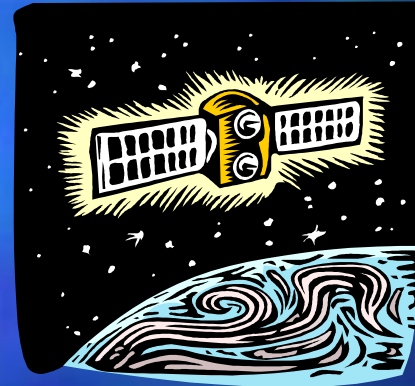


Evaluation of 1MHz, 16-bit Analog to Digital Converters



Sahar Kashef

Research Advisors: Chris Wright, Jerry Cabak
UCO/Lick Engineering Lab

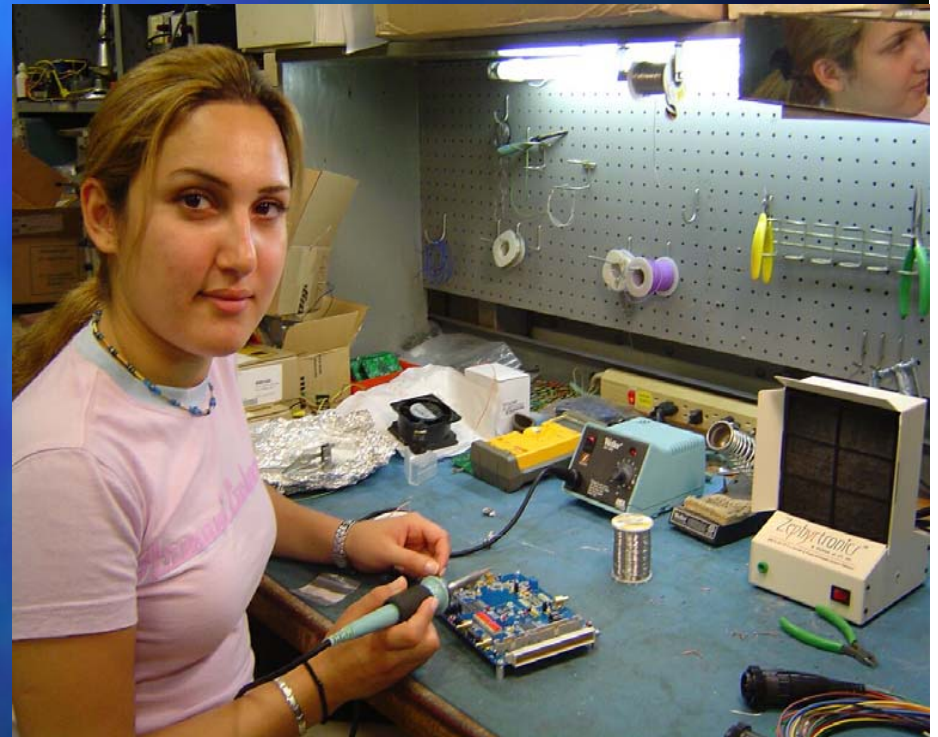
Center for Adaptive Optics

August 9, 2004

University of California, Santa Cruz

Overview:

- Charge Coupled Device
- Connection Schematic
- Objective
- Project Goal
- ADC Tests
- The graphs
- Conclusion



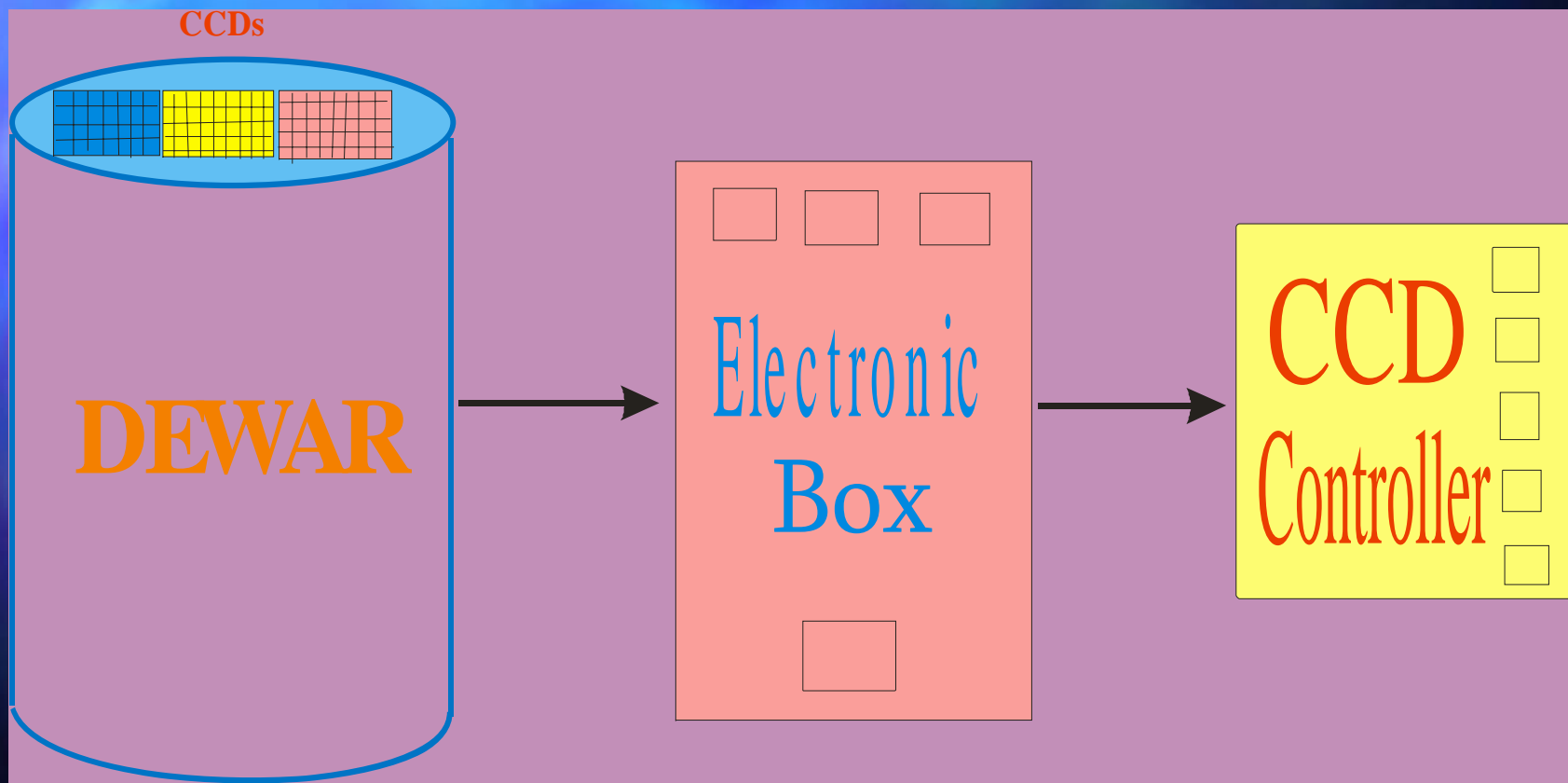
Charge Coupled Device(CCD):

- CCDs are composed of CCD detectors, preamplifiers, analog switches, and a CCD controller
- CCD controllers are used to control the timing and readout of the astronomy-grade CCDs

