

NIM Card Voltage Gain Analysis

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Abstract

The gain coefficients $g = \frac{V_{out} - V_{offset}}{V_{in}}$ for 10 NIM voltage gain cards were obtained through measurements of the output voltage V_{out} , input voltage V_{in} , and offset voltage V_{offset} .

1 Introduction

1.1 A Description of the NIM Gain Cards

There were 11 NIM cards in the collection considered in this report. They were labeled 1-11 on the top, front of each card with either a sharpie or a sticker. The card labeled “1” was found to be faulty. The other 10 cards were analyzed. Each card had five gain settings. They were (nominally) $g = 0.5, 1, 2, 5,$ and 10 . The desired gain could be set by turning a labeled dial on the front of each card. I was told that the gain setting could also be controlled via computer by connecting it by cable to another NIM card designed for that purpose. This capability was not tested in this analysis, however. The toggle switches on the front of each card were all left in position “1” instead of “200” although the position of the switch was found to have no effect on the cards’ function in this analysis. The input voltage was provided to the port labeled “SIGNAL IN” and the output voltage was measured from the connector labeled “V OUT.”

1.2 The Method

1.2.1 Summary

A value for V_{offset} for each gain card was obtained by measuring the output voltage from each card when providing no input voltage. V_{offset} likely depends on variables such as the crate in which the cards are held and how long they have been left on before the measurements were made, so it would be a good idea to remeasure V_{offset} for each card whenever they are moved to a new environment. Output voltages were then measured for a range of input voltages for each of the five gain settings on each card. This data

was then processed by a C program written for the purpose which output average values for each gain setting on each card along with estimated errors on each value.

1.2.2 Details

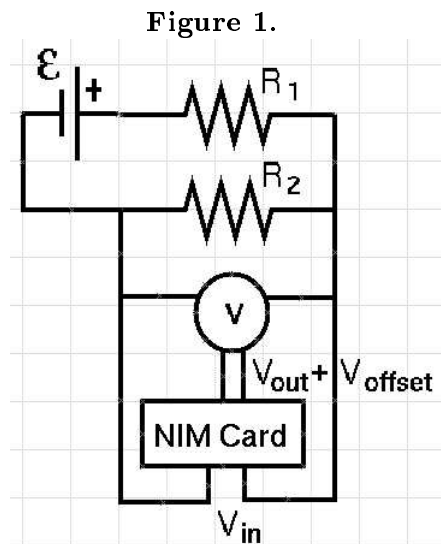


Figure 1 is a diagram of the test circuit. The power supply was a Power/Mate Corp. (PMC) Regulated Power Supply and the voltmeter was a Hewlett-Packard (HP) 3457A Multimeter with two inputs.

The first resistor (R_1) was either $100\text{k}\Omega$ or 150Ω depending on the desired voltage range. Each NIM gain card was tested over the range from -10V to $+10\text{V}$. Use of the $100\text{k}\Omega$ resistor yielded higher precision measurements over the range which it provided.¹

Offset voltage measurements for each card were made by measuring the output voltage from each card with the power supply turned off. These measurements were made after having left the crate containing the cards turned on for days first to allow the cards' temperatures to stabilize as it was suggested that this might affect the results. Also, when the cards are used in an experiment, the crate is left on.

The offset voltages would gradually decrease over time. In some cases, they did not stabilize even after a half an hour. This is reflected in the estimated uncertainty on the offset measurements.

It is likely that the offset voltages depend on which crate is used and other variables. They should be remeasured whenever the environment in which the cards are used is changed.

¹Indicated by less fluctuation in the voltage reading over time

+3.006400e+03		+1.497924e+03		4.982449e-01
+2.158500e+03		+1.075424e+03		4.982273e-01
+1.993550e+03		+9.932536e+02		4.982336e-01
+1.001030e+03		+4.987436e+02		4.982304e-01
-5.355100e+02		-2.668104e+02		4.982361e-01
-1.504000e+03		-7.493764e+02		4.982556e-01
-2.517380e+03		-1.254236e+03		4.982309e-01
-3.496300e+03		-1.741986e+03		4.982371e-01
-4.530300e+03		-2.257126e+03		4.982289e-01
-5.531500e+03		-2.755896e+03		4.982186e-01
-6.475700e+03		-3.226476e+03		4.982436e-01
-7.475000e+03		-3.724376e+03		4.982443e-01
-8.500200e+03		-4.235276e+03		4.982561e-01

Calculated Gain: 4.982359e-01 +/- 2.730646e-06
 19 of 20 data points used.

Gain: 2			1 outliers removed.	
	Vin(mV)	Vout(mV)	Gcalc	
+5.014300e+03		+9.989398e+03		1.992182e+00
+4.511900e+03		+8.988598e+03		1.992198e+00
+4.005600e+03		+7.979698e+03		1.992136e+00
+3.508400e+03		+6.989398e+03		1.992190e+00
+3.003200e+03		+5.982998e+03		1.992208e+00
+2.483300e+03		+4.947198e+03		1.992187e+00
+2.042800e+03		+4.069498e+03		1.992118e+00
+1.085400e+03		+2.162298e+03		1.992167e+00
+5.075600e+02		+1.011128e+03		1.992136e+00
+2.927950e+02		+5.832884e+02		1.992139e+00
-4.018000e+02		-8.004616e+02		1.992189e+00
-6.538000e+02		-1.302482e+03		1.992171e+00
-1.238800e+03		-2.467902e+03		1.992171e+00
-1.787600e+03		-3.560802e+03		1.992141e+00
-2.328300e+03		-4.638302e+03		1.992179e+00
-2.748700e+03		-5.475902e+03		1.992218e+00
-3.289500e+03		-6.553402e+03		1.992116e+00
-3.703700e+03		-7.378202e+03		1.992196e+00
-4.266800e+03		-8.500302e+03		1.992186e+00

Calculated Gain: 1.992170e+00 +/- 6.944850e-06
 19 of 20 data points used.

