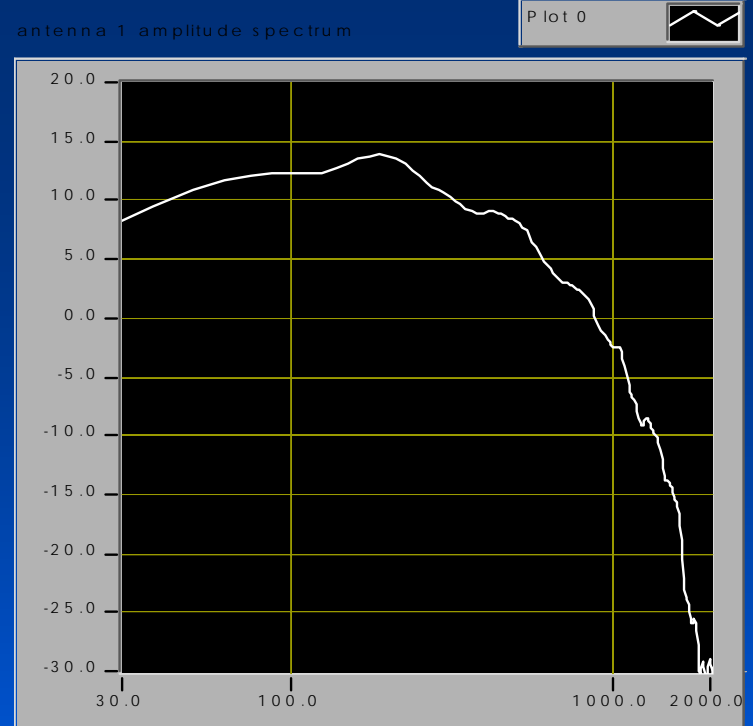




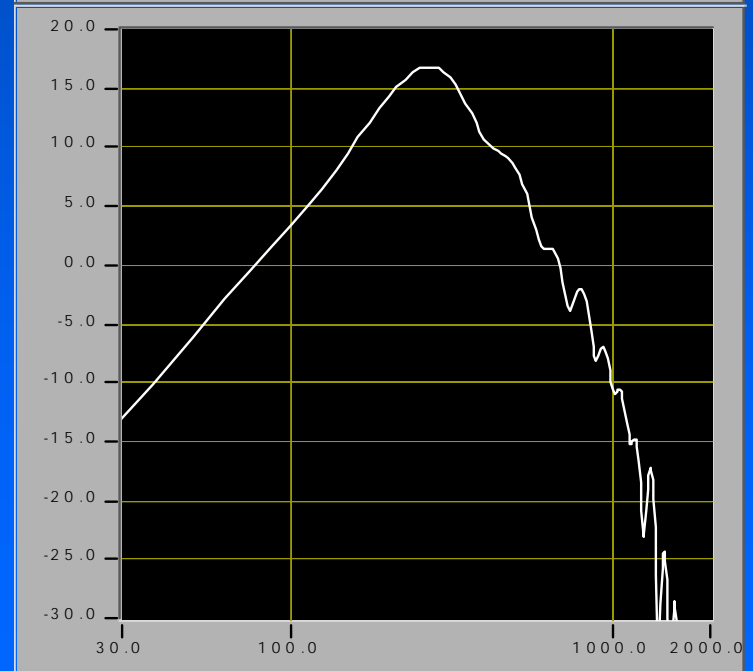
Conducted Generator Characteristics



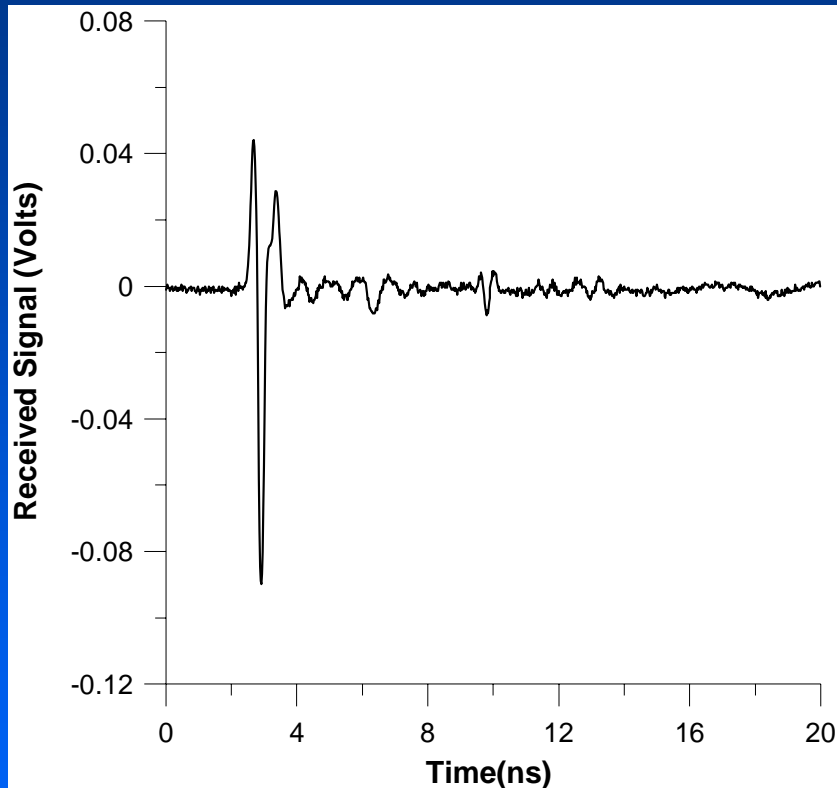
**TEM
Horn**



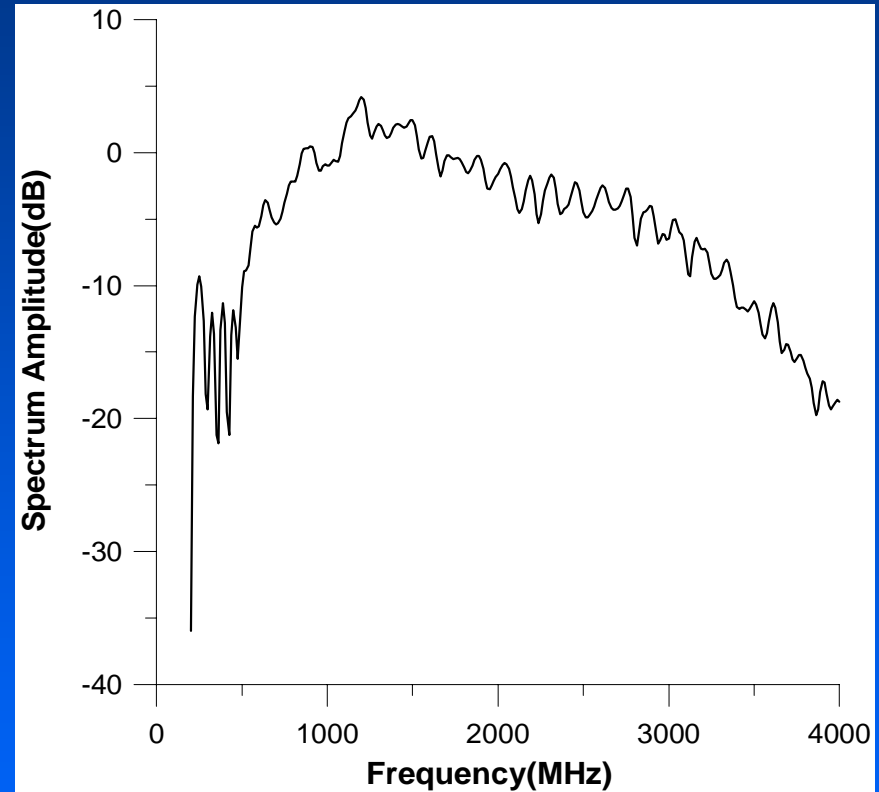
**Biconical
Antenna**



