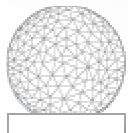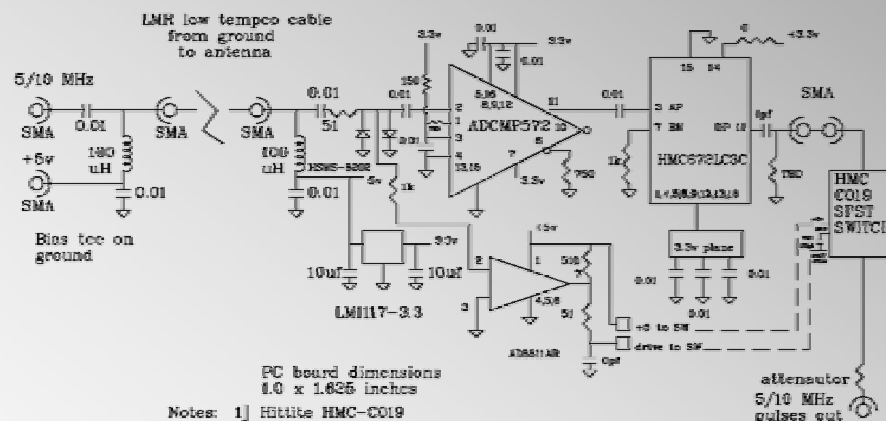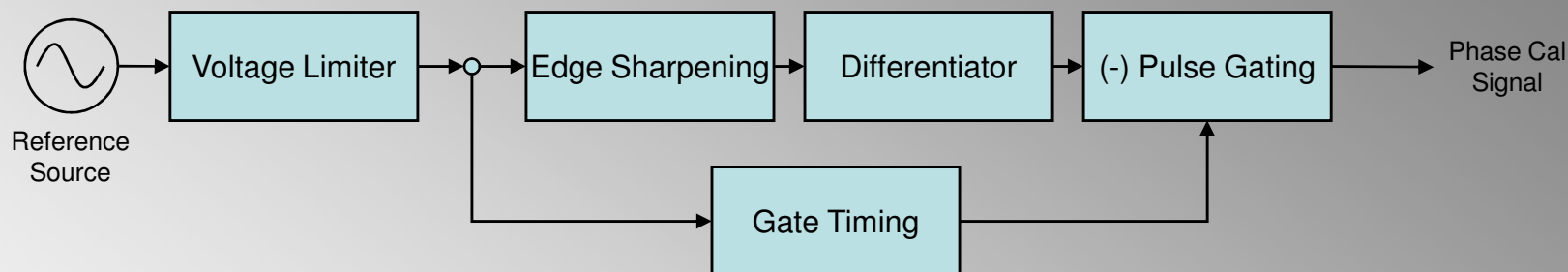# VLBI2010 Phase Calibration Signal Generator and Broadband Considerations

Christopher Beaudoin

Research Engineer

MIT Haystack Observatory

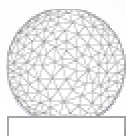# Digital Phase Calibration Signal Generator

Digital Phase Calibration Signal Generator
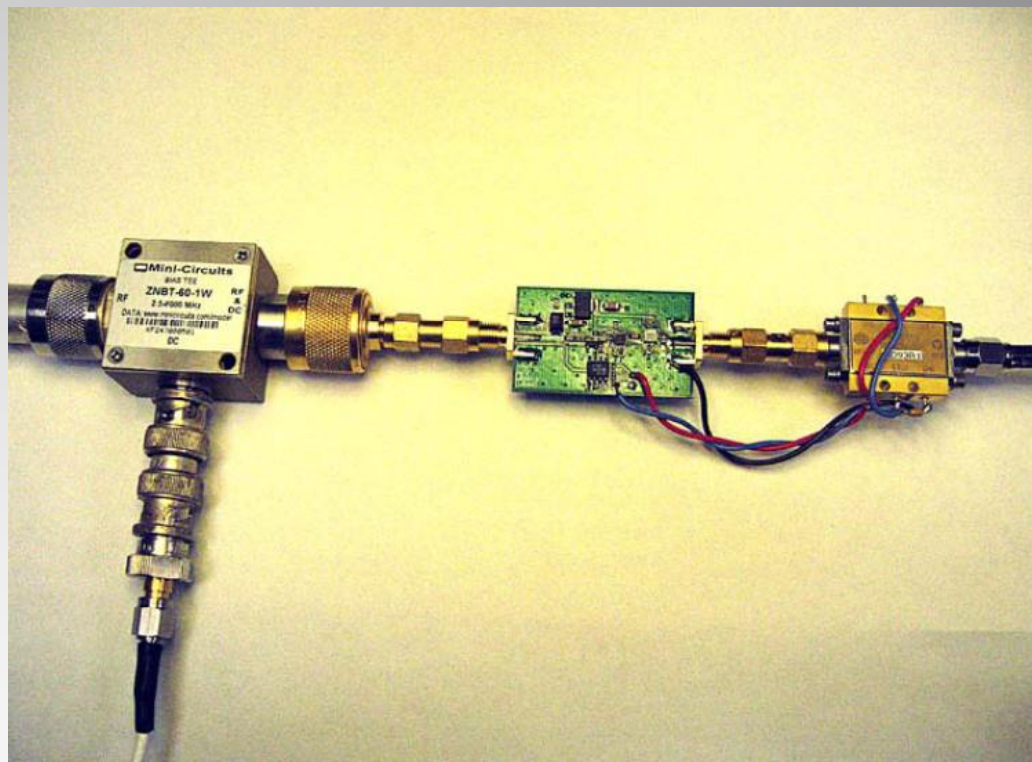