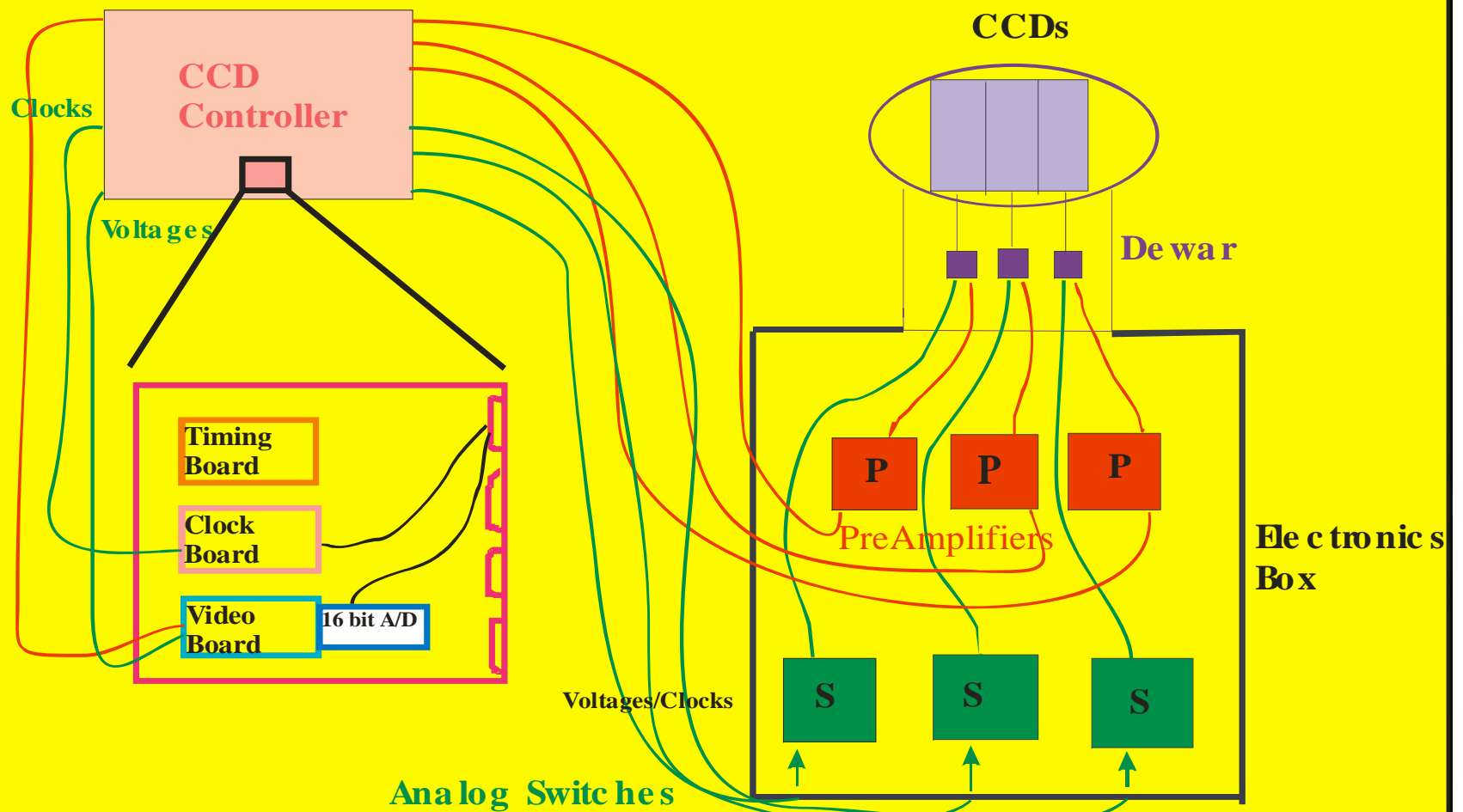
CCD Controller:

- Based on a board set from Astronomical Research Cameras(ARC)
- Consists of a timing board, a utility board, multiple clock generation boards, and multiple video boards