1.5 GHz UWB Scattering Measurement Device

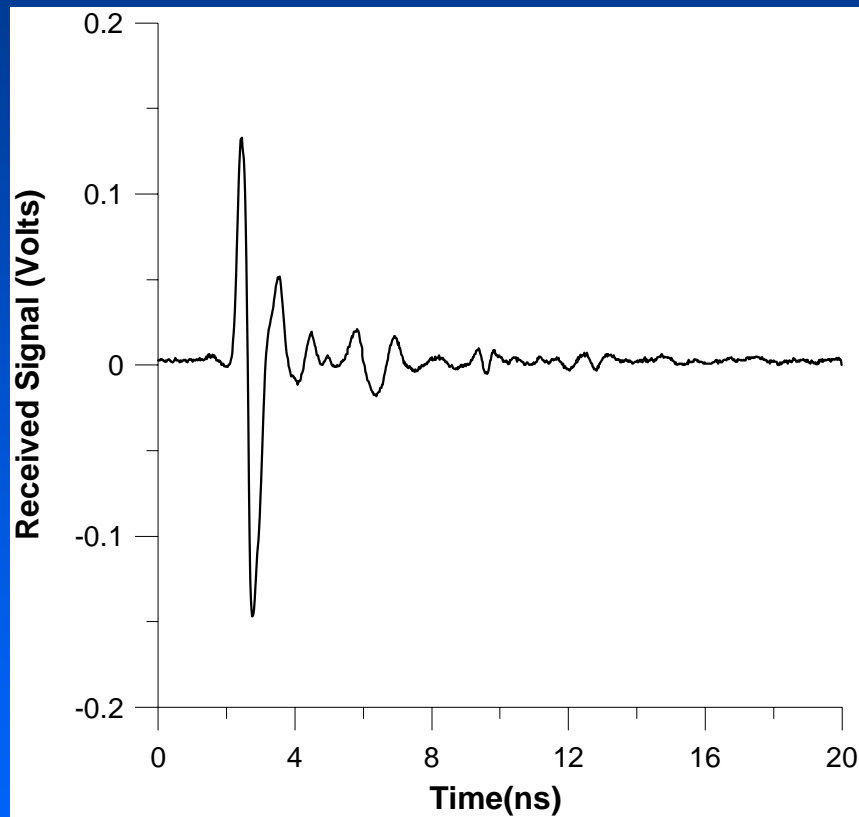


Time Domain

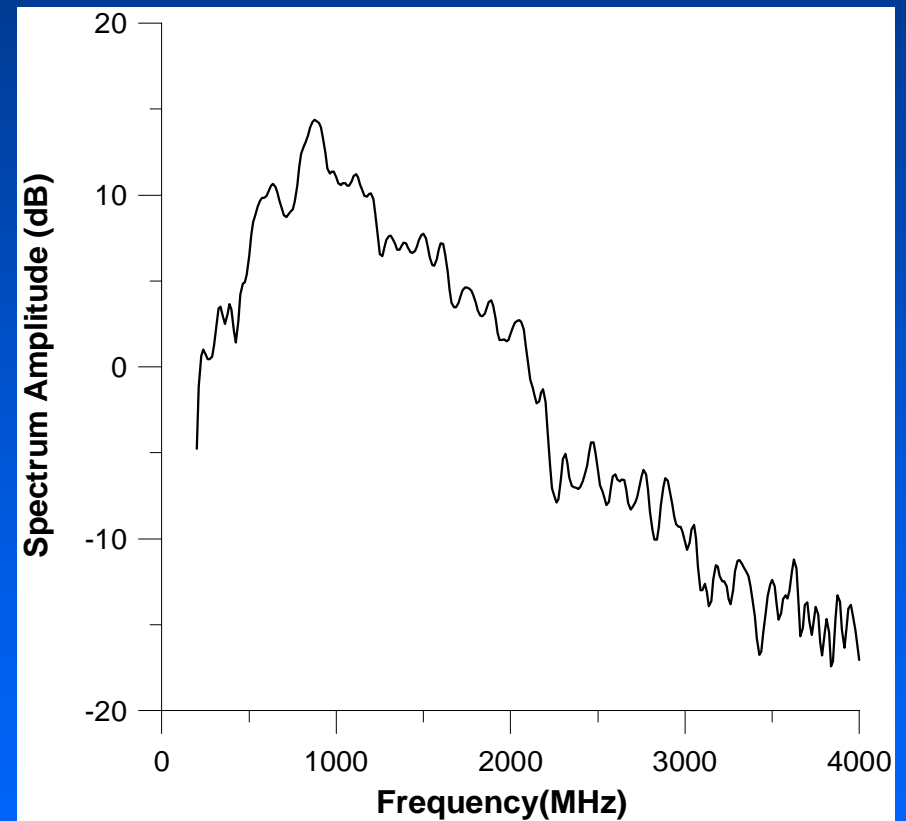


Frequency Domain

900 MHz UWB Scattering Measurement Device

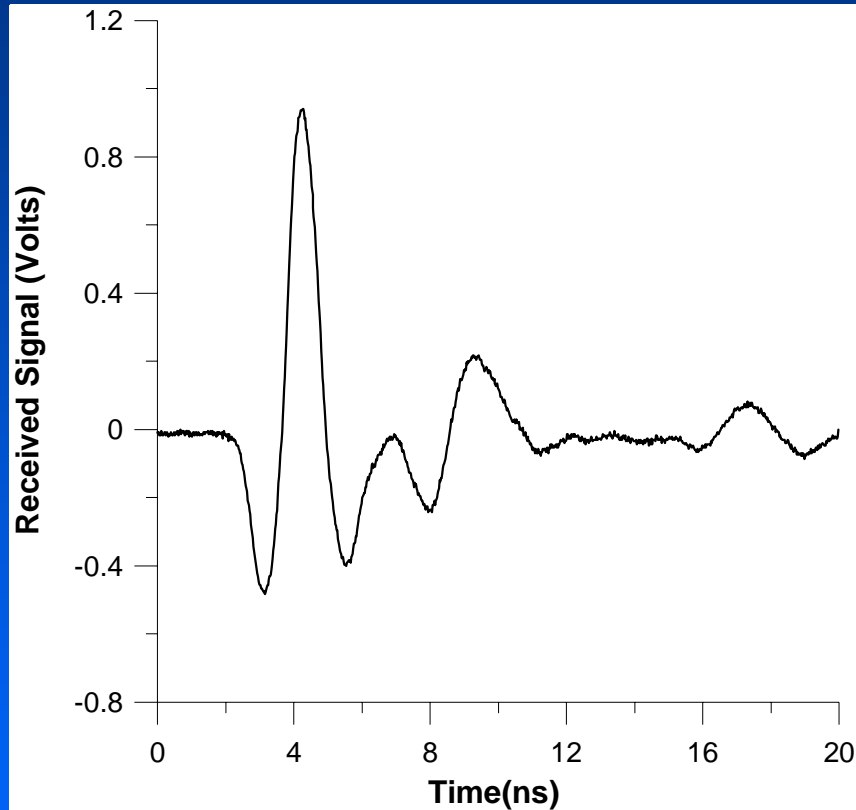


Time Domain