Gain: 5			2 outliers removed.
	Vin(mV)	Vout(mV)	Gcalc

+1.996190e+03		+9.974641e+03		4.996839e+00
+1.806300e+03		+9.024941e+03		4.996369e+00
+1.610000e+03		+8.036941e+03		4.996372e+00
+1.394400e+03		+6.966941e+03		4.996572e+00
+1.242360e+03		+6.207541e+03		4.996250e+00
+1.002600e+03		+5.009241e+03		4.996501e+00
+8.172000e+02		+4.083141e+03		4.996091e+00
+5.908000e+02		+2.951691e+03		4.996566e+00
+3.958300e+02		+1.977791e+03		4.996210e+00
+2.024000e+02		+1.011091e+03		4.996175e+00
-1.136100e+02		-5.676194e+02		4.996328e+00
-3.269400e+02		-1.633449e+03		4.996802e+00
-5.012200e+02		-2.504259e+03		4.996430e+00
-6.536500e+02		-3.266159e+03		4.996321e+00
-9.076400e+02		-4.534959e+03		4.996426e+00
-1.125400e+03		-5.622859e+03		4.996554e+00
-1.298540e+03		-6.488059e+03		4.996494e+00
-1.506150e+03		-7.525559e+03		4.996548e+00

Calculated Gain: 4.996436e+00 +/- 4.686684e-05

18 of 20 data points used.

Gain: 10		0 outliers removed.		
Vin(mV)	Vout(mV)	Gcalc		
+9.891700e+02		+9.861176e+03		9.969142e+00
+8.019000e+02		+7.993776e+03		9.968544e+00
+7.038800e+02		+7.017176e+03		9.969279e+00
+6.095700e+02		+6.076876e+03		9.969119e+00
+5.748200e+02		+5.730576e+03		9.969340e+00
+4.999100e+02		+4.983776e+03		9.969346e+00
+4.015000e+02		+4.002976e+03		9.970052e+00
+3.069000e+02		+3.059576e+03		9.969292e+00
+2.062750e+02		+2.056426e+03		9.969341e+00
+1.018250e+02		+1.015146e+03		9.969514e+00
-6.560000e+01		-6.539342e+02		9.968509e+00
-1.518000e+02		-1.513164e+03		9.968144e+00
-2.465030e+02		-2.457264e+03		9.968496e+00
-3.498700e+02		-3.487924e+03		9.969201e+00
-4.558300e+02		-4.544224e+03		9.969121e+00
-5.521700e+02		-5.504724e+03		9.969256e+00
-6.537000e+02		-6.516924e+03		9.969289e+00
-7.466000e+02		-7.442824e+03		9.968958e+00
-8.489000e+02		-8.462524e+03		9.968812e+00
-9.541900e+02		-9.512524e+03		9.969214e+00

Calculated Gain: 9.969098e+00 +/- 9.526278e-05
20 of 20 data points used.

End Card 2 report-----

Card Number 5 5_unix.out
Gains analyzed: 1, 0.5, 2, 5, 10
Number of data points per gain: 17

Offsets:

Gain 1 offset = +2.680e-02 mV
Gain 0.5 offset = +1.740e-02 mV
Gain 2 offset = +4.620e-02 mV
Gain 5 offset = +1.018e-01 mV
Gain 10 offset = +2.040e-01 mV

Gain: 1 3 outliers removed.
 Vin(mV) Vout(mV) Gcalc
+9.993300e+03 | +9.930973e+03 | 9.937631e-01
+9.106800e+03 | +9.050273e+03 | 9.937929e-01
+8.024500e+03 | +7.974073e+03 | 9.937159e-01
+6.980600e+03 | +6.936973e+03 | 9.937503e-01
+4.797400e+03 | +4.767373e+03 | 9.937410e-01
+4.063800e+03 | +4.038573e+03 | 9.937923e-01
+3.024200e+03 | +3.004983e+03 | 9.936457e-01
+1.984100e+03 | +1.971973e+03 | 9.938880e-01
+1.172000e+03 | +1.164473e+03 | 9.935778e-01
+5.019000e+02 | +4.988632e+02 | 9.939494e-01
+3.970000e+01 | +3.937320e+01 | 9.937806e-01
-2.514000e+02 | -2.517268e+02 | 9.937237e-01
-2.246700e+03 | -2.232727e+03 | 9.934741e-01
-3.501000e+03 | -3.479027e+03 | 9.937535e-01

Calculated Gain: 9.937392e-01 +/- 3.149183e-05
14 of 17 data points used.

Gain: 0.5 1 outliers removed.
 Vin(mV) Vout(mV) Gcalc
+9.826300e+03 | +4.884983e+03 | 4.971335e-01
+8.664800e+03 | +4.307483e+03 | 4.971243e-01
+8.213700e+03 | +4.083383e+03 | 4.971429e-01
+6.775100e+03 | +3.368183e+03 | 4.971414e-01
+5.888400e+03 | +2.927193e+03 | 4.971117e-01

+4.840600e+03		+2.406243e+03		4.970959e-01
+4.139000e+03		+2.057583e+03		4.971207e-01
+3.335000e+03		+1.657683e+03		4.970563e-01
+2.224200e+03		+1.105773e+03		4.971552e-01
+1.694500e+03		+8.423426e+02		4.971039e-01
+8.088000e+02		+4.020426e+02		4.970853e-01
-1.130800e+02		-5.623440e+01		4.972975e-01
-5.996000e+02		-2.981574e+02		4.972605e-01
-3.070500e+03		-1.526317e+03		4.970908e-01
-4.342400e+03		-2.158517e+03		4.970794e-01
-8.155100e+03		-4.054017e+03		4.971144e-01

Calculated Gain: 4.971321e-01 +/- 1.581525e-05
 16 of 17 data points used.

Gain: 2 0 outliers removed.