Connection Schematic

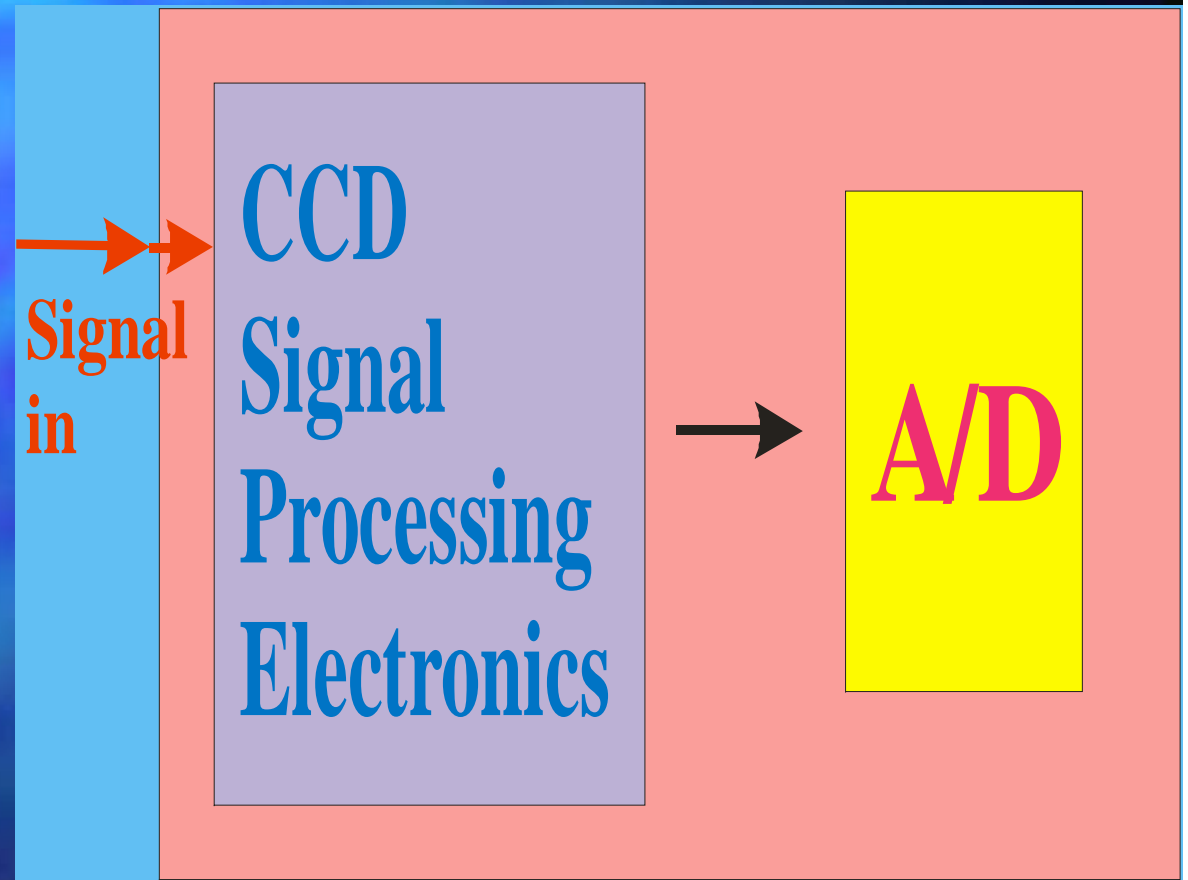


Component Schematic



Video Board

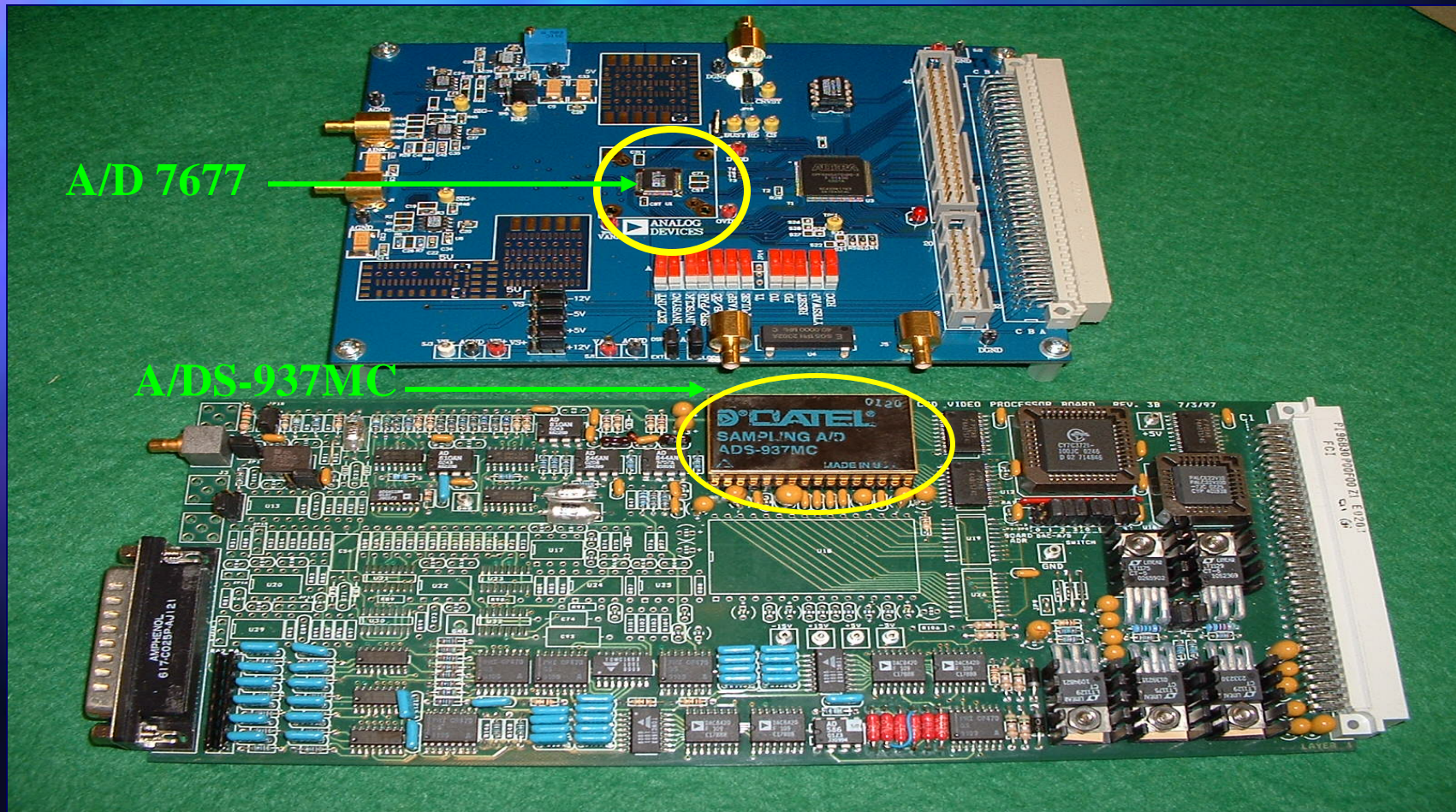
Video boards contain all of the CCD signal processing circuitry and a 16-bit Analog to Digital (A/D) converter to digitize the CCD signal



Overall Objective:

To shrink the size of the video board component of the CCD and use a 16-bit analog digital converter (ADC) with faster readout speed to achieve identical or better performance.

Analog to Digital Converters



Project Goal:

A full performance evaluation of a new integrated 16-bit ADC (AD 7677) to be later compared to the existing ADC on the ARC

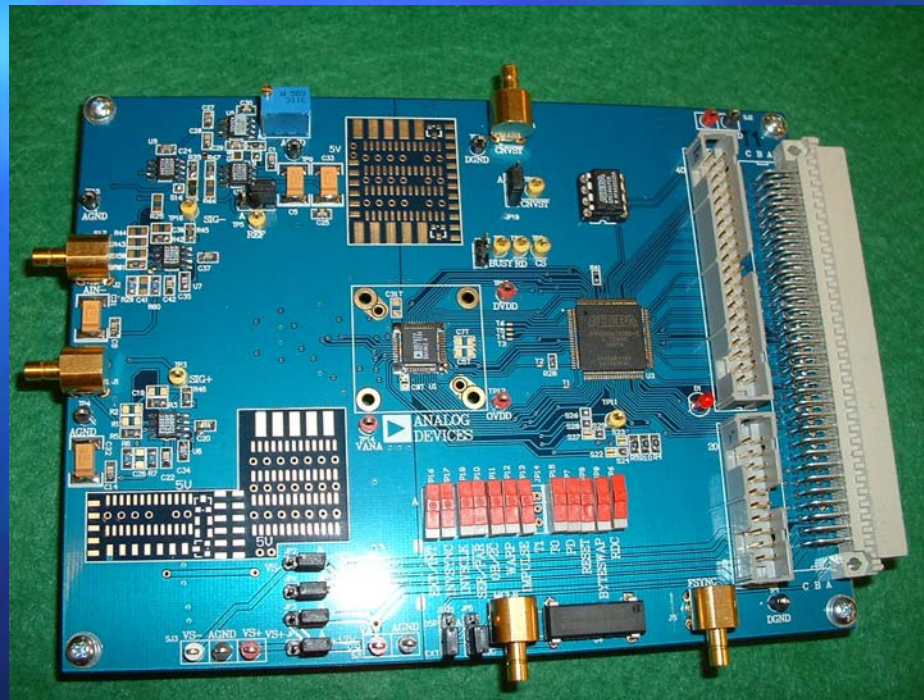


Figure 1: AD 7677

3 ways of testing the A/D converter:

- Gain (V_{out}/V_{in}) & Offset
- Frequency Response
- Noise

Noise Test (Amp PPK): 0.0000456 V

(No input- grounded)