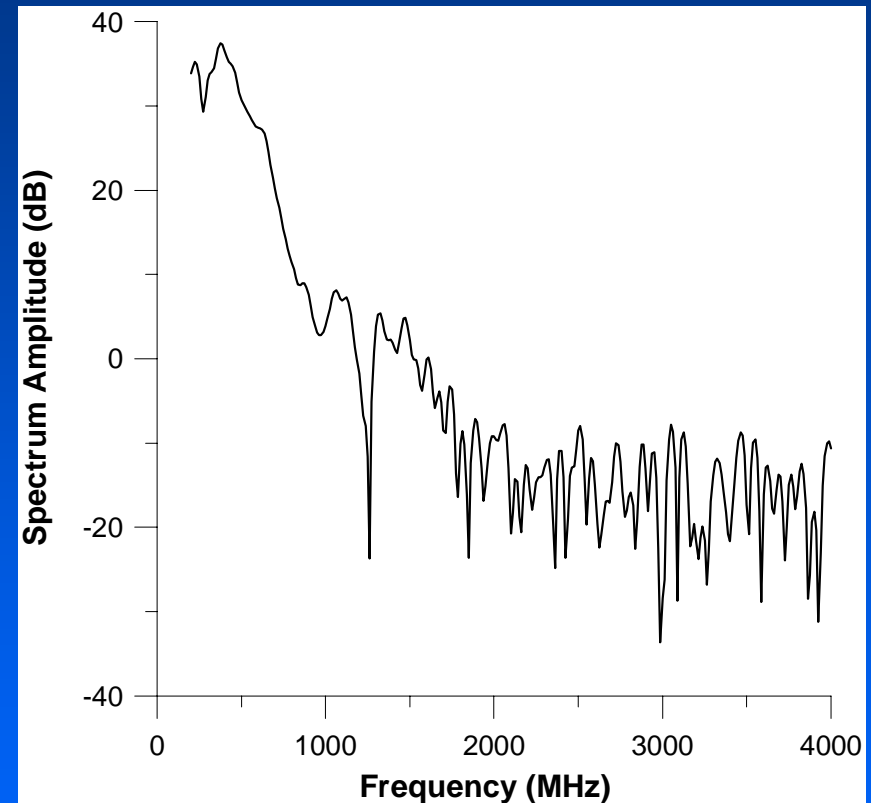


Frequency Domain

300 MHz UWB Scattering Measurement Device

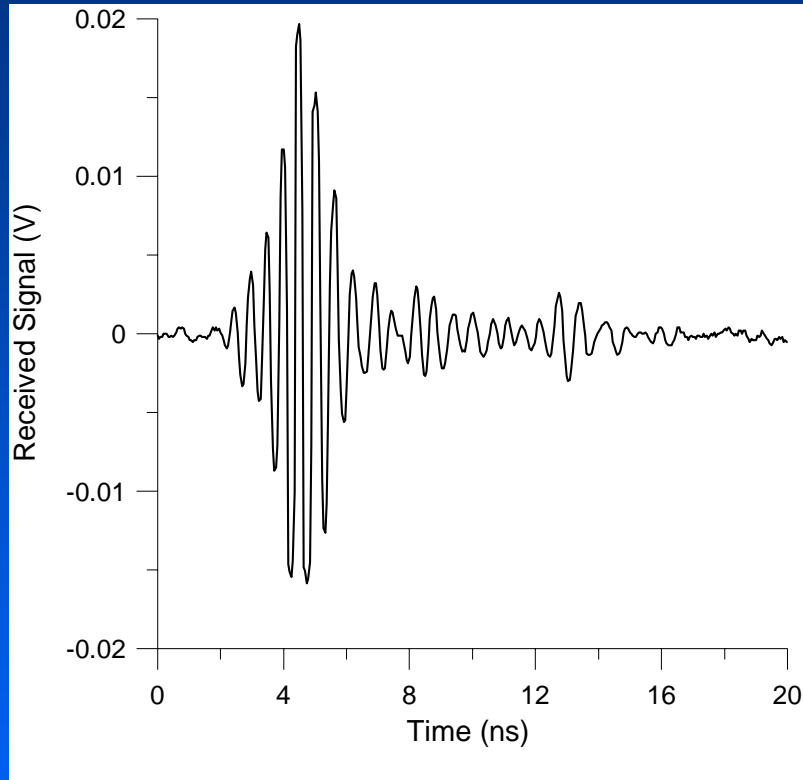


Time Domain

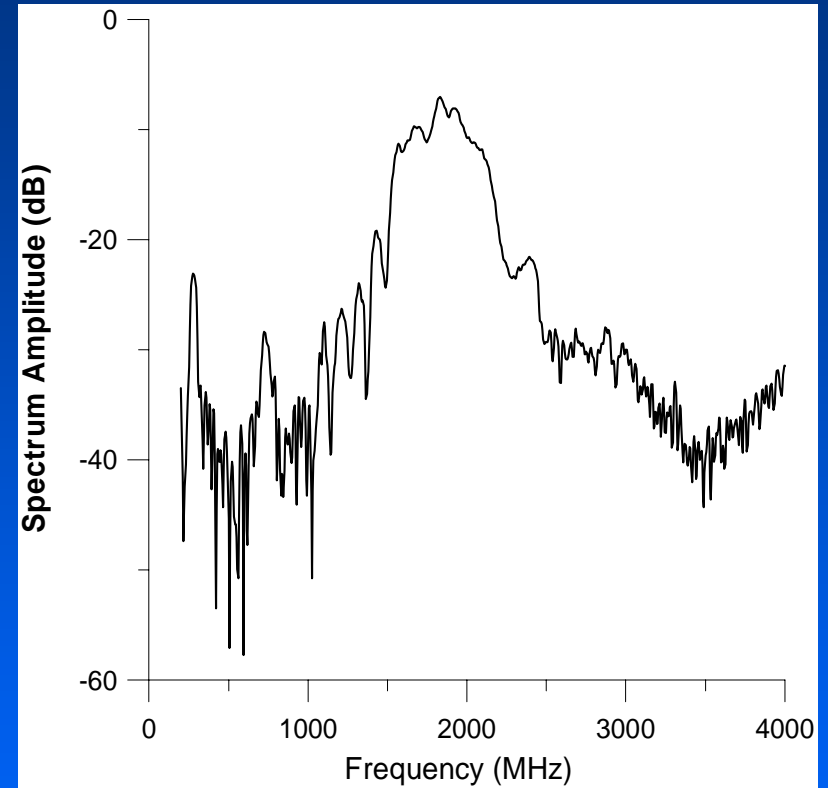


Frequency Domain

Security Detection Device

