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Acceptance Testing of the Prototype Electrometer for the SAMPIE Flight Experiment

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ACCEPTANCE TESTING OF THE PROTOTYPE ELECTROMETER FOR THE SAMPIE FLIGHT EXPERIMENT

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SUMMARY

The Solar Array Module Plasma Interaction Experiment (SAMPIE) has two key instruments at the heart of its data acquisition capability. One of these, the electrometer, is designed to measure both ion and electron current from most of the samples included in the experiment. The accuracy requirement, specified by the project's Principal Investigator, is for agreement within 10% with a calibrated laboratory instrument. Plasma chamber testing was performed to assess the capabilities of the prototype design. Agreement was determined to be within 2% for electron collection and within 3% for ion collection.

INTRODUCTION

The Solar Array Module Plasma Interactions Experiment (SAMPIE)[1,2] is an approved NASA flight experiment manifested for shuttle launch in early 1994. The SAMPIE experiment is designed to investigate the interaction of high voltage space power systems with ionospheric plasma. To study the behavior of solar cells, a number of solar cell coupons (representing design technologies of current interest) will be biased to high voltages to measure both arcing and current collection. Additionally, SAMPIE will include experiments to study the basic nature of arcing and current collection.

The measurement of plasma current collection is especially important in view of the fact that the ground potential of large space structures with respect to the ionosphere can differ significantly from that of the plasma. This occurs as a result of current balance. Because of their large mass and low mobility, ions collected by negatively biased surfaces result in a relatively small plasma current density. The lightweight electrons, on the other hand, are readily collected by positively biased surfaces. Ram and wake effects further complicate the picture. Ram ion energy is considerably higher than ambient thermal energy so ion collection is enhanced on ram facing surfaces relative to surfaces which are oblique to plasma flow. The spacecraft will reach equilibrium at whatever potential results in a net collected current of zero. The