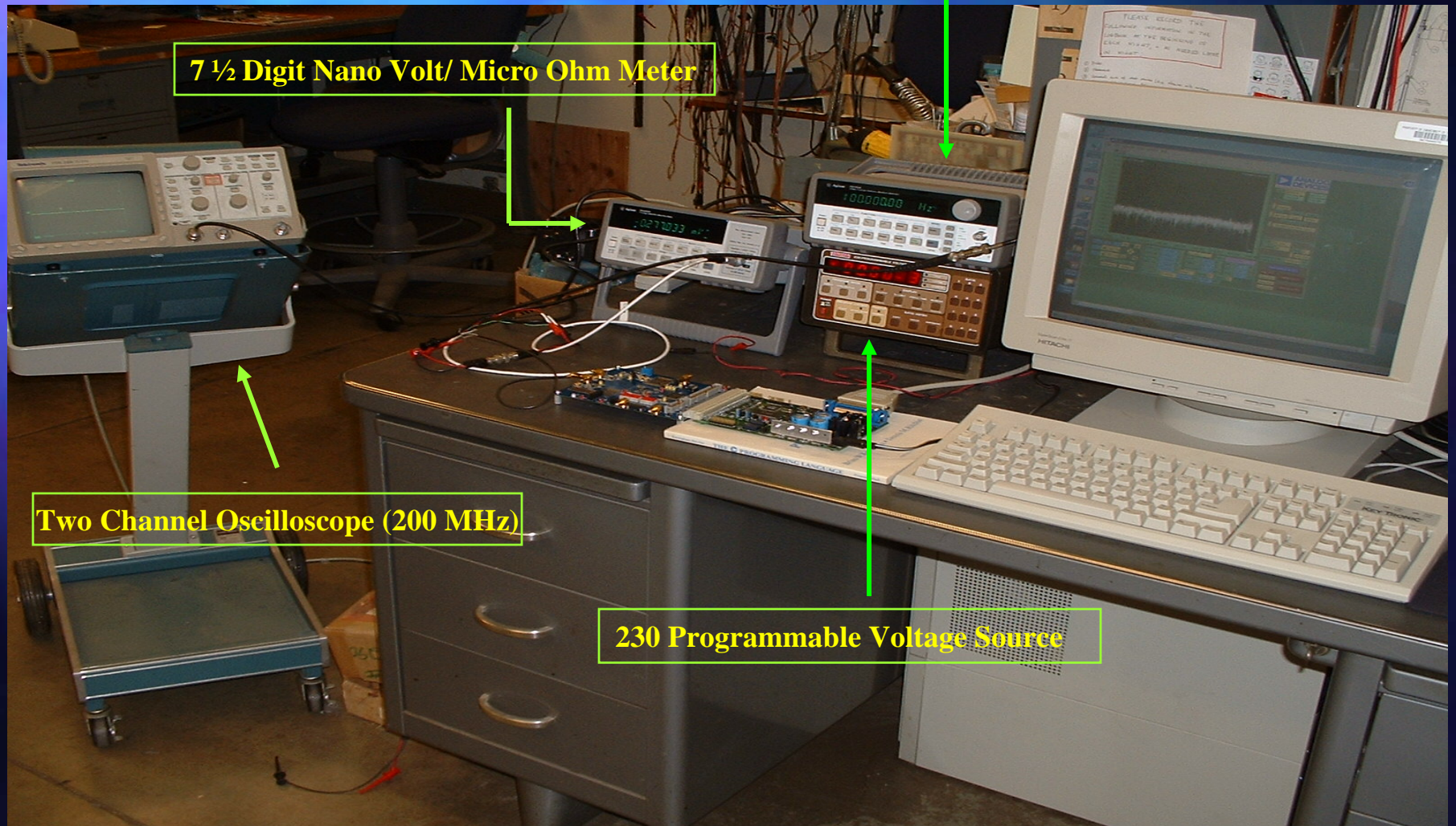
Test Equipment:

15 MHz Function/ Arbitrary
Waveform Generator

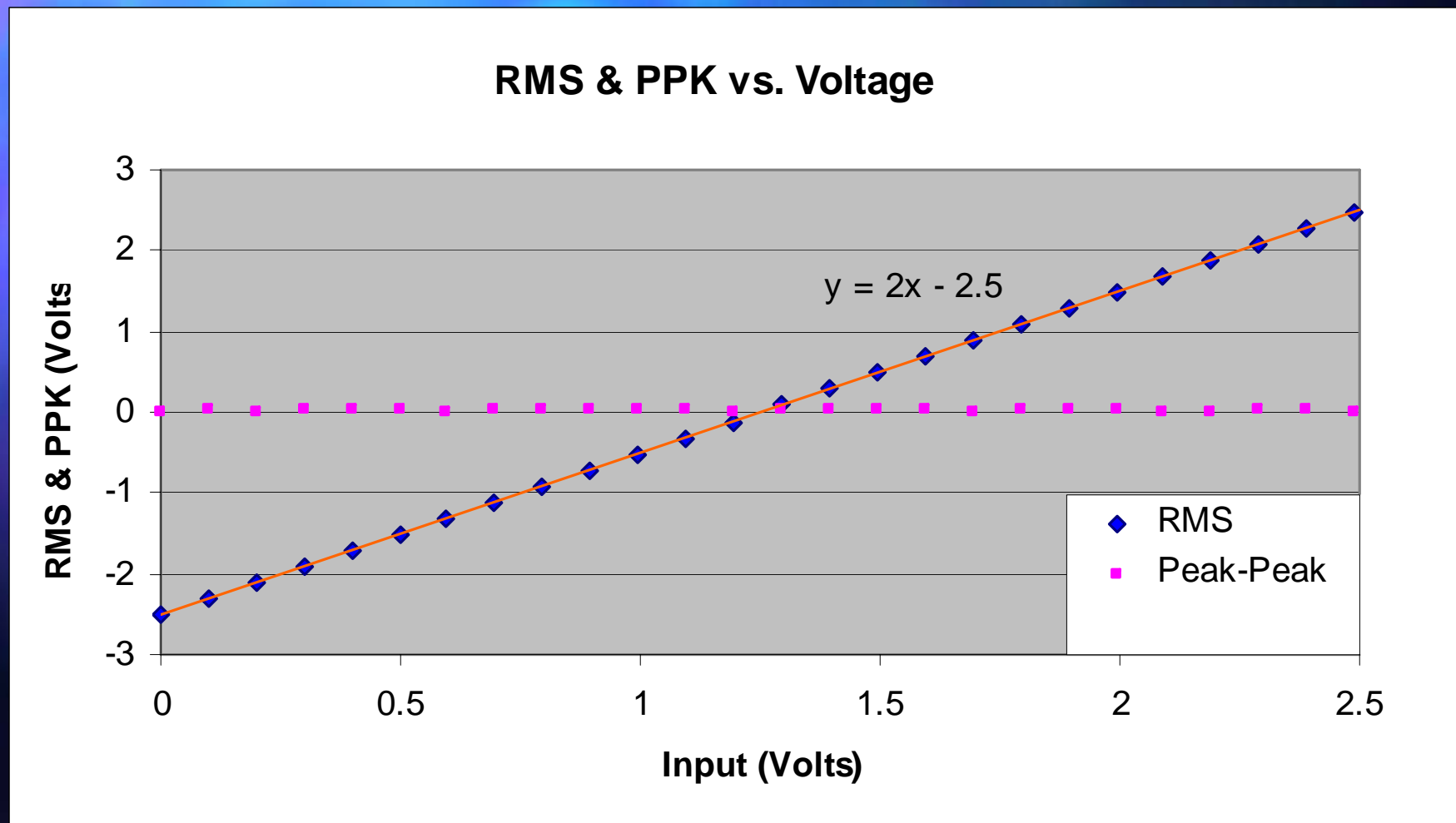
7 1/2 Digit Nano Volt/ Micro Ohm Meter

Two Channel Oscilloscope (200 MHz)

