

# Low Noise Instrumentation for Time and Frequency Applications

VIII INTERNATIONAL SYMPOSIUM  
“METROLOGY OF TIME AND SPACE”

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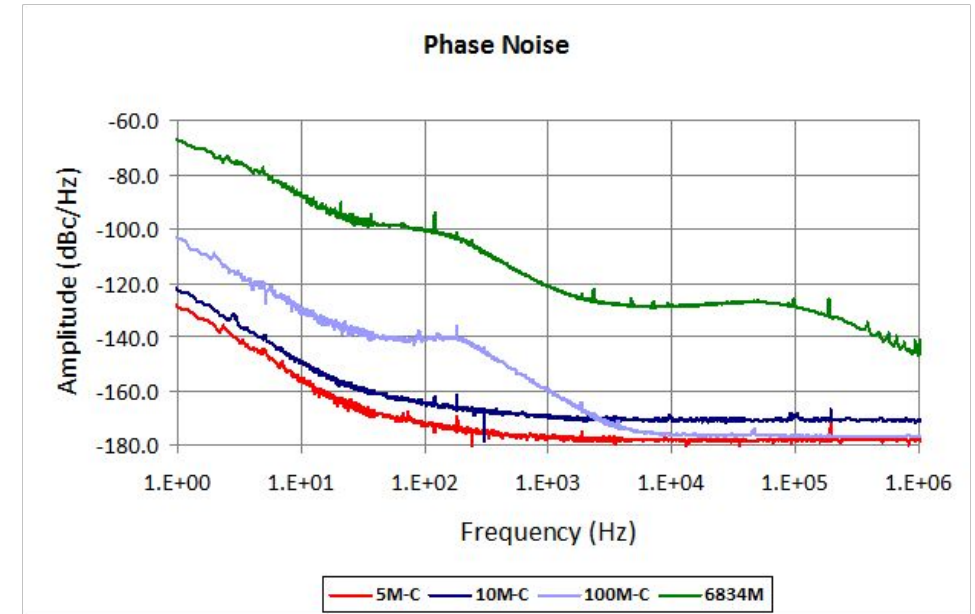
# Low Noise Instrumentation for Time and Frequency Applications

- **Atomic Clocks**
- **Timescales**
- **Frequency Distribution**
- **Time Distribution**
- **Microwave and Optical to RF Synthesizers**



# Instrumentation for Atomic Clocks

- Microwave Synthesizer
  - CS-1 9.192 GHz Frequency Synthesizer
  - RB-1 6.834 GHz Frequency Synthesizer
  - $\mu\text{Hz}$  resolution, PM, FM and AM modulation

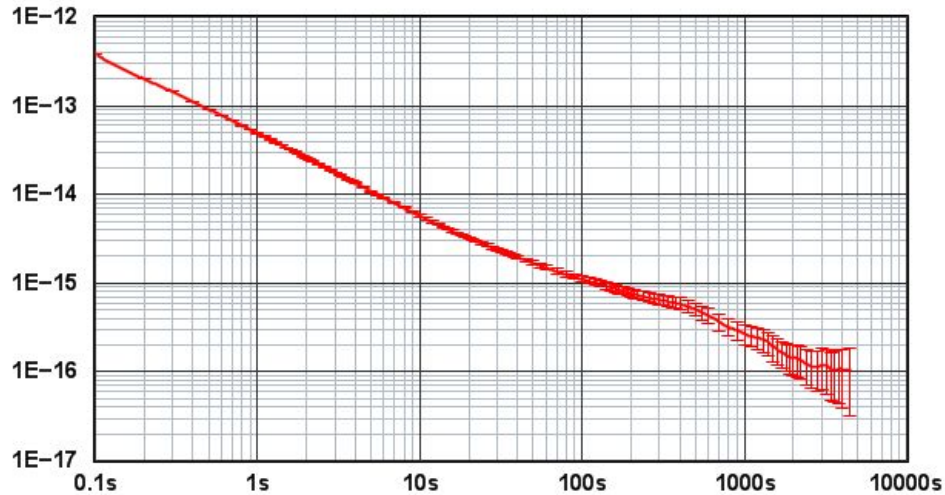


# Instrumentation for Timescales

- Frequency and Phase Offset Generator
  - HROG-5 for 5 MHz signals
  - HROG-10 for 10 MHz signals
  - freq resolution  $5 \times 10^{-19}$ , time resolution  $< 1$  fs