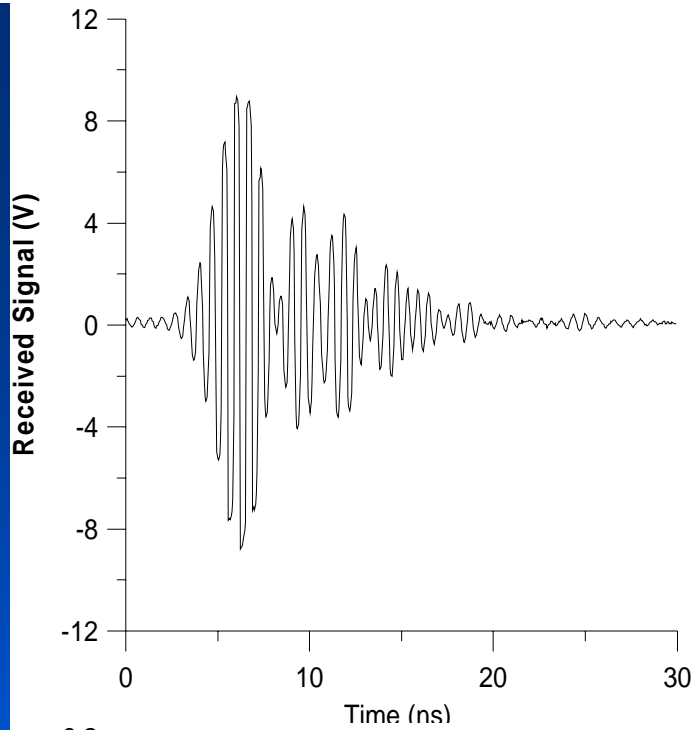


Time Domain

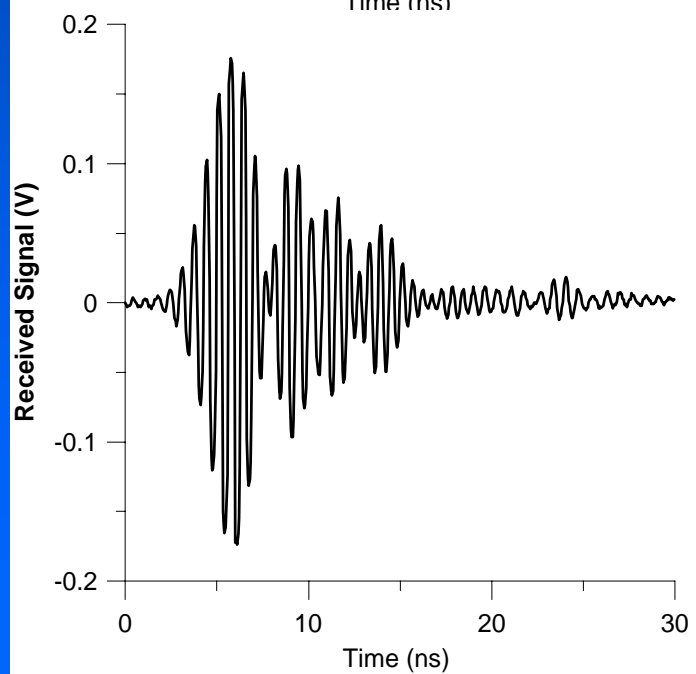
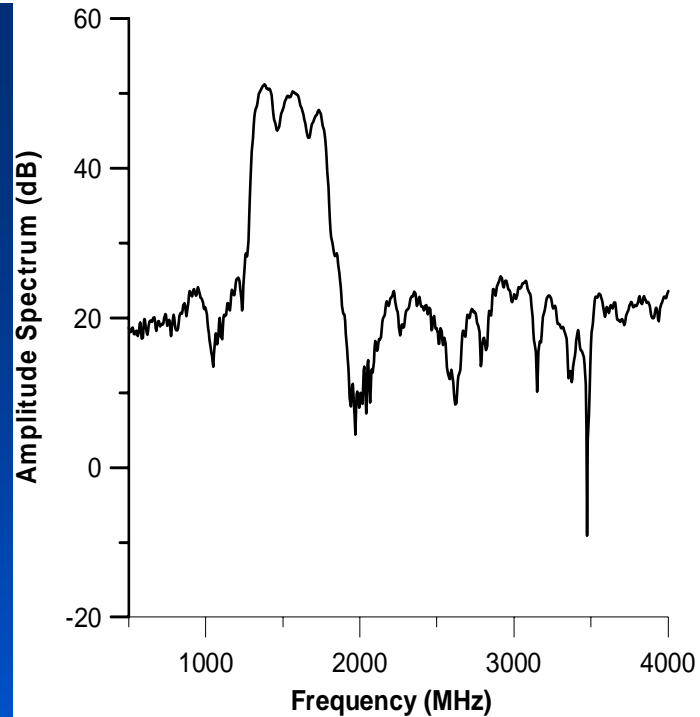


Frequency Domain

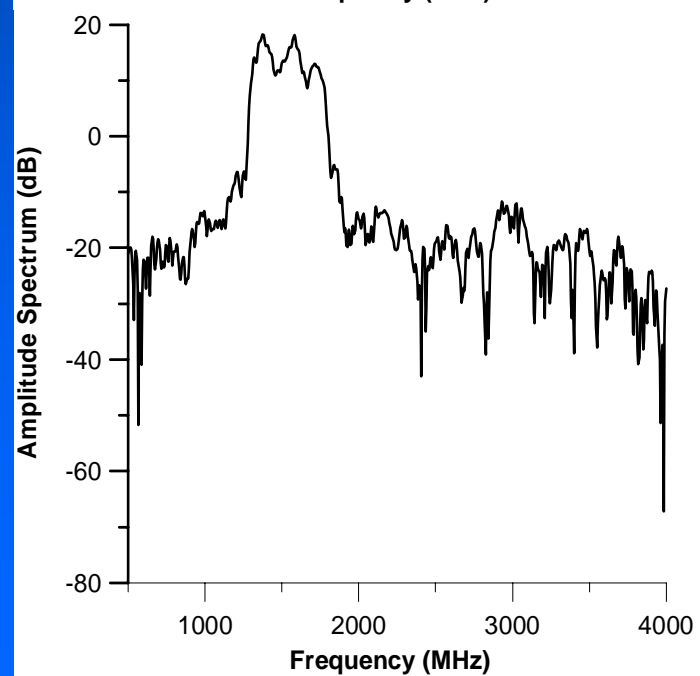
UWB Information Transmission
Device
Conducted & Radiated
Characteristics