Vin(mV)	Vout(mV)	Gcalc		
+4.907600e+03		+9.761354e+03		1.989028e+00
+4.294600e+03		+8.541654e+03		1.988929e+00
+3.409100e+03		+6.780154e+03		1.988840e+00
+3.114800e+03		+6.195154e+03		1.988941e+00
+2.677400e+03		+5.324854e+03		1.988815e+00
+2.170700e+03		+4.316954e+03		1.988738e+00
+1.763990e+03		+3.508254e+03		1.988817e+00
+1.117600e+03		+2.222954e+03		1.989042e+00
+7.667000e+02		+1.524824e+03		1.988814e+00
+3.654000e+02		+7.265038e+02		1.988242e+00
-5.602400e+02		-1.114546e+03		1.989408e+00
-1.813000e+03		-3.605546e+03		1.988718e+00
-2.073400e+03		-4.124046e+03		1.989026e+00
-2.373700e+03		-4.721046e+03		1.988898e+00
-3.003500e+03		-5.973546e+03		1.988862e+00
-4.074000e+03		-8.101246e+03		1.988524e+00
-5.463900e+03		-1.086725e+04		1.988917e+00

Calculated Gain: 1.988857e+00 +/- 5.882660e-05
 17 of 17 data points used.

Gain: 5 4 outliers removed.

Vin(mV)	Vout(mV)	Gcalc		
+2.187000e+03		+1.087350e+04		4.971878e+00
+2.117800e+03		+1.053000e+04		4.972140e+00
+1.911700e+03		+9.505398e+03		4.972223e+00
+1.298600e+03		+6.457198e+03		4.972430e+00

+1.025600e+03		+5.099698e+03		4.972405e+00
+5.989600e+02		+2.978298e+03		4.972449e+00
+4.968000e+02		+2.469898e+03		4.971615e+00
+3.823000e+02		+1.900998e+03		4.972530e+00
+2.311000e+02		+1.150598e+03		4.971745e+00
+1.143800e+02		+5.686682e+02		4.971009e+00
-5.216000e+00		-2.598180e+01		4.972759e+00
-6.350000e+02		-3.155602e+03		4.972412e+00
-9.140000e+02		-4.543502e+03		4.972152e+00

Calculated Gain: 4.972134e+00 +/- 1.302582e-04
 13 of 17 data points used.

Gain: 10			1 outliers removed.	
Vin(mV)		Vout(mV)	Gcalc	
+1.073700e+03		+1.068070e+04		9.947561e+00
+9.463000e+02		+9.413496e+03		9.947687e+00
+7.454000e+02		+7.414996e+03		9.947674e+00
+6.542500e+02		+6.508096e+03		9.947415e+00
+5.709500e+02		+5.679496e+03		9.947449e+00
+4.839500e+02		+4.814096e+03		9.947507e+00
+4.009000e+02		+3.987796e+03		9.947109e+00
+3.106500e+02		+3.090096e+03		9.947195e+00
+2.301500e+02		+2.289296e+03		9.946974e+00
+1.045600e+01		+1.039560e+02		9.947474e+00
-1.124400e+02		-1.118494e+03		9.947390e+00
-2.384700e+02		-2.372154e+03		9.947982e+00
-3.228900e+02		-3.212104e+03		9.947750e+00
-4.248000e+02		-4.225804e+03		9.947745e+00
-5.185300e+02		-5.158204e+03		9.947847e+00
-6.518500e+02		-6.484504e+03		9.947494e+00

Calculated Gain: 9.947516e+00 +/- 6.726351e-05
 16 of 17 data points used.

End Card 5 report-----

Card Number 6 6a_unix.out
 Gains analyzed: 1, 0.5, 2, 5, 10
 Number of data points per gain: 20

Offsets:
 Gain 1 offset = +2.410e-02 mV
 Gain 0.5 offset = +3.270e-02 mV

Gain 2 offset = +9.000e-03 mV
 Gain 5 offset = -4.160e-02 mV
 Gain 10 offset = -1.207e-01 mV

Gain: 1 0 outliers removed.

Vin(mV)	Vout(mV)	Gcalc
+1.005830e+04	+9.996876e+03	9.938932e-01
+9.301500e+03	+9.244576e+03	9.938801e-01
+7.488000e+03	+7.442476e+03	9.939204e-01
+6.916500e+03	+6.874276e+03	9.938952e-01
+5.957800e+03	+5.921576e+03	9.939199e-01
+4.905000e+03	+4.874976e+03	9.938789e-01
+3.840500e+03	+3.816876e+03	9.938487e-01
+2.852000e+03	+2.834876e+03	9.939958e-01
+1.445000e+03	+1.436276e+03	9.939626e-01
+4.440000e+02	+4.412859e+02	9.938872e-01
+2.758500e+02	+2.741759e+02	9.939311e-01
-3.420000e+02	-3.398741e+02	9.937839e-01
-6.531900e+02	-6.491941e+02	9.938825e-01
-1.437300e+03	-1.428624e+03	9.939638e-01
-2.461700e+03	-2.446624e+03	9.938758e-01
-3.551300e+03	-3.529724e+03	9.939245e-01
-5.057500e+03	-5.027024e+03	9.939741e-01
-6.835000e+03	-6.792924e+03	9.938441e-01
-8.023000e+03	-7.973224e+03	9.937958e-01
-9.500000e+03	-9.442424e+03	9.939394e-01

Calculated Gain: 9.938998e-01 +/- 1.242072e-05
 20 of 20 data points used.

Gain: 0.5 2 outliers removed.