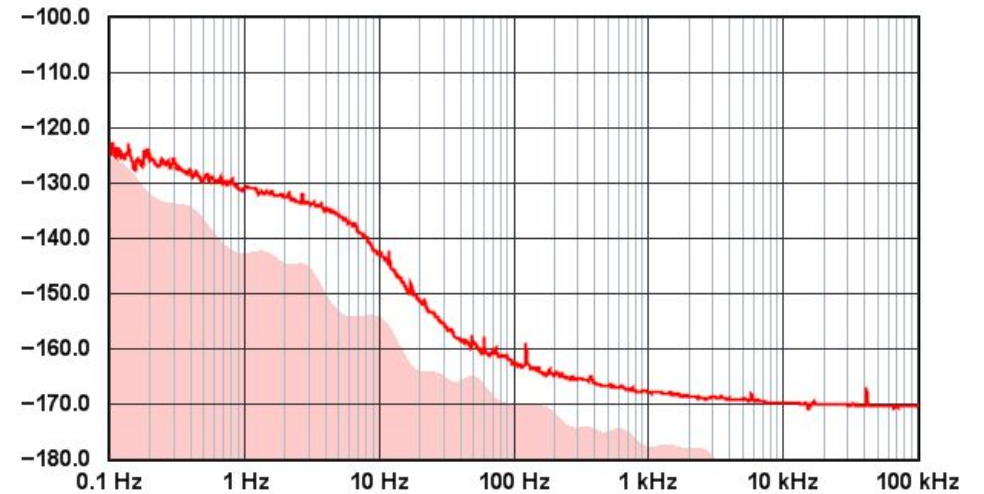


Allan Deviation  $\sigma_y(\tau)$



Trace	Notes
HROG-5	

Phase Noise  $\mathcal{L}(f)$  in dBc/Hz



Trace	Notes
HROG-5	



# Instrumentation for Frequency Distribution

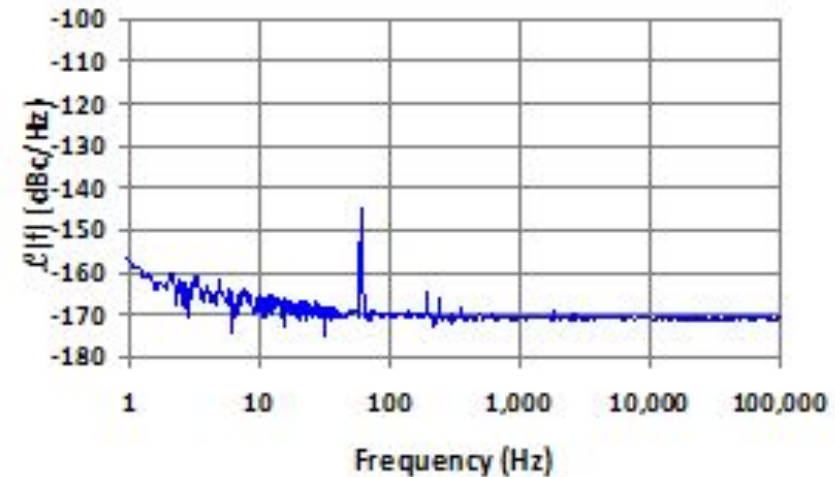
- Frequency Distribution Amplifiers
  - HPDA-15RMi (1 – 50 MHz)
  - LNDA-15RMi (1 – 50 MHz)
  - HPDA-100RM (80 – 120 MHz)



## HPDA-15RMi FEATURES

- 1-50 MHz
- Unity gain
- Low VSWR
- High isolation: 140 dB
- High output: +18 dBm
- Low phase noise: -155 dBc/Hz @ 1 Hz  
-171 dBc/Hz @ 10 kHz
- Low distortion: -48 dBc
- Low temperature coefficient: 1.2 ps/°C

*HPDA-15RMi Phase Noise Plot*

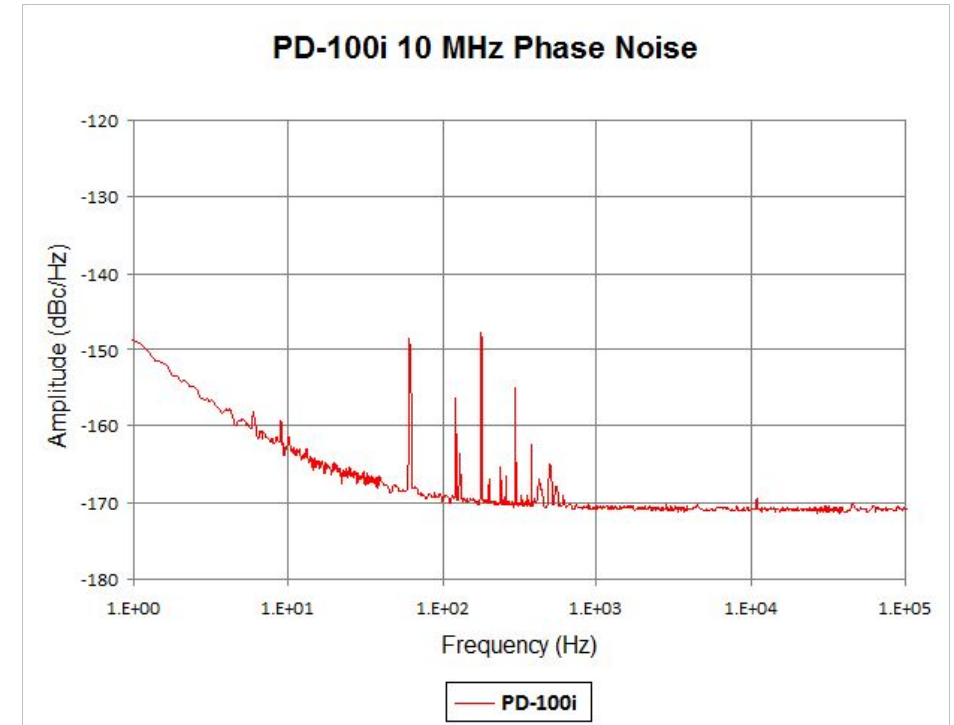
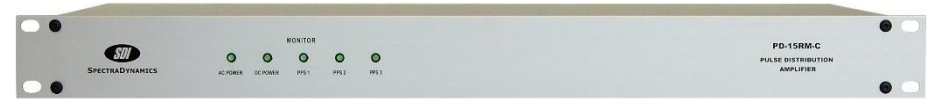