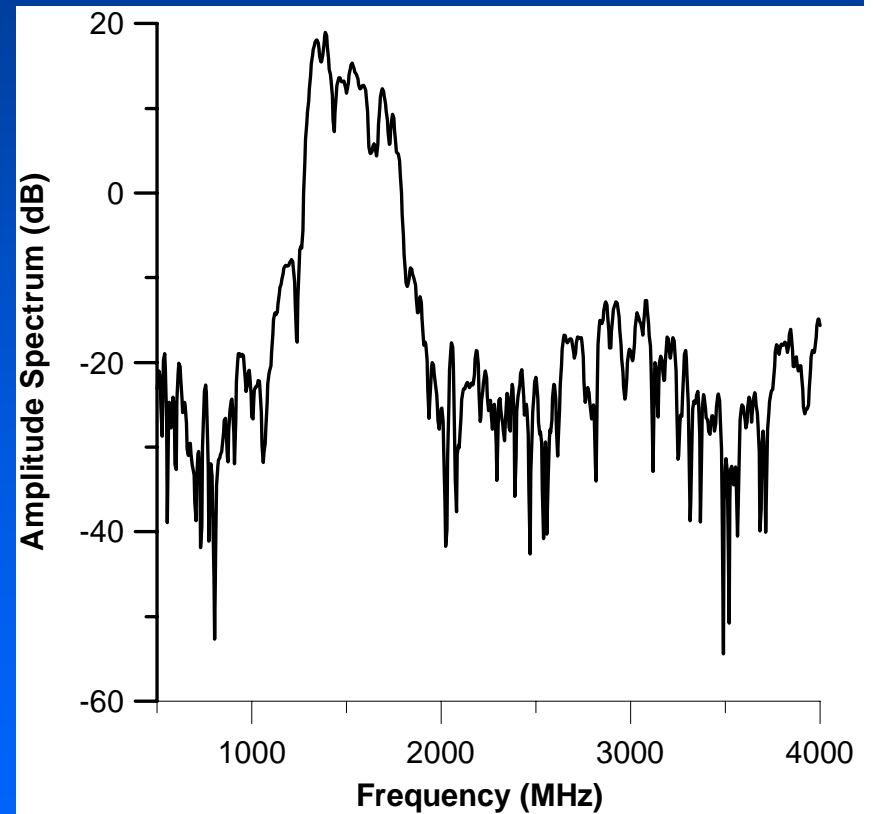
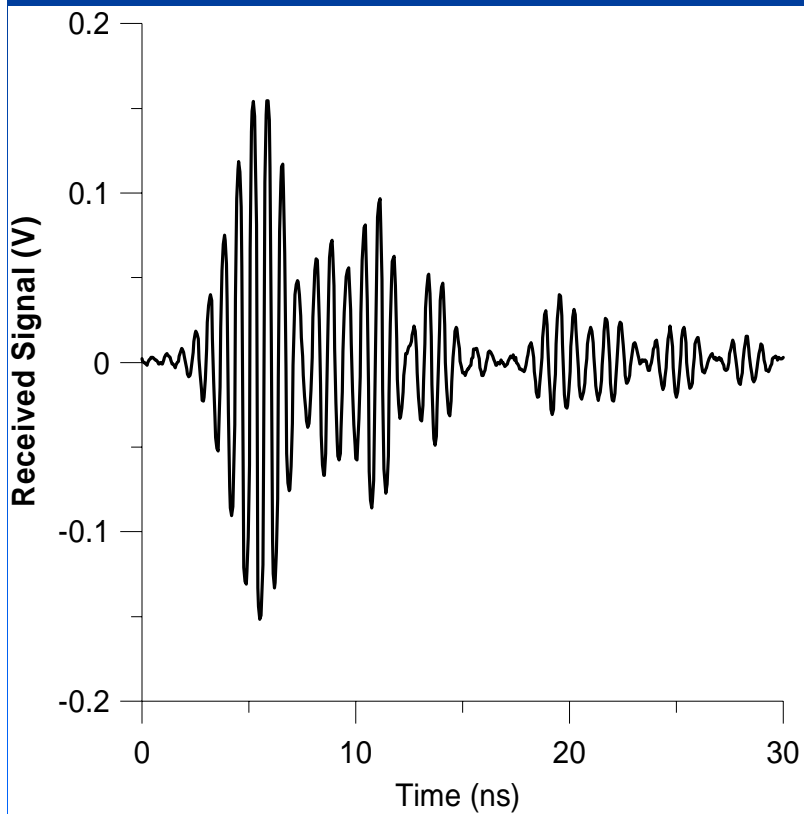
conducted