Vin(mV)	Vout(mV)	Gcalc
+1.018610e+04	+5.069667e+03	4.969341e-01
+9.387900e+03	+4.665167e+03	4.969447e-01
+8.193200e+03	+4.071567e+03	4.969436e-01
+7.306800e+03	+3.631067e+03	4.969432e-01
+6.422600e+03	+3.191667e+03	4.969577e-01
+4.928000e+03	+2.449007e+03	4.969355e-01
+3.352200e+03	+1.665827e+03	4.969295e-01
+2.524900e+03	+1.254697e+03	4.969152e-01
+1.295950e+03	+6.439773e+02	4.969166e-01
+3.787000e+02	+1.881823e+02	4.968932e-01
+1.779000e+02	+8.839730e+01	4.969191e-01
-2.682000e+02	-1.332737e+02	4.969421e-01

-5.426200e+02		-2.696507e+02		4.968684e-01
-8.262000e+02		-4.105127e+02		4.968786e-01
-1.255000e+03		-6.235827e+02		4.969413e-01
-2.660400e+03		-1.322063e+03		4.969213e-01
-3.955400e+03		-1.965523e+03		4.969091e-01
-6.081500e+03		-3.021953e+03		4.969550e-01

Calculated Gain: 4.969249e-01 +/- 5.892843e-06
18 of 20 data points used.

Gain: 2		0 outliers removed.	
Vin(mV)		Vout(mV)	Gcalc
+5.074400e+03		+1.008849e+04	1.988115e+00
+4.169800e+03		+8.290091e+03	1.988127e+00
+3.072800e+03		+6.108891e+03	1.988054e+00
+2.322100e+03		+4.616591e+03	1.988110e+00
+1.574270e+03		+3.130091e+03	1.988281e+00
+6.497400e+02		+1.291721e+03	1.988058e+00
+5.163000e+02		+1.026361e+03	1.987916e+00
+4.251500e+02		+8.452410e+02	1.988101e+00
+2.617000e+02		+5.202910e+02	1.988120e+00
+1.248400e+02		+2.481970e+02	1.988121e+00
+1.676000e+01		+3.332400e+01	1.988305e+00
-1.029400e+02		-2.046490e+02	1.988042e+00
-1.779000e+02		-3.536790e+02	1.988078e+00
-2.539100e+02		-5.047890e+02	1.988063e+00
-4.065100e+02		-8.081690e+02	1.988067e+00
-6.384900e+02		-1.269389e+03	1.988111e+00
-1.482500e+03		-2.947349e+03	1.988094e+00
-2.803600e+03		-5.574009e+03	1.988161e+00
-4.087700e+03		-8.126809e+03	1.988113e+00
-4.930000e+03		-9.801809e+03	1.988197e+00

Calculated Gain: 1.988112e+00 +/- 1.861976e-05
20 of 20 data points used.

Gain: 5		2 outliers removed.	
Vin(mV)		Vout(mV)	Gcalc
+1.999000e+03		+9.959242e+03	4.982112e+00
+1.632100e+03		+8.131342e+03	4.982134e+00
+1.488600e+03		+7.416042e+03	4.981890e+00
+1.259200e+03		+6.273542e+03	4.982165e+00
+1.086750e+03		+5.414242e+03	4.982049e+00
+8.950000e+02		+4.459242e+03	4.982393e+00

+7.749000e+02		+3.860742e+03		4.982245e+00
+5.727400e+02		+2.853422e+03		4.982054e+00
+3.921700e+02		+1.953852e+03		4.982155e+00
+1.083000e+02		+5.395816e+02		4.982286e+00
-1.858300e+02		-9.257784e+02		4.981857e+00
-4.174000e+02		-2.079518e+03		4.982076e+00
-6.423200e+02		-3.200158e+03		4.982187e+00
-8.337500e+02		-4.157358e+03		4.981968e+00
-1.056000e+03		-5.260958e+03		4.982199e+00
-1.190450e+03		-5.931058e+03		4.982131e+00
-1.233500e+03		-6.145458e+03		4.982257e+00
-1.393950e+03		-6.943758e+03		4.982113e+00

Calculated Gain: 4.982126e+00 +/- 3.166186e-05
 18 of 20 data points used.

Gain: 10		0 outliers removed.		
Vin(mV)	Vout(mV)	Gcalc		
+9.978000e+02		+9.921421e+03		9.943296e+00
+9.374000e+02		+9.320821e+03		9.943269e+00
+8.311000e+02		+8.263221e+03		9.942511e+00
+7.449500e+02		+7.406421e+03		9.942172e+00
+6.531000e+02		+6.493421e+03		9.942460e+00
+5.597200e+02		+5.565221e+03		9.942866e+00
+4.565200e+02		+4.539021e+03		9.942655e+00
+3.695400e+02		+3.674121e+03		9.942417e+00
+2.973200e+02		+2.956081e+03		9.942421e+00
+1.751100e+02		+1.741021e+03		9.942440e+00
+2.654000e+01		+2.638907e+02		9.943131e+00
-9.869900e+01		-9.812293e+02		9.941634e+00
-1.724550e+02		-1.714519e+03		9.941836e+00
-2.905200e+02		-2.888429e+03		9.942274e+00
-4.444700e+02		-4.419279e+03		9.942807e+00
-5.543700e+02		-5.511679e+03		9.942239e+00
-7.300000e+02		-7.258579e+03		9.943259e+00
-8.160500e+02		-8.113379e+03		9.942258e+00
-8.905000e+02		-8.853879e+03		9.942593e+00
-9.666000e+02		-9.610279e+03		9.942354e+00

Calculated Gain: 9.942545e+00 +/- 1.018021e-04
 20 of 20 data points used.