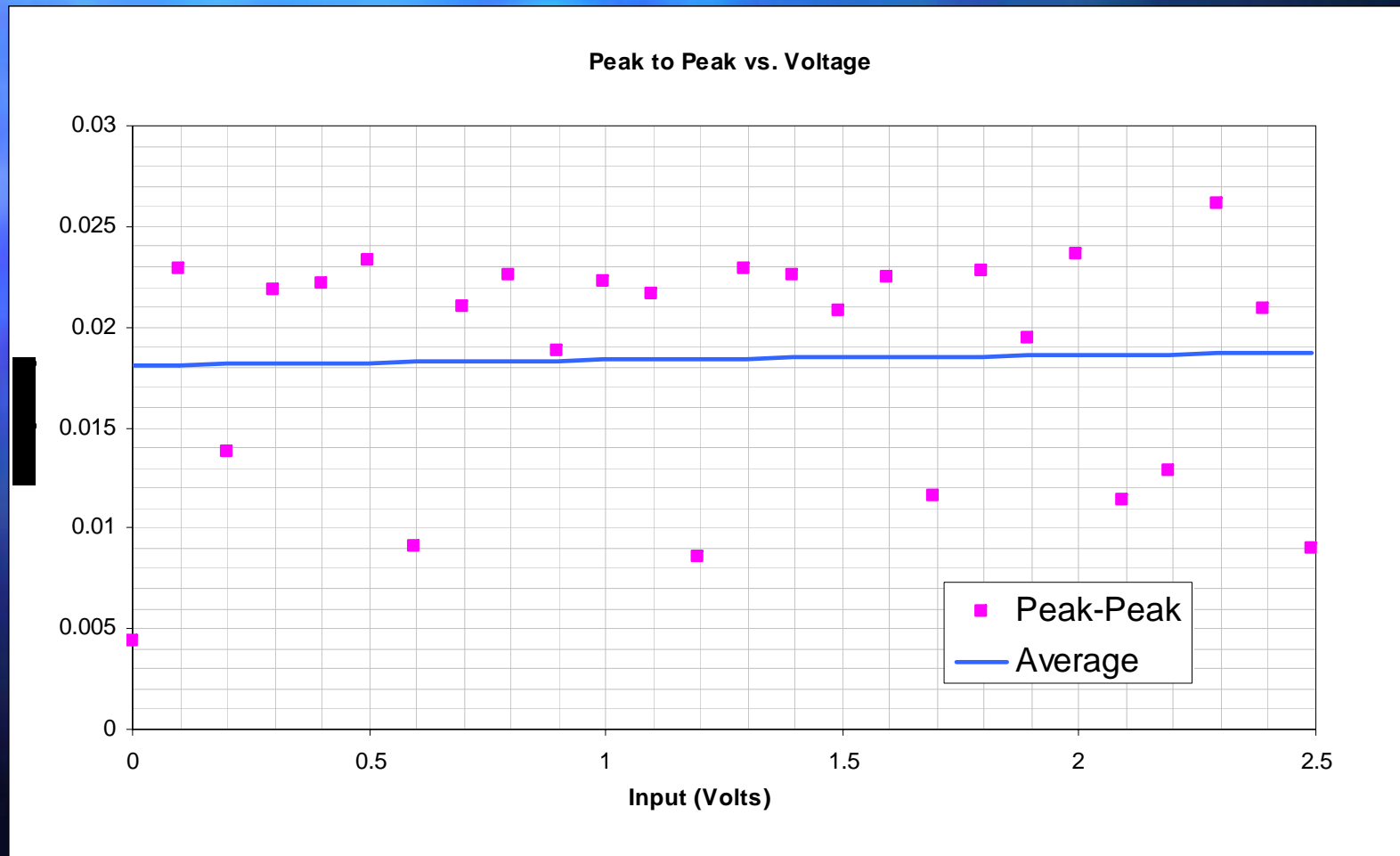
230 Programmable Voltage Source



Gain and Offset Test:

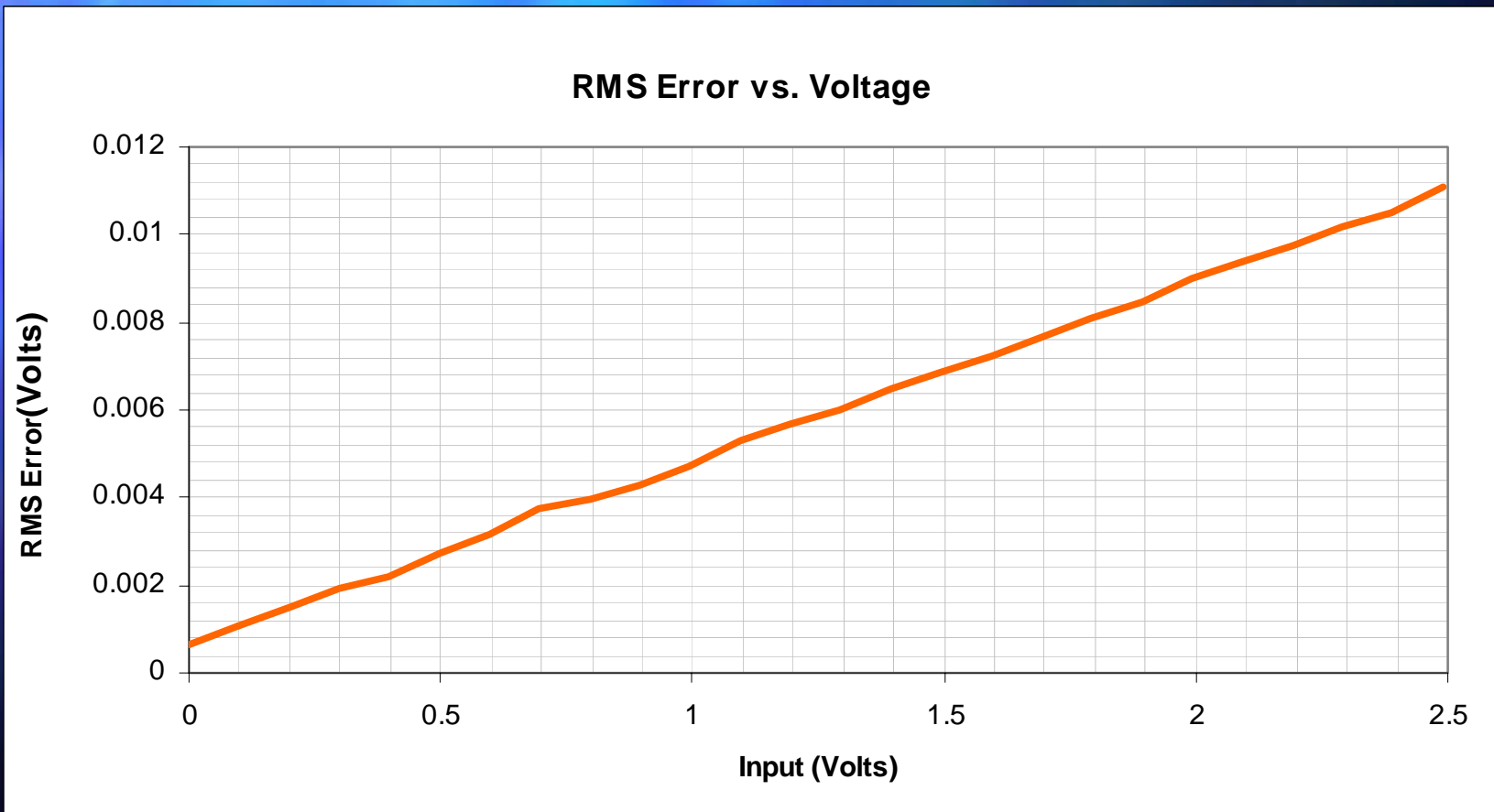


Gain and Offset test continued:



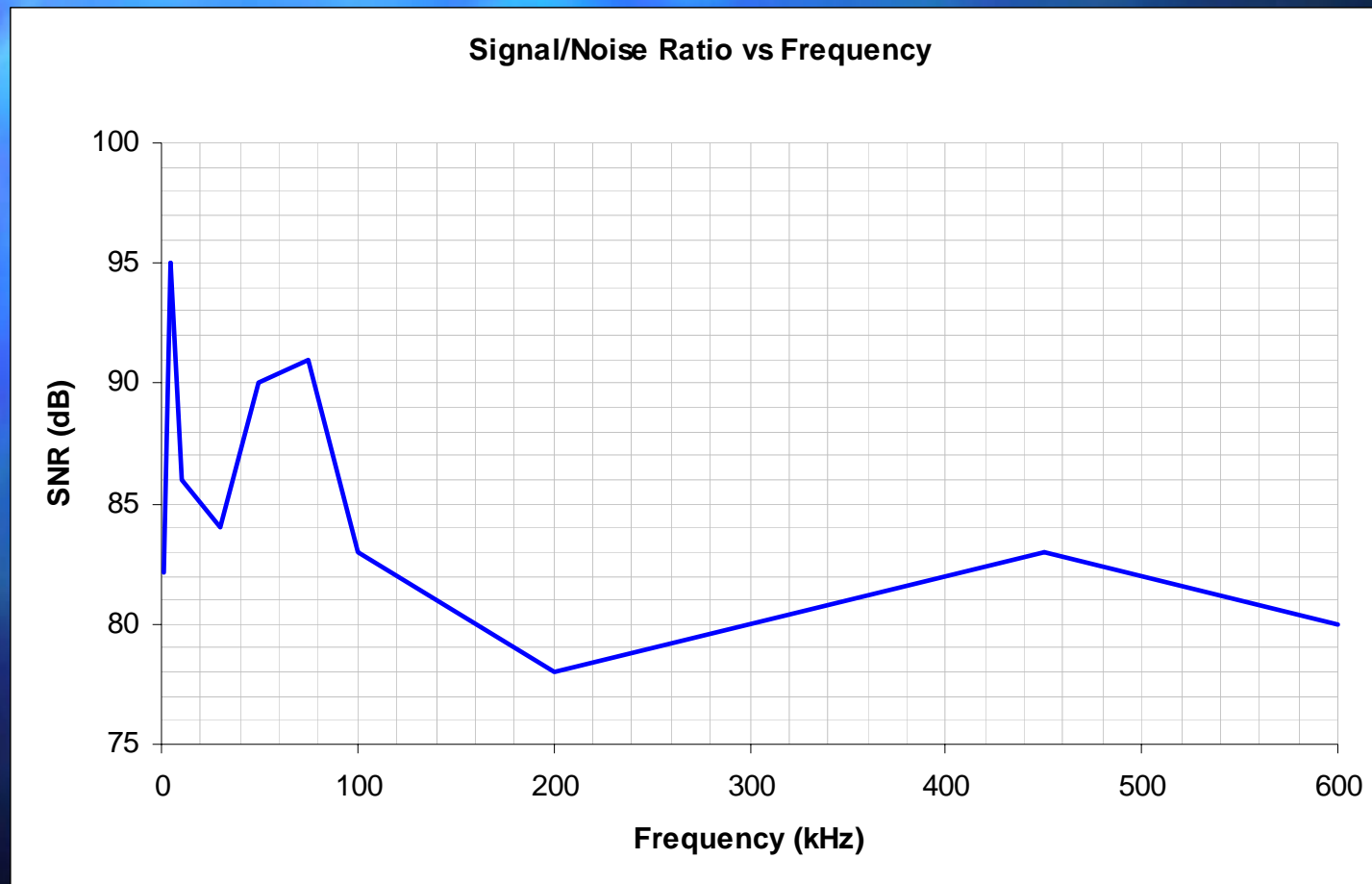
The average DC peak to peak: 0.0184 V

Gain and Offset Voltage test continued:



The average DC % error: 0.117 (.06)

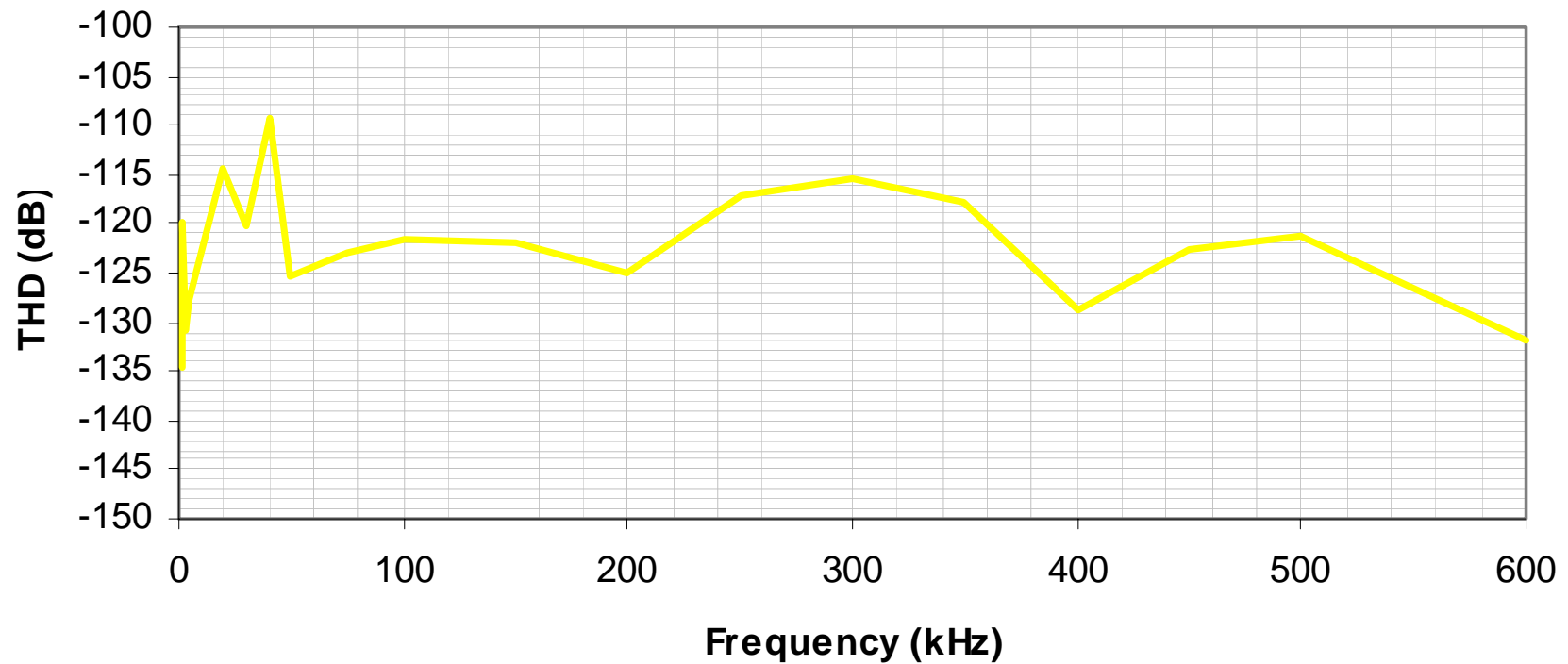
Frequency Response:



Signal to Noise Ratio: 85 dB (94)

Frequency Response:

Total Harmonic Distortion vs Frequency



Total Harmonic Distortion: -122 dB (-110)

Conclusion:

- Data was collected on output voltage, signal to noise ratio, and total harmonic distortion
- In future the collected data is ready to be compared to similar data from the current ADC being used in the ARC
- Possible problems: Errors due to improper equipment and a non-controlled environment

Acknowledgements:

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- Lisa Hunter, Malika Moutawakkil, Hilary O'Bryan
- National Science Foundation Science and Technology Center for Adaptive Optics , managed by the university of California at Santa Cruz under a cooperative agreement No. AST-9876783

References:

- Kester, Walt. Analog-Digital Conversion; Analog Devices, 2004.
- <http://www.analog.com>

Charge Coupled Device (CCD)

A **charge-coupled device (CCD)**, is an integrated circuit containing an array of linked, or coupled, capacitors. Under the control of an external circuit, each capacitor can transfer its electric charge to one or other of its neighbors. CCDs are used in digital photography and astronomy (particularly in photometry and optical and UV spectroscopy).

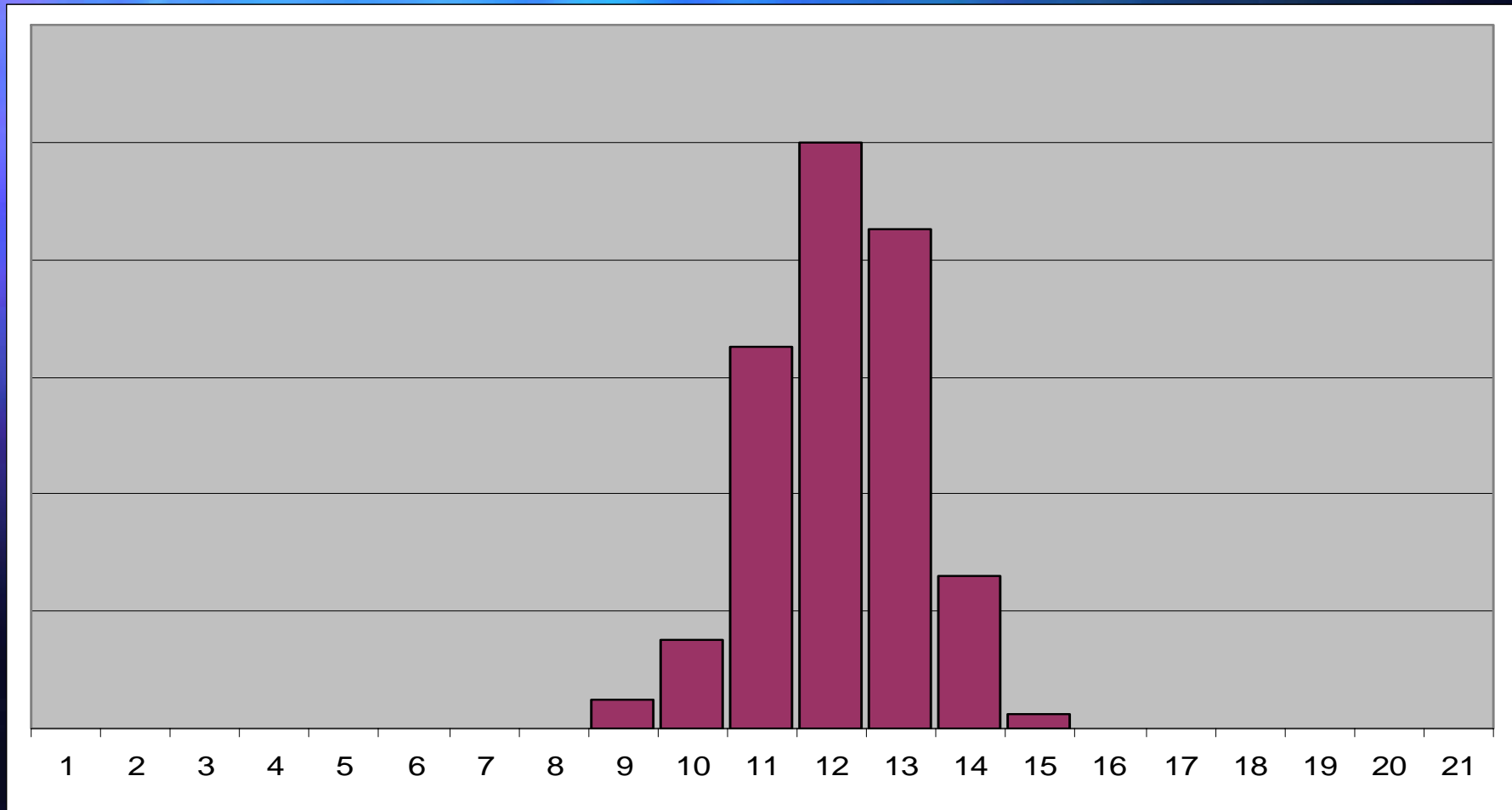
Noise test:

Noise test:

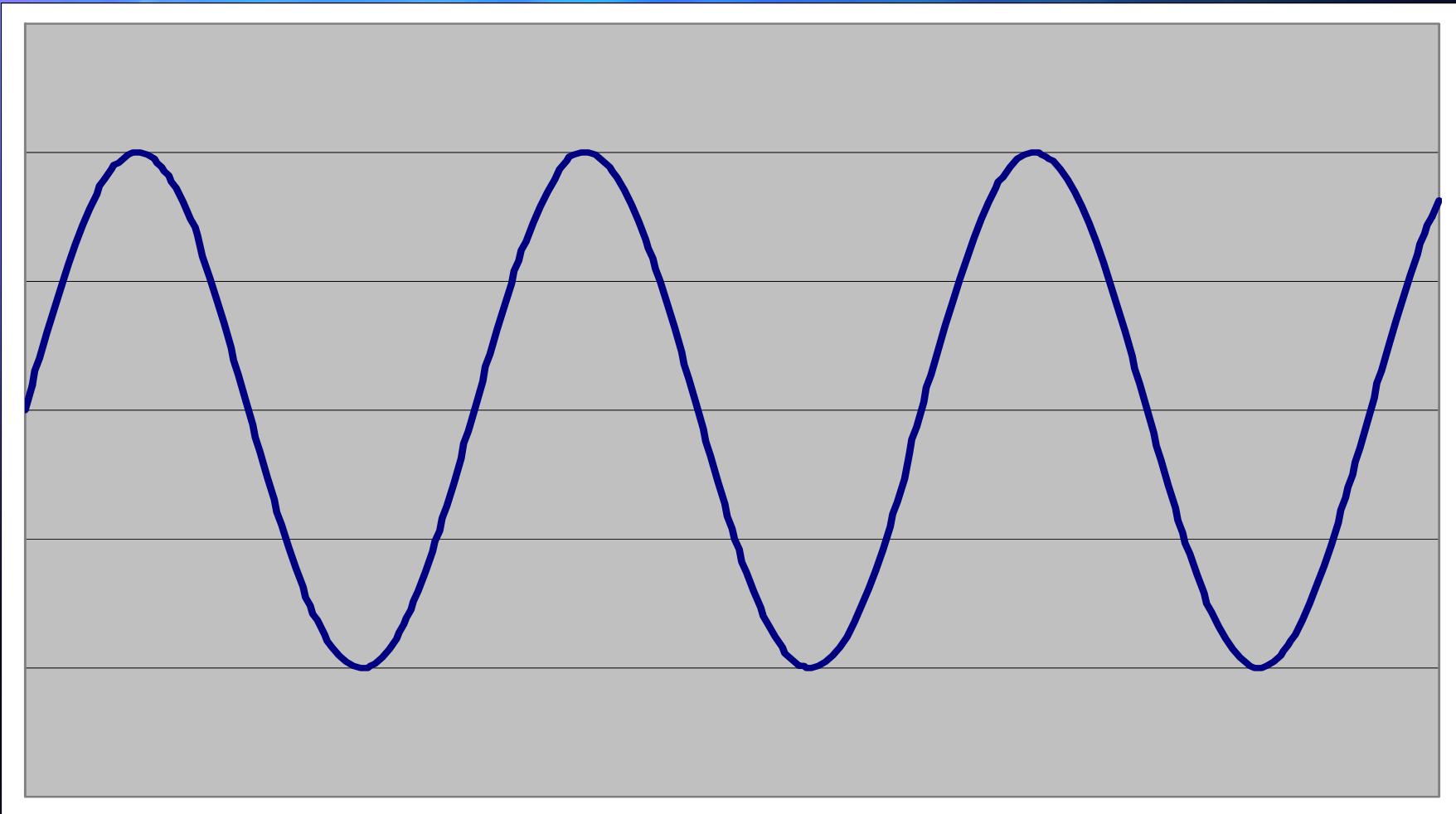
Amp RMS(V)	Amp ppk(Vpp)	Amp Max(V)	
2.5	0.000076	-2.499924	
2.5	0	-2.5	
2.5	0.000076	-2.499924	
2.5	0	-2.5	
2.5	0.000076	-2.49992	
2.5	0.0000456	-2.4999536	Average

-
- The performance of new integrated 16-bit ADCs from Analog Devices will be later compared to the existing ADC on the Astronomical Research Camera (ARC) video boards.

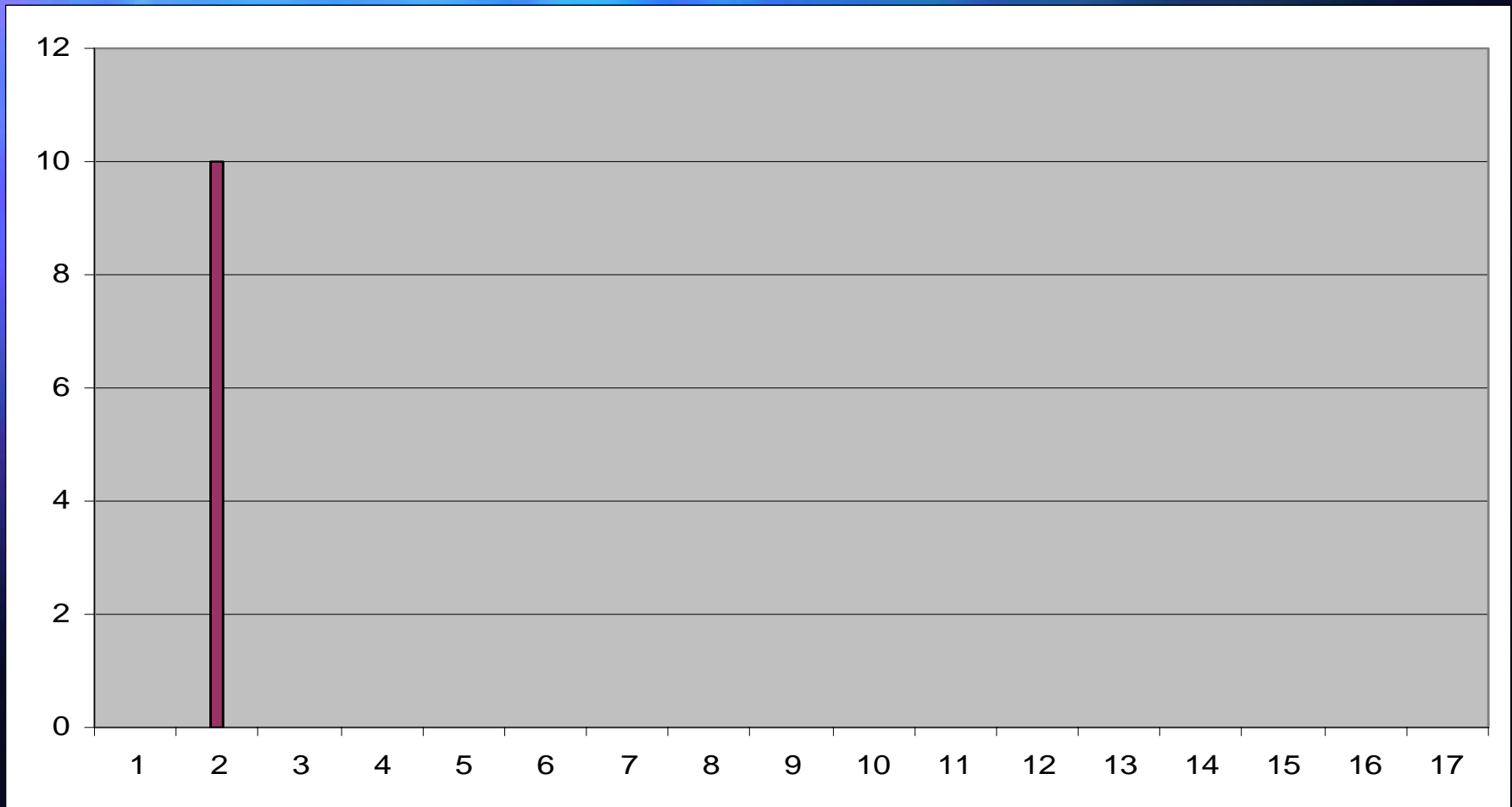
DC Test (Histogram)



AC Test



Frequency Analysis



Summary of Results:

- The average DC % error: 0.117 (.06)
- The average DC peak to peak: 0.0184 V
- Signal to Noise Ratio: 85 dB (94)
- Total Harmonic Distortion: -122 dB (-110)
- Noise Test (Amp PPK): 0.0000456 V

(No input- grounded)

RMS & PPK vs. Voltage