**NIST
TEM
horn**



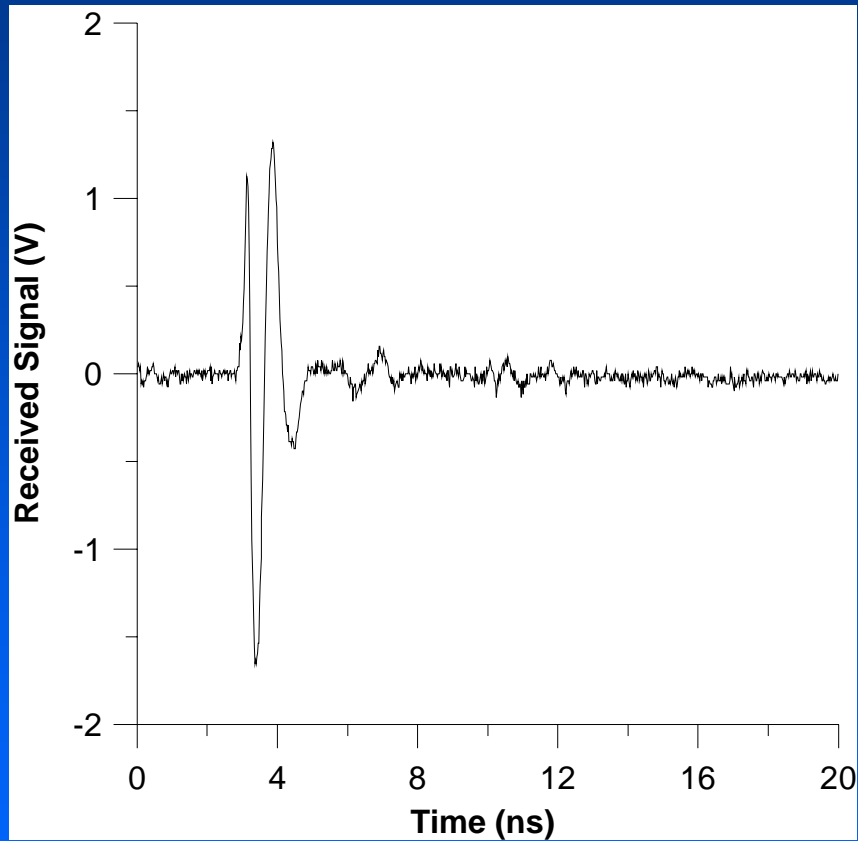
With supplied antenna



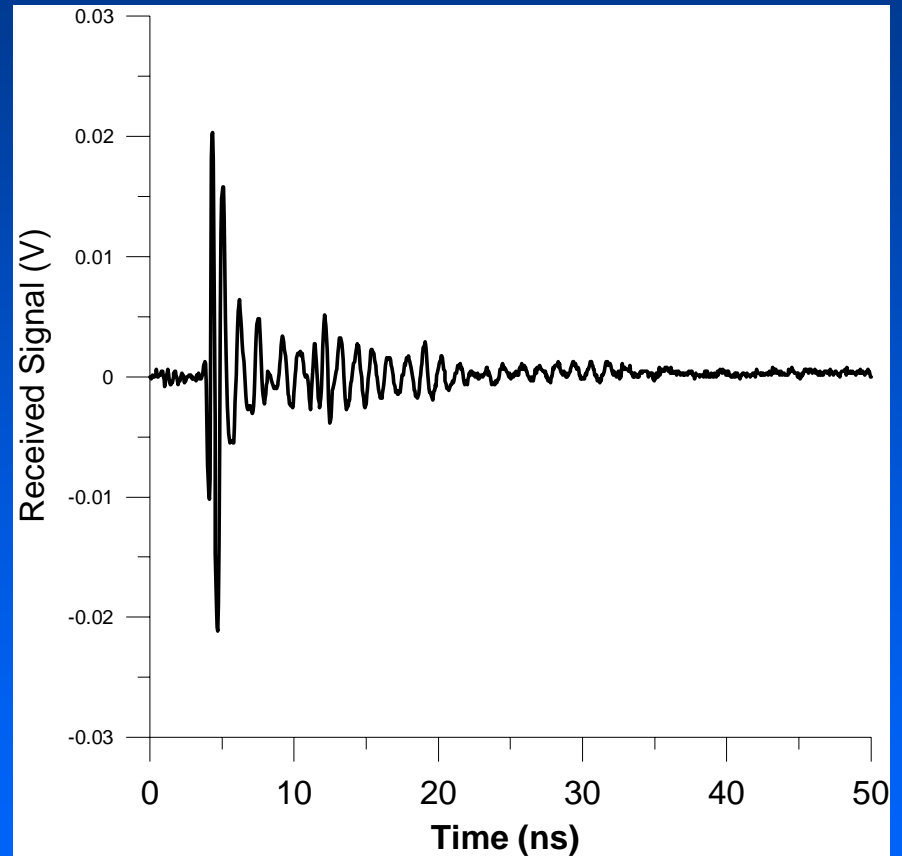
Things to note:

- Transmitting antenna extends temporal response & modifies spectrum
- Useful pulse parameters can be calculated from the time-domain waveform-e.g peak power
- Digitized waveform can be used in communication systems simulations

A more striking example of antenna influence...