End Card 6 report-----

Card Number 6 6b_unix.out
Gains analyzed: 1
Number of data points per gain: 19

Offsets:

Gain 1 offset = +2.410e-02 mV

Gain: 1		1 outliers removed.
Vin(mV)	Vout(mV)	Gcalc
+1.009940e+04	+1.003768e+04	9.938883e-01
+9.014300e+03	+8.959376e+03	9.939070e-01
+8.311200e+03	+8.260576e+03	9.939089e-01
+6.906900e+03	+6.864676e+03	9.938867e-01
+6.081700e+03	+6.044576e+03	9.938958e-01
+5.118500e+03	+5.087176e+03	9.938802e-01
+4.021200e+03	+3.996576e+03	9.938764e-01
+3.174500e+03	+3.155176e+03	9.939127e-01
+2.137800e+03	+2.124726e+03	9.938843e-01
+1.042300e+03	+1.035826e+03	9.937886e-01
-4.677000e+02	-4.648041e+02	9.938082e-01
-1.475100e+03	-1.466034e+03	9.938540e-01
-2.564300e+03	-2.548584e+03	9.938713e-01
-3.384100e+03	-3.363424e+03	9.938903e-01
-5.502000e+03	-5.468524e+03	9.939157e-01
-6.847000e+03	-6.805224e+03	9.938987e-01
-7.793500e+03	-7.746324e+03	9.939468e-01
-8.540400e+03	-8.488224e+03	9.938907e-01

Calculated Gain: 9.938836e-01 +/- 8.734908e-06
18 of 19 data points used.

End Card 6 report-----

Card Number 7 7_unix.out
Gains analyzed: 1, 0.5, 2, 5, 10
Number of data points per gain: 20

Offsets:

Gain 1 offset = +1.280e-02 mV
Gain 0.5 offset = +2.850e-02 mV
Gain 2 offset = -1.850e-02 mV
Gain 5 offset = -1.069e-01 mV
Gain 10 offset = -2.520e-01 mV

Gain: 1 2 outliers removed.

Vin(mV)	Vout(mV)	Gcalc
+9.987600e+03	+9.966187e+03	9.978561e-01
+9.094200e+03	+9.074787e+03	9.978654e-01
+9.320100e+03	+8.302287e+03	9.978817e-01
+6.898300e+03	+6.883687e+03	9.978834e-01
+6.148000e+03	+6.134987e+03	9.978659e-01
+4.973000e+03	+4.962387e+03	9.978563e-01
+4.064300e+03	+4.055587e+03	9.978349e-01
+2.971200e+03	+2.964767e+03	9.978511e-01
+2.086050e+03	+2.081567e+03	9.978608e-01
+9.970000e+02	+9.948672e+02	9.978631e-01
-6.070500e+02	-6.057528e+02	9.978105e-01
-1.437400e+03	-1.434253e+03	9.978527e-01
-2.462300e+03	-2.457013e+03	9.979090e-01
-3.485000e+03	-3.477713e+03	9.978803e-01
-4.711700e+03	-4.701713e+03	9.978438e-01
-5.559500e+03	-5.547513e+03	9.978506e-01
-6.507400e+03	-6.493413e+03	9.978997e-01
-7.469200e+03	-7.453513e+03	9.978696e-01

Calculated Gain: 9.978630e-01 +/- 5.423506e-06
 18 of 20 data points used.

Gain: 0.5 3 outliers removed.

Vin(mV)	Vout(mV)	Gcalc
+1.062790e+04	+5.273371e+03	4.981808e-01
+9.058300e+03	+4.512671e+03	4.981705e-01
+8.105000e+03	+4.037671e+03	4.981726e-01
+7.102300e+03	+3.538171e+03	4.981554e-01
+5.740300e+03	+2.859562e+03	4.981615e-01
+4.644400e+03	+2.313662e+03	4.981607e-01
+3.620100e+03	+1.803392e+03	4.981523e-01
+2.802600e+03	+1.396122e+03	4.981653e-01
+1.710600e+03	+8.521615e+02	4.981675e-01
+8.068000e+02	+4.019215e+02	4.981570e-01
-1.232480e+03	-6.139685e+02	4.981657e-01
-2.263300e+03	-1.127498e+03	4.981638e-01
-3.280600e+03	-1.693422e+04	4.981481e-01
-4.439400e+03	-2.211548e+03	4.981880e-01
-5.195600e+03	-2.588178e+03	4.981788e-01
-6.192900e+03	-3.085228e+03	4.981782e-01
-7.397200e+03	-3.685128e+03	4.981792e-01

Calculated Gain: $4.981674e-01 \pm 2.697842e-06$
17 of 20 data points used.

Gain: 2 1 outliers removed.

Vin(mV)	Vout(mV)	Gcalc
+4.931100e+03	+9.829519e+03	1.993372e+00
+4.533100e+03	+9.036219e+03	1.993386e+00
+4.056900e+03	+8.086918e+03	1.993374e+00
+3.507600e+03	+6.992019e+03	1.993391e+00
+3.029000e+03	+6.037819e+03	1.993337e+00
+2.484270e+03	+4.952119e+03	1.993390e+00
+2.006200e+03	+3.999119e+03	1.993380e+00
+1.491100e+03	+2.972159e+03	1.993266e+00
+1.012800e+03	+2.019568e+03	1.993380e+00
+5.017600e+02	+1.000198e+03	1.993319e+00
-2.362700e+02	-4.709615e+02	1.993329e+00
-6.548300e+02	-1.305292e+03	1.993229e+00
-1.274400e+03	-2.540171e+03	1.993406e+00
-1.762100e+03	-3.512581e+03	1.993427e+00
-2.300200e+03	-4.585282e+03	1.993402e+00
-2.776400e+03	-5.534481e+03	1.993277e+00
-3.290100e+03	-6.558082e+03	1.993349e+00
-3.686200e+03	-7.347881e+03	1.993345e+00
-4.300300e+03	-8.571981e+03	1.993375e+00

Calculated Gain: $1.993354e+00 \pm 1.185985e-05$
19 of 20 data points used.

Gain: 5 2 outliers removed.