- Temperature Drift Coefficient
  - 5 ± 1   ps/°C at   5 MHz Reference Frequency
  - 2 ± 0.3 ps/°C at 10 MHz Reference Frequency

MIT
HAYSTACK
OBSERVATORY
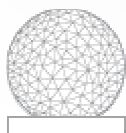
Digital Phase/Noise Calibration Signal Generator

H/V Outputs to Dewar

Noise Cal Generator

Maser Reference Input

Pulse Gating Switch

Phase Cal Generator

Bias Tee

MIT HAYSTACK OBSERVATORY

Phase Cal Spectrum

$P_{avg} = -46\ dBm\ @\ 20\ MHz$

$P_{pk} = -13\ dBm\ assuming\ 25\ ps\ pulse$

Average Power (dBm)

Frequency (GHz)

Tunnel Diode
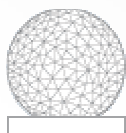Digital

$P_{avg} = -43\ dBm\ @\ 5\ MHz$

$P_{pk} = -4\ dBm\ assuming\ 25\ ps\ pulse$

A Vision for Geodetic VLBI

MIT
HAYSTACK
OBSERVATORY
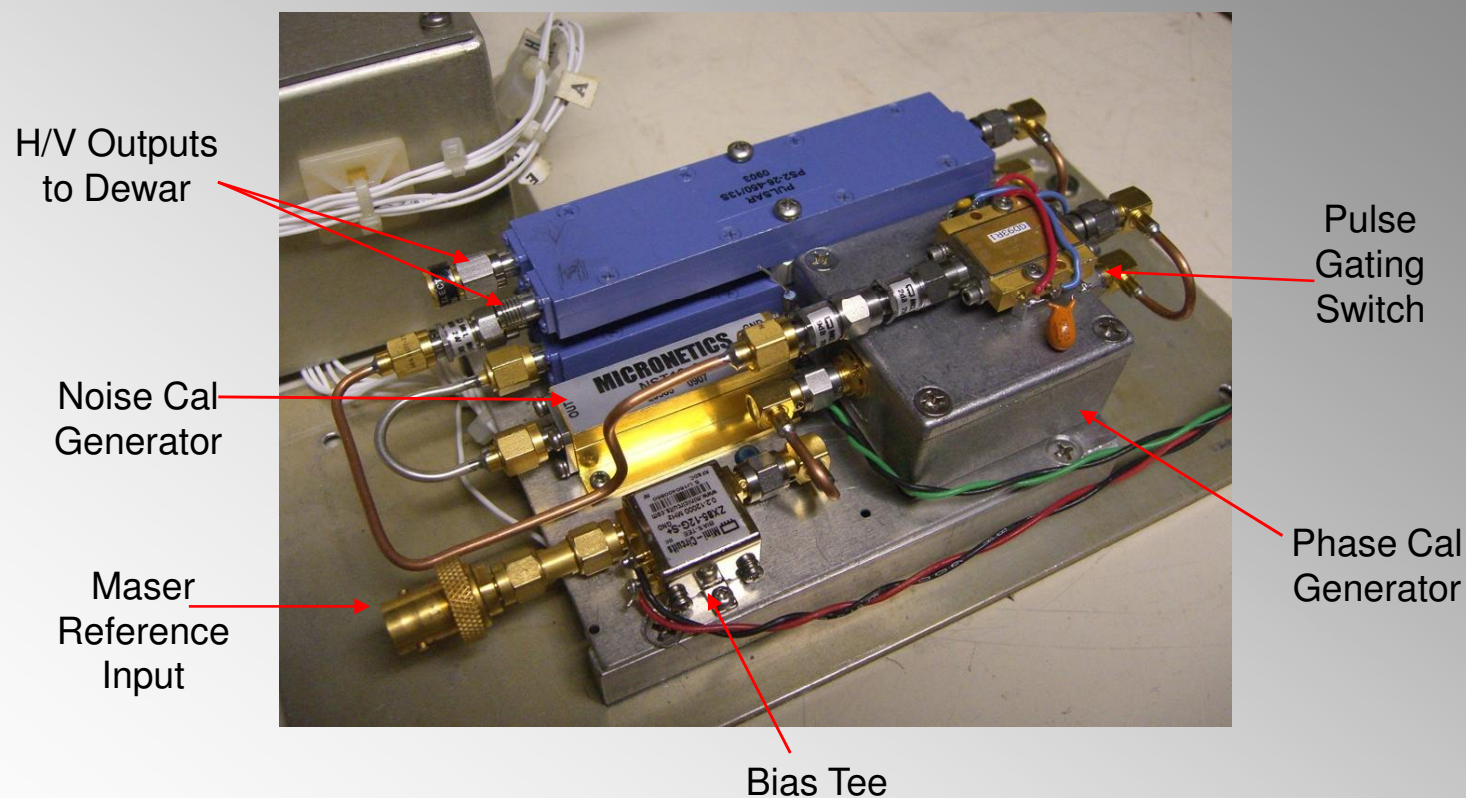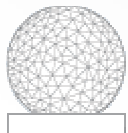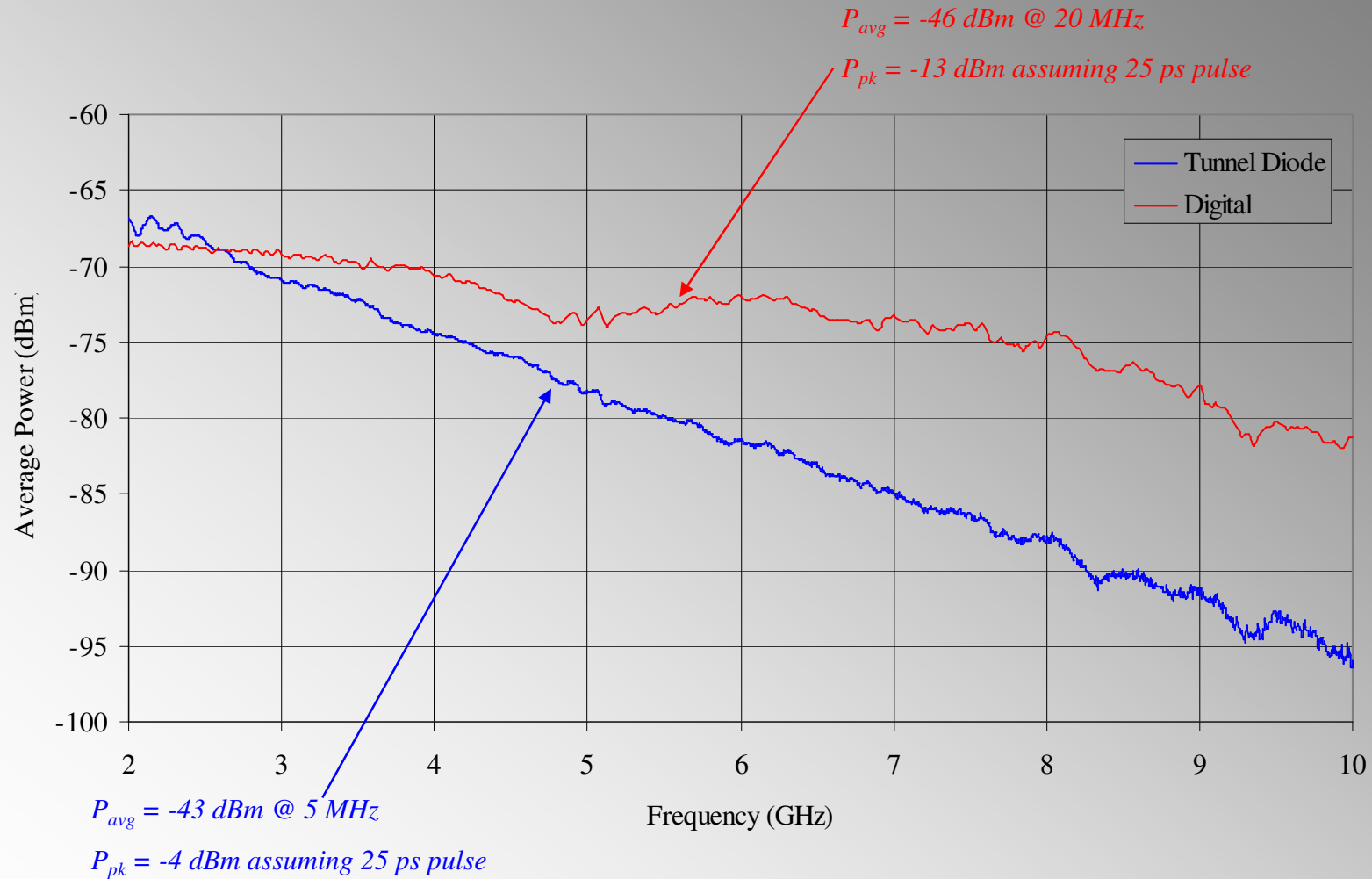
System Considerations