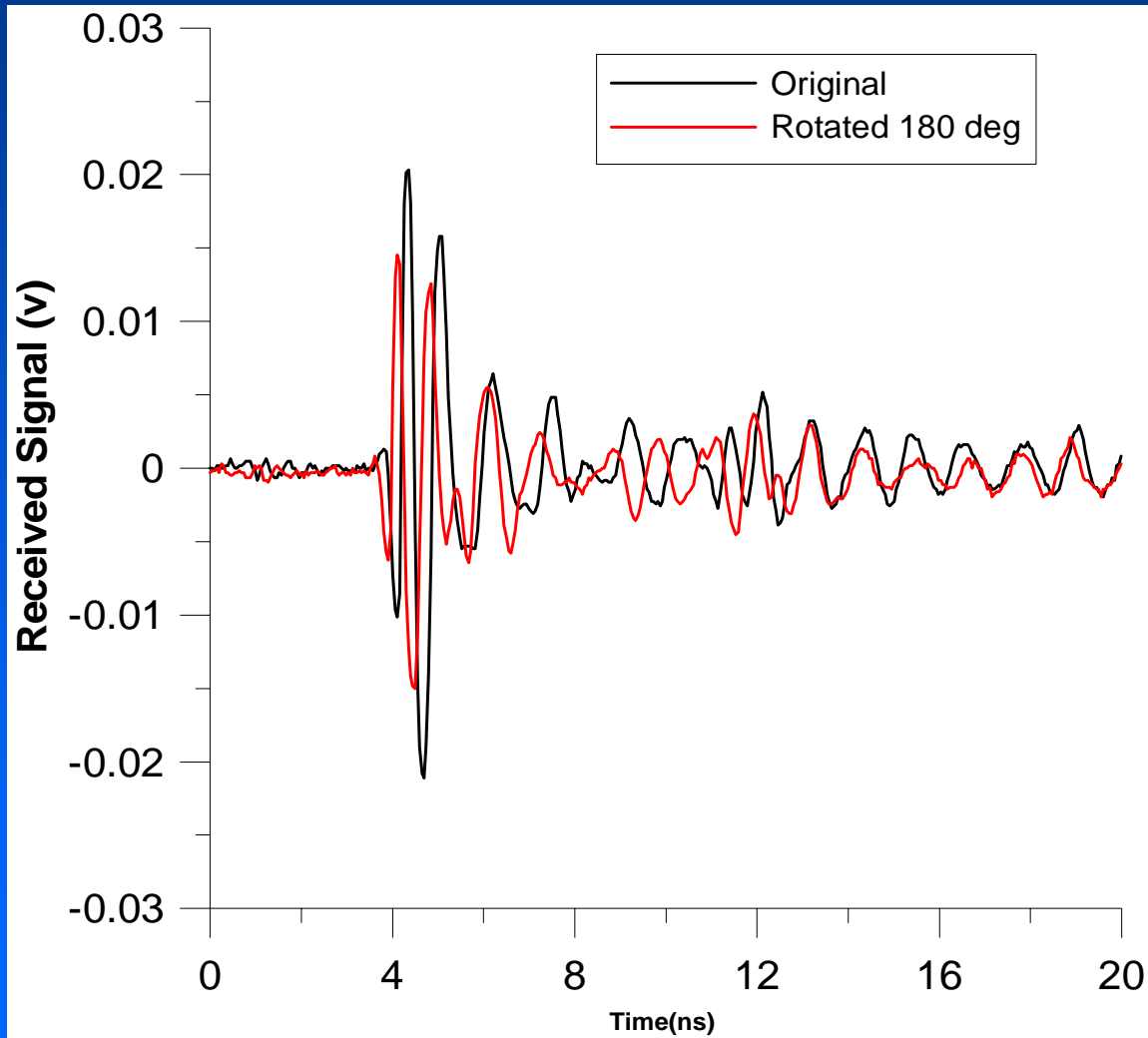


Conducted

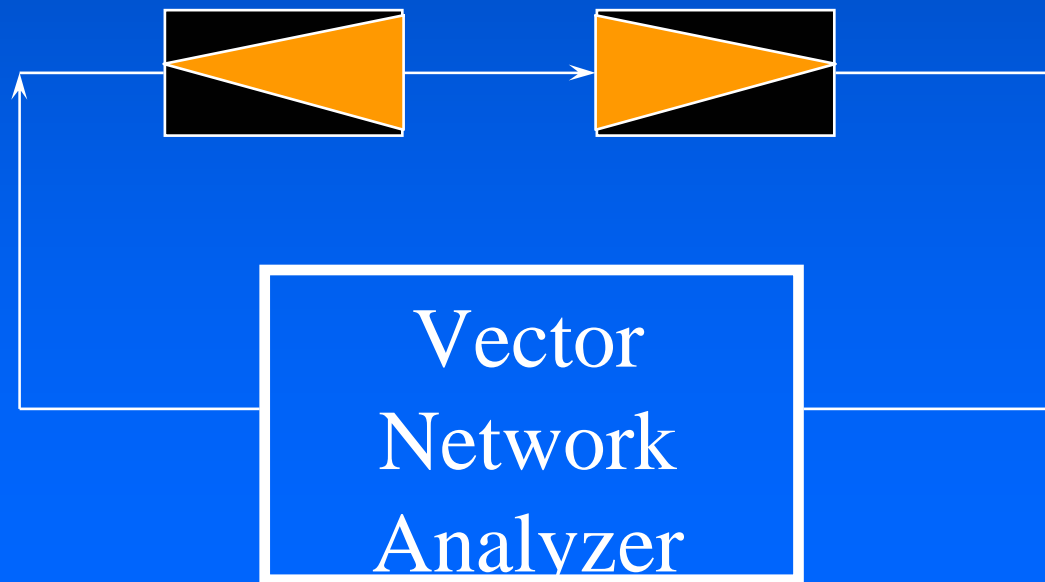
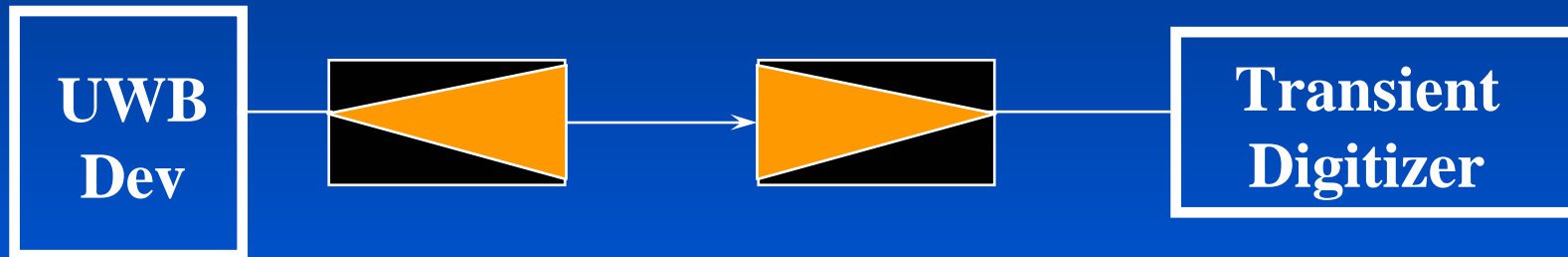
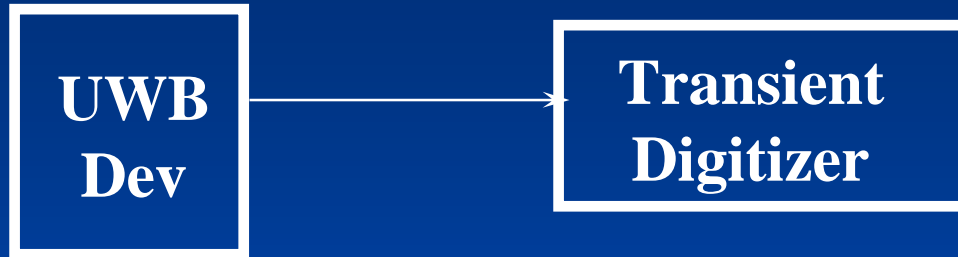