# Instrumentation for Time Distribution

- 1 PPS Generators
  - PPS-2i
- 1 PPS Distribution Amplifiers
  - PD-15RMi
- RF Clock Distribution Amplifiers
  - PD-100i (1 – 100MHz Sine to Square)

## PD-15RMi FEATURES

- 1PPS - 100 MHz
- 50 ohm output: 2.4 Vp-p
- Low temp. coefficient: 3 ps/°C
- Matched channel delays : 100ps typical
- Rise and Fall Time < 900ps





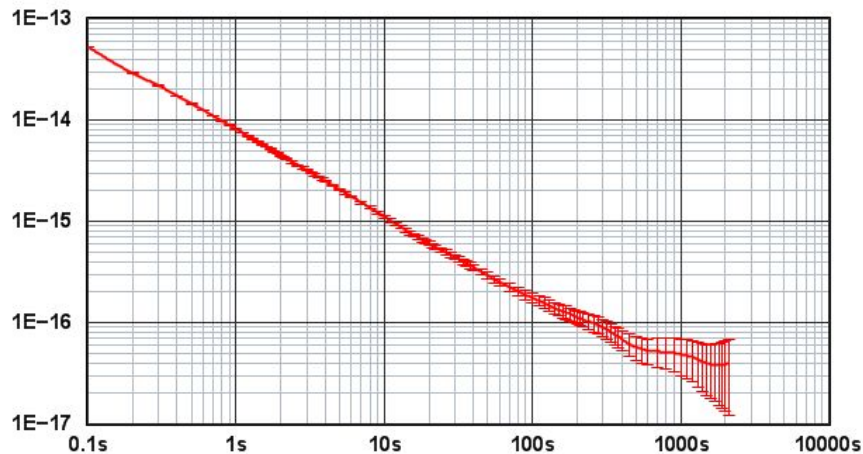
# Microwave and Optical to RF Synthesizers

- Optical Pulse to RF Synthesizer

- FC-160-10P – 800-1650 nm, repetition rate of 160 MHz
  - Outputs at 10 MHz, 100 MHz and 1PPS
- FC-1000-10 – 1GHz reference
  - Outputs at 10 MHz and 100 MHz

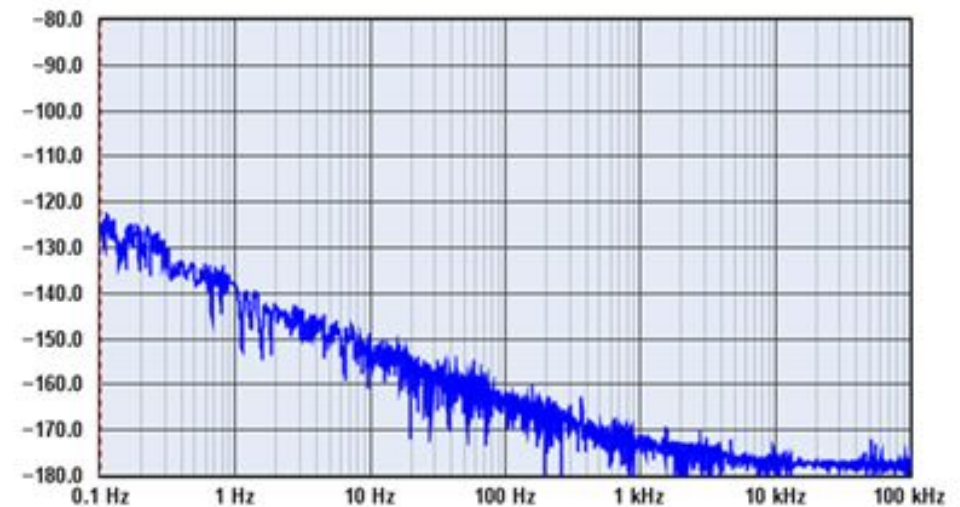


Allan Deviation  $\sigma_y(\tau)$



Trace	Notes
FC-080-10P	10 MHz Output , 80 MHz Repetition Rate

Phase Noise  $\mathcal{L}(f)$  in dBc/Hz



# Thank you

## Contact

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