Vin(mV)	Vout(mV)	Gcalc
+2.246200e+03	+1.121151e+04	4.991322e+00
+1.999100e+03	+9.978207e+03	4.991350e+00
+1.740900e+03	+8.689607e+03	4.991445e+00
+1.507500e+03	+7.524707e+03	4.991514e+00
+1.245200e+03	+6.215807e+03	4.991814e+00
+1.000700e+03	+4.994907e+03	4.991413e+00
+5.701000e+02	+2.845737e+03	4.991645e+00
+3.206600e+02	+1.600577e+03	4.991508e+00
+1.044010e+02	+5.210969e+02	4.991302e+00
-2.170500e+02	-1.083343e+03	4.991214e+00
-4.994000e+02	-2.493293e+03	4.992051e+00
-6.550000e+02	-3.269793e+03	4.991453e+00
-8.970000e+02	-4.475993e+03	4.991348e+00
-1.194200e+03	-5.960793e+03	4.991442e+00

-1.445600e+03		-7.215493e+03		4.990905e+00
-1.601700e+03		-7.994793e+03		4.991558e+00
-1.650100e+03		-8.235493e+03		4.991548e+00
-1.801400e+03		-8.991793e+03		4.991703e+00

Calculated Gain: 4.991474e+00 +/- 5.790309e-05
 18 of 20 data points used.

Gain: 10			1 outliers removed.	
Vin(mV)		Vout(mV)	Gcalc	
+9.928000e+02		+9.921652e+03		9.993606e+00
+8.015000e+02		+8.009452e+03		9.993078e+00
+7.003500e+02		+6.998752e+03		9.993221e+00
+6.006200e+02		+6.001852e+03		9.992761e+00
+5.009600e+02		+5.006052e+03		9.992918e+00
+4.001800e+02		+3.998952e+03		9.992883e+00
+3.003570e+02		+3.001232e+03		9.992216e+00
+2.000200e+02		+1.998572e+03		9.991861e+00
+1.006190e+02		+1.005482e+03		9.992964e+00
+1.601800e+01		+1.600310e+02		9.990698e+00
-4.875900e+01		-4.871880e+02		9.991755e+00
-1.251550e+02		-1.250508e+03		9.991674e+00
-2.312400e+02		-2.310548e+03		9.991991e+00
-3.255100e+02		+3.253152e+03		9.992457e+00
-4.311300e+02		-4.308048e+03		9.992134e+00
-5.278700e+02		-5.274548e+03		9.992550e+00
-6.378200e+02		-6.373448e+03		9.993362e+00
-7.309000e+02		-7.304148e+03		9.993801e+00
-8.311000e+02		-8.305848e+03		9.992583e+00

Calculated Gain: 9.992553e+00 +/- 1.747038e-04
 19 of 20 data points used.

End Card 7 report-----

Card Number 8 8_unix.out
 Gains analyzed: 1, 0.5, 2, 5, 10
 Number of data points per gain: 20

Offsets:
 Gain 1 offset = +1.050e-02 mV
 Gain 0.5 offset = +8.600e-03 mV
 Gain 2 offset = +1.420e-02 mV
 Gain 5 offset = +2.510e-02 mV

Gain 10 offset = +3.910e-02 mV

Gain: 1 1 outliers removed.

Vin(mV)	Vout(mV)	Gcalc
+1.008240e+04	+1.001079e+04	9.928975e-01
+9.070600e+03	+9.006090e+03	9.928880e-01
+8.113500e+03	+8.055889e+03	9.928994e-01
+7.088900e+03	+7.038590e+03	9.929029e-01
+6.034600e+03	+5.991689e+03	9.928893e-01
+5.075300e+03	+5.039189e+03	9.928851e-01
+4.096500e+03	+4.067390e+03	9.928938e-01
+3.068000e+03	+3.046090e+03	9.928584e-01
+2.048700e+03	+2.034049e+03	9.928489e-01
+1.018220e+03	+1.010980e+03	9.928891e-01
-5.035500e+02	-4.999505e+02	9.928518e-01
-1.495190e+03	-1.484551e+03	9.928842e-01
-2.500120e+03	-2.482271e+03	9.928605e-01
-3.523400e+03	-3.498311e+03	9.928792e-01
-4.505100e+03	-4.473011e+03	9.928771e-01
-5.496900e+03	-5.457910e+03	9.929070e-01
-6.526000e+03	-6.479611e+03	9.928916e-01
-7.512200e+03	-7.458711e+03	9.928796e-01
-8.506100e+03	-8.445711e+03	9.929004e-01

Calculated Gain: 9.928833e-01 +/- 3.960035e-06
19 of 20 data points used.

Gain: 0.5 2 outliers removed.

Vin(mV)	Vout(mV)	Gcalc
+9.986100e+03	+4.961991e+03	4.968898e-01
+9.031500e+03	+4.490691e+03	4.968806e-01
+8.081200e+03	+4.015391e+03	4.968989e-01
+7.000400e+03	+3.478491e+03	4.968649e-01
+6.028000e+03	+2.995101e+03	4.968901e-01
+5.012500e+03	+2.490661e+03	4.968317e-01
+4.030100e+03	+2.002281e+03	4.968892e-01
+3.006810e+03	+1.494051e+03	4.968829e-01
+2.043100e+03	+1.015181e+03	4.968722e-01
+1.011450e+03	+5.025614e+02	4.968908e-01
-5.112000e+02	-2.540106e+02	4.968537e-01
-1.543550e+03	-7.669186e+02	4.968775e-01
-2.495280e+03	-1.239849e+03	4.968652e-01
-3.506300e+03	-1.742159e+03	4.968677e-01
-4.495500e+03	-2.233669e+03	4.968664e-01

-5.502100e+03		-2.733809e+03		4.968954e-01
-6.503800e+03		-3.231709e+03		4.969069e-01
-7.497800e+03		-3.725709e+03		4.969039e-01

Calculated Gain: 4.968793e-01 +/- 4.488931e-06
 18 of 20 data points used.

Gain: 2 0 outliers removed.