Radiated

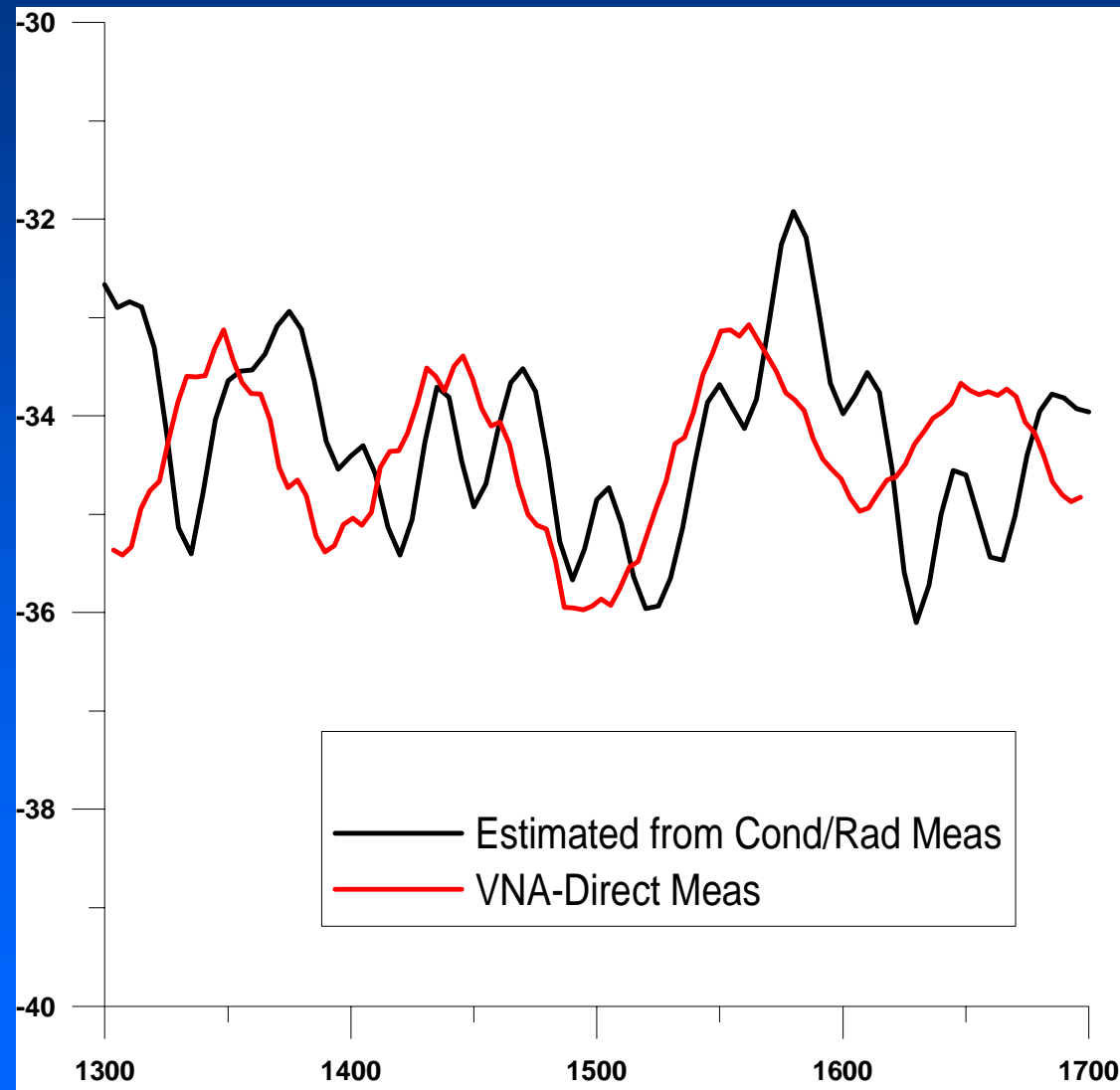
Impact of Common Mode Radiation



Estimating $|S_{12}|$ - Wellness Check



Consistency Check—vs. VNA

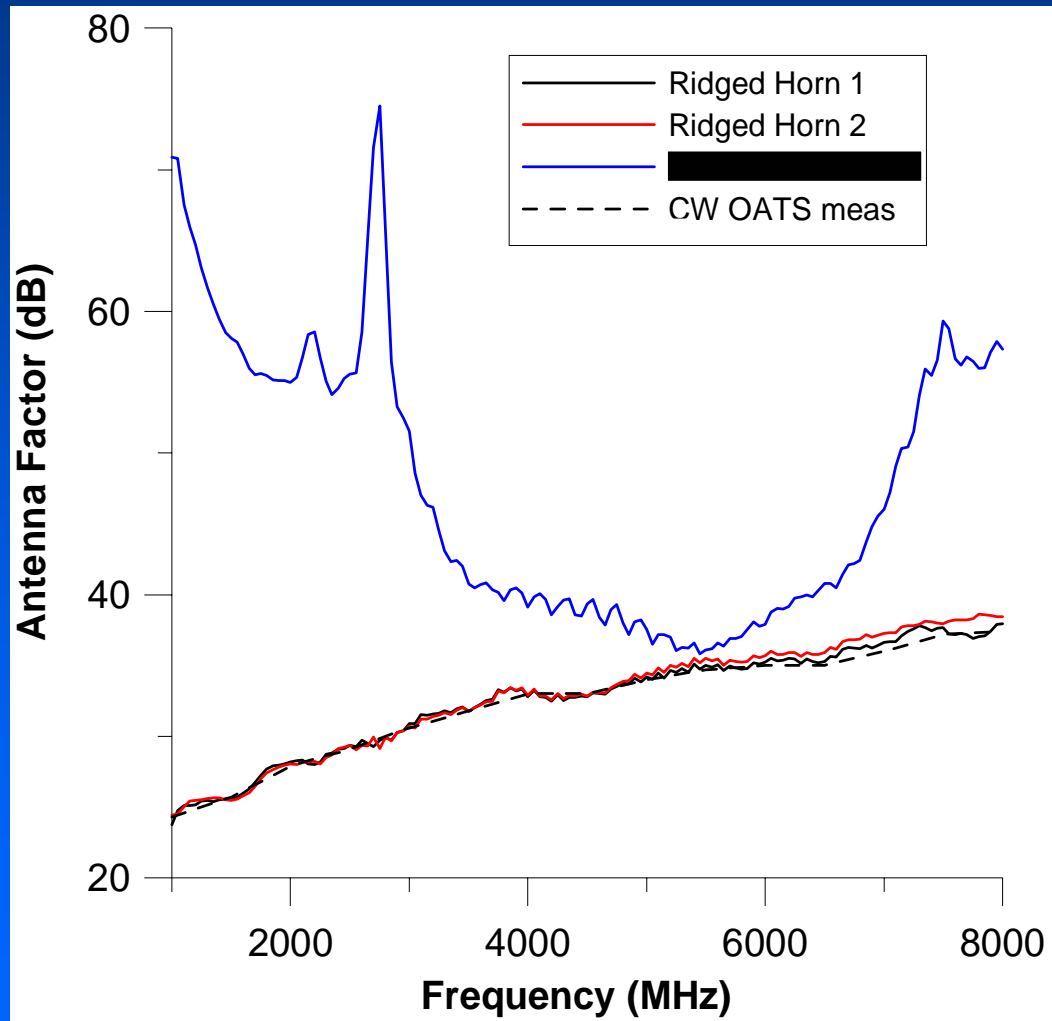


3-Antenna Calibration

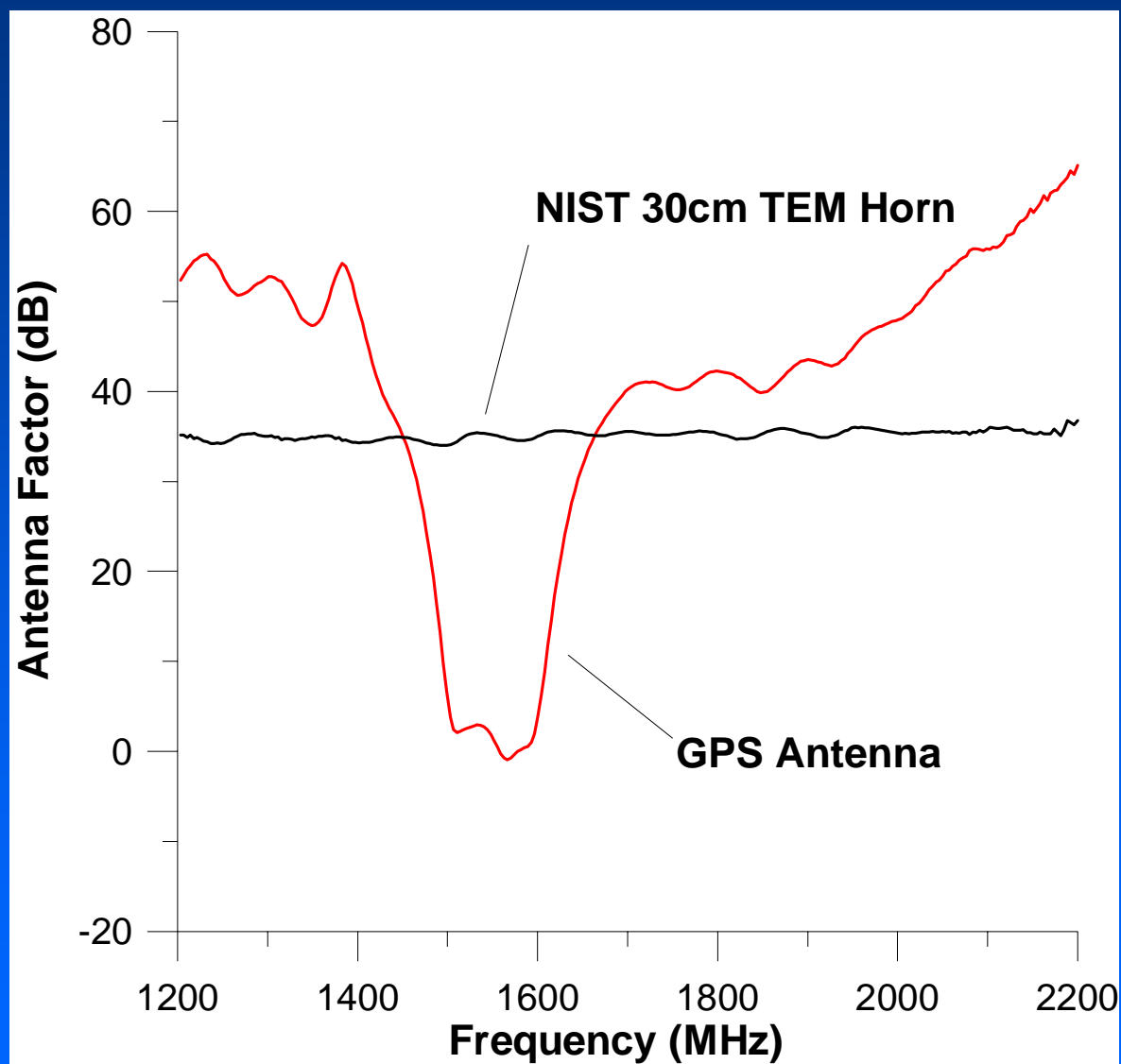


$|S_{12}|$

Antenna Factors Obtained from NIST Time-Domain Measurements



Active GPS Antenna Calibrated with NIST TEM Horns



Conclusions

- There is a wide variety of UWB signal types
- The NIST measurement system has unique full-bandwidth measurement capabilities
- 40-50 dB dynamic range achieved with prototype system
- Antenna calibrations can be performed in ordinary room environments—under certain conditions
- There's lots more work to be done

Acknowledgements

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**ITS-Bill Kissick, Ron Ketchum, Brent Bedford,
Frank Sanders,
Bob Matheson, Roger Dalke**

**Great Interagency Team Effort
&**

Fun!