-Phase Cal Spectral Flatness-

- In operational S/X system, phase cal power levels in S and X band can be set independently

- In the new broadband hardware the phase cal power cannot be set independently across the receiver bandwidth.

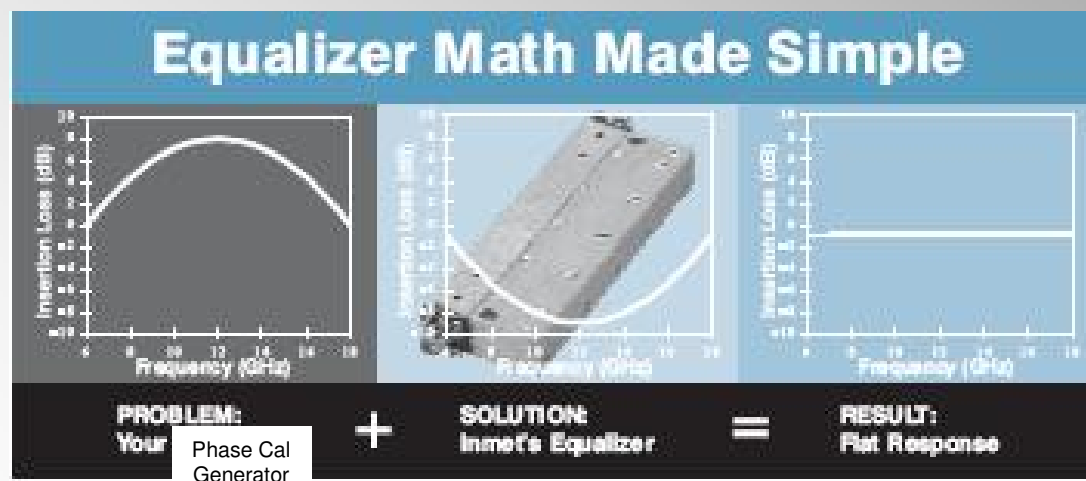- Need phase cal power equalization across the receiver's RF bandwidth (2-12 GHz)

- Aeroflex-Inmet provides a broadband COTs solution:
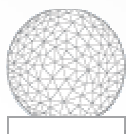
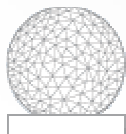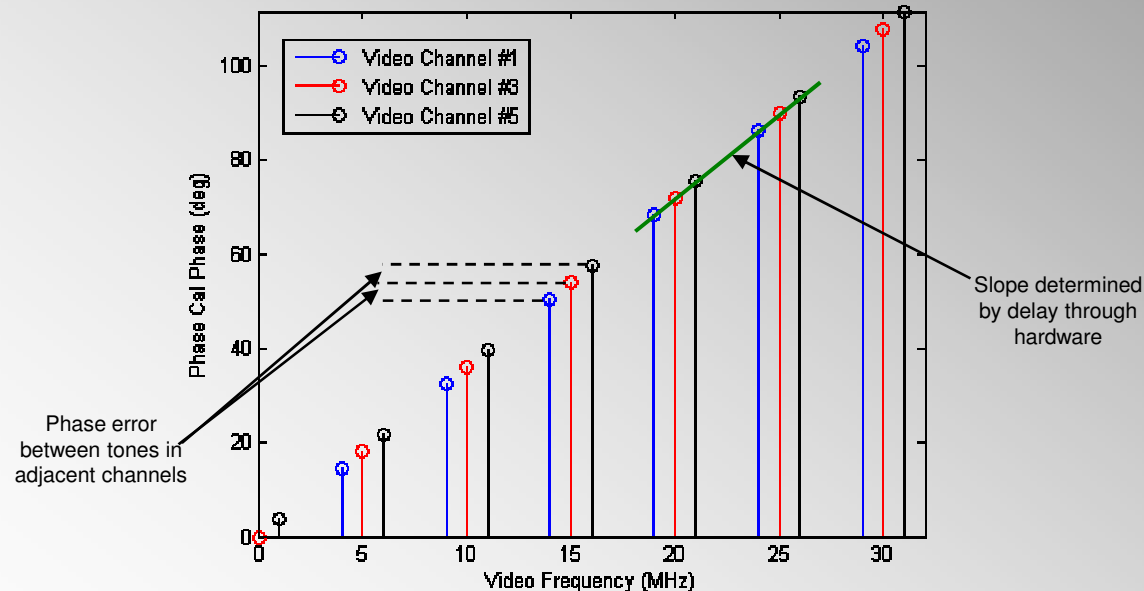# System Considerations
-Saturation Overhead-