Vin(mV)	Vout(mV)	Gcalc		
+4.964500e+03		+9.863686e+03		1.986844e+00
+4.520400e+03		+8.980486e+03		1.986657e+00
+4.027600e+03		+8.001186e+03		1.986589e+00
+3.511300e+03		+6.975386e+03		1.986554e+00
+3.005400e+03		+5.970686e+03		1.986653e+00
+2.508950e+03		+4.984886e+03		1.986841e+00
+2.017200e+03		+4.007886e+03		1.986856e+00
+1.512570e+03		+3.005166e+03		1.986795e+00
+1.035600e+03		+2.057556e+03		1.986825e+00
+5.065300e+02		+1.006366e+03		1.986784e+00
-3.052800e+02		-6.065142e+02		1.986747e+00
-6.541000e+02		-1.299524e+03		1.986736e+00
-1.224700e+03		-2.433144e+03		1.986727e+00
-1.700600e+03		-3.378914e+03		1.986895e+00
-2.192200e+03		-4.355614e+03		1.986869e+00
-2.733400e+03		-5.430914e+03		1.986871e+00
-3.277200e+03		-6.511114e+03		1.986792e+00
-3.730200e+03		-7.411014e+03		1.986761e+00
-4.284400e+03		-8.511614e+03		1.986653e+00
-4.756500e+03		-9.450314e+03		1.986821e+00

Calculated Gain: 1.986763e+00 +/- 2.195712e-05
 20 of 20 data points used.

Gain: 5 2 outliers removed.

Vin(mV)	Vout(mV)	Gcalc		
+1.996460e+03		+9.932075e+03		4.974843e+00
+1.748800e+03		+9.700075e+03		4.974868e+00
+1.501100e+03		+7.467775e+03		4.974893e+00
+1.253650e+03		+6.236775e+03		4.974872e+00
+1.009850e+03		+5.023875e+03		4.974862e+00
+8.364000e+02		+4.160975e+03		4.974915e+00
+6.368500e+02		+3.168275e+03		4.974802e+00
+4.446800e+02		+2.212195e+03		4.974845e+00
+2.210350e+02		+1.099615e+03		4.974857e+00

+1.179300e+02		+5.866849e+02		4.974613e+00
-1.701080e+02		-8.461851e+02		4.974676e+00
-3.968600e+02		-1.974225e+03		4.975106e+00
-5.119600e+02		-2.546835e+03		4.974997e+00
-6.537600e+02		-3.252525e+03		4.974958e+00
-9.088900e+02		-4.521725e+03		4.974733e+00
-1.137100e+03		-5.657025e+03		4.975027e+00
-1.309000e+03		-6.511925e+03		4.974900e+00
-1.614750e+03		-8.033425e+03		4.974827e+00

Calculated Gain: 4.974866e+00 +/- 2.788107e-05
 18 of 20 data points used.

Gain: 10			0 outliers removed.	
	Vin(mV)	Vout(mV)	Gcalc	
+9.576000e+02		+9.508161e+03		9.929157e+00
+8.531100e+02		+8.471261e+03		9.929858e+00
+7.648500e+02		+7.594761e+03		9.929739e+00
+6.531100e+02		+6.484961e+03		9.929355e+00
+5.463000e+02		+5.424461e+03		9.929454e+00
+4.509600e+02		+4.477861e+03		9.929619e+00
+3.532800e+02		+3.507861e+03		9.929407e+00
+2.541700e+02		+2.523681e+03		9.929106e+00
+1.525540e+02		+1.514741e+03		9.929211e+00
+5.459200e+01		+5.420909e+02		9.929860e+00
-1.041140e+02		-1.033699e+03		9.928531e+00
-2.020550e+02		-2.006119e+03		9.928579e+00
-3.018500e+02		-2.996989e+03		9.928736e+00
-4.077100e+02		-4.048339e+03		9.929457e+00
-5.023100e+02		-4.987639e+03		9.929404e+00
-6.068100e+02		-6.025239e+03		9.929367e+00
-7.049000e+02		-6.999139e+03		9.929265e+00
-8.035000e+02		-7.978239e+03		9.929358e+00
-9.017500e+02		-8.953839e+03		9.929403e+00
-1.006740e+03		-9.996339e+03		9.929415e+00

Calculated Gain: 9.929314e+00 +/- 8.135748e-05
 20 of 20 data points used.

End Card 8 report-----

Card Number 9 9_unix.out
 Gains analyzed: 1, 0.5, 2, 5, 10
 Number of data points per gain: 20

Offsets:

Gain 1 offset = -3.700e-03 mV
Gain 0.5 offset = -5.200e-03 mV
Gain 2 offset = -4.000e-03 mV
Gain 5 offset = +9.600e-03 mV
Gain 10 offset = +1.220e-02 mV

Gain: 1 4 outliers removed.

Vin(mV)	Vout(mV)	Gcalc
+1.001390e+04	+9.968804e+03	9.954966e-01
+9.048000e+03	+9.007304e+03	9.955022e-01
+8.021000e+03	+7.985104e+03	9.955247e-01
+7.124500e+03	+7.092504e+03	9.955090e-01
+6.035000e+03	+6.007904e+03	9.955101e-01
+5.009400e+03	+4.986804e+03	9.954892e-01
+4.052800e+03	+4.034704e+03	9.955349e-01
+3.007000e+03	+2.993544e+03	9.955250e-01
+2.053750e+03	+2.044524e+03	9.955076e-01
+1.101000e+03	+1.096234e+03	9.954600e-01
-5.103900e+02	-5.080563e+02	9.955089e-01
-1.474370e+03	-1.467676e+03	9.955222e-01
-2.683900e+03	-2.671846e+03	9.955134e-01
-3.574000e+03	-3.557996e+03	9.955250e-01
-4.592300e+03	-4.571696e+03	9.954944e-01
-5.498000e+03	-5.473396e+03	9.955178e-01

Calculated Gain: 9.955088e-01 +/- 4.523275e-06
16 of 20 data points used.