- In order for the receiver to operate in a linear mode, components in the chain must not be overdriven

- The peak power of the phase cal pulse needs to be considered

- The operational S/X system operates with 1 MHz rail frequency

- Broadband rail frequency is currently configured for 5 MHz to accommodate receiver overhead

Pulse Width: 25 ps
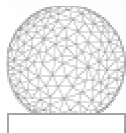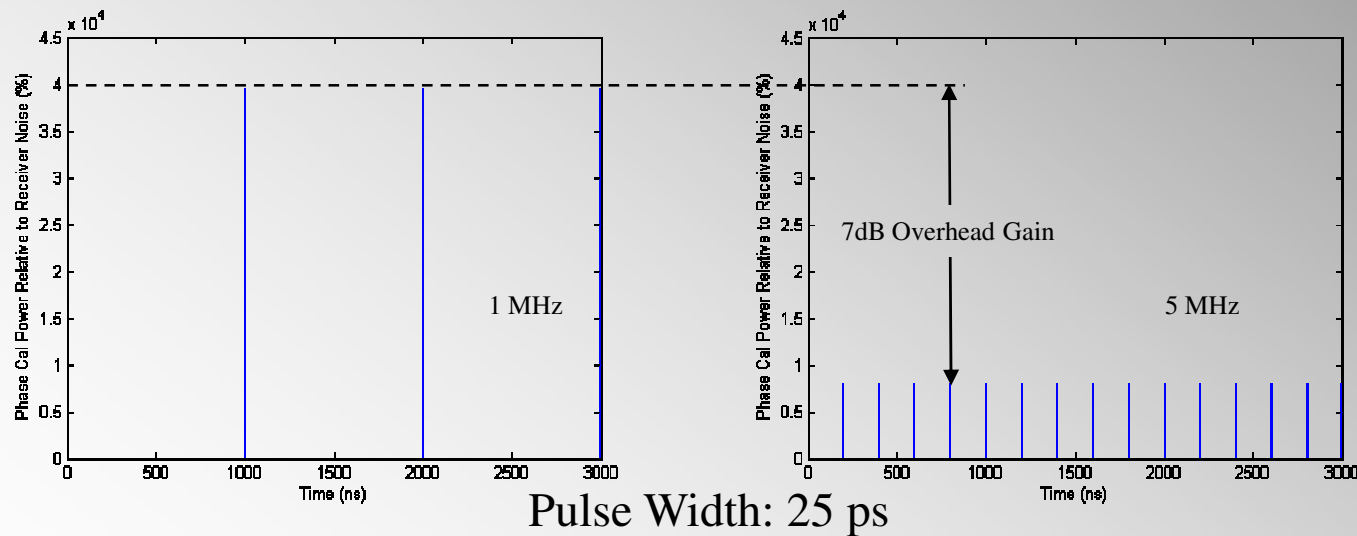
Post-Process Considerations

-Ramifications of 5 MHz Rail Spacing -

- DBE1 is configured for uniformly spaced 32 MHz channels every 64 MHz

- Phase cal currently produces rails every 5 MHz

- Result is that pcal tones no longer appear at the same video frequency in every channel

- When correcting inter-channel fringe phases with the tone phases an additional deterministic phase error is introduced unless the difference is compensated

Slope determined by delay through hardware

Phase error between tones in adjacent channels

MIT
HAYSTACK
OBSERVATORY

Post-Process Considerations

- Phase Cal Delay Function -

- In a given band the DBE video channel-to-channel phase is constant

- In principal, phase cal correction only has to be applied on a band-by-band basis

- From all phase cal tones in a given band the multi-channel phase cal delay function can be constructed

- Tones that are deemed corrupt by RFI are simply left out of the construction

- Such a method provides relief from RFI in compensating for hardware related delays