Gain: 0.5 2 outliers removed.

Vin(mV)	Vout(mV)	Gcalc
+1.006580e+04	+5.007105e+03	4.974374e-01
+9.081000e+03	+4.516905e+03	4.974017e-01
+8.016500e+03	+3.987605e+03	4.974247e-01
+7.063800e+03	+3.513805e+03	4.974384e-01
+6.179500e+03	+3.073905e+03	4.974359e-01
+5.013600e+03	+2.493815e+03	4.974101e-01
+4.191700e+03	+2.084995e+03	4.974104e-01
+3.088700e+03	+1.536395e+03	4.974245e-01
+2.066950e+03	+1.028145e+03	4.974214e-01
+1.014280e+03	+5.045252e+02	4.974220e-01
-4.509600e+02	-2.242828e+02	4.973825e-01
-1.461400e+03	-7.268748e+02	4.974170e-01

-2.547550e+03		-1.267195e+03		4.973961e-01
-3.469900e+03		-1.725915e+03		4.974049e-01
-4.529700e+03		-2.253095e+03		4.974172e-01
-5.457300e+03		-2.714555e+03		4.974240e-01
-6.620900e+03		-3.293395e+03		4.974322e-01
-7.596000e+03		-3.778495e+03		4.974245e-01

Calculated Gain: 4.974181e-01 +/- 3.526079e-06
 18 of 20 data points used.

Gain:	2	0 outliers removed.		
	Vin(mV)	Vout(mV)	Gcalc	
+5.000500e+03		+9.964904e+03		1.992782e+00
+4.556200e+03		+9.079204e+03		1.992714e+00
+4.016900e+03		+8.004704e+03		1.992757e+00
+3.510300e+03		+6.995104e+03		1.992737e+00
+3.026200e+03		+6.030604e+03		1.992798e+00
+2.514700e+03		+5.011104e+03		1.992724e+00
+2.054500e+03		+4.094004e+03		1.992701e+00
+1.502200e+03		+2.993474e+03		1.992727e+00
+1.065850e+03		+2.123964e+03		1.992742e+00
+5.121000e+02		+1.020474e+03		1.992724e+00
-3.203500e+02		-6.383460e+02		1.992652e+00
-7.136200e+02		-1.422026e+03		1.992694e+00
-1.275600e+03		-2.541936e+03		1.992738e+00
-1.686200e+03		-3.360196e+03		1.992762e+00
-2.305400e+03		-4.594196e+03		1.992798e+00
-2.735920e+03		-5.452096e+03		1.992783e+00
-3.293900e+03		-6.563796e+03		1.992713e+00
-3.770100e+03		-7.512896e+03		1.992758e+00
-4.271500e+03		-8.511896e+03		1.992718e+00
-4.692900e+03		-9.351696e+03		1.992733e+00

Calculated Gain: 1.992738e+00 +/- 8.167332e-06
 20 of 20 data points used.

Gain:	5	0 outliers removed.		
	Vin(mV)	Vout(mV)	Gcalc	
+1.927620e+03		+9.589190e+03		4.974627e+00
+1.703320e+03		+8.473490e+03		4.974691e+00
+1.493450e+03		+7.429390e+03		4.974650e+00
+1.302550e+03		+6.479790e+03		4.974696e+00
+1.108820e+03		+5.515890e+03		4.974559e+00
+9.023100e+02		+4.488690e+03		4.974665e+00

+6.533900e+02		+3.250490e+03		4.974809e+00
+5.001400e+02		+2.487980e+03		4.974568e+00
+3.001400e+02		+1.493070e+03		4.974580e+00
+1.000430e+02		+4.976904e+02		4.974765e+00
-2.001800e+02		-9.957696e+02		4.974371e+00
-4.000500e+02		-1.990000e+03		4.974377e+00
-6.002000e+02		-2.985690e+03		4.974491e+00
-8.005500e+02		-3.982410e+03		4.974592e+00
-1.002600e+03		-4.987810e+03		4.974875e+00
-1.196980e+03		-5.954610e+03		4.974694e+00
-1.400000e+03		-6.964210e+03		4.974435e+00
-1.600520e+03		-7.961910e+03		4.974577e+00
-1.799860e+03		-8.953710e+03		4.974670e+00
-1.999600e+03		-9.947110e+03		4.974550e+00

Calculated Gain: 4.974612e+00 +/- 2.944530e-05
 20 of 20 data points used.

Gain: 10			1 outliers removed.	
Vin(mV)		Vout(mV)	Gcalc	
+9.522000e+02		+9.480788e+03		9.956719e+00
+8.503000e+02		+8.466388e+03		9.956942e+00
+7.525500e+02		+7.493188e+03		9.957063e+00
+6.502500e+02		+6.474688e+03		9.957228e+00
+5.500200e+02		+5.476688e+03		9.957252e+00
+4.500500e+02		+4.481488e+03		9.957755e+00
+3.500000e+02		+3.483988e+03		9.956898e+00
+2.501580e+02		+2.490798e+03		9.957127e+00
+1.500290e+02		+1.493858e+03		9.958068e+00
+5.013300e+01		+4.992278e+02		9.956345e+00
-1.002820e+02		-9.984422e+02		9.956370e+00
-2.000400e+02		-1.991672e+03		9.956685e+00
-3.007700e+02		-2.994672e+03		9.957791e+00
-4.001000e+02		-3.984112e+03		9.957072e+00
-5.005600e+02		-4.984112e+03		9.957213e+00
-6.003700e+02		-5.978012e+03		9.957490e+00
-7.007200e+02		-6.977412e+03		9.957102e+00
-8.016100e+02		-7.981712e+03		9.957387e+00
-9.032000e+02		-8.993512e+03		9.957077e+00

Calculated Gain: 9.957136e+00 +/- 1.025225e-04
 19 of 20 data points used.

End Card 9 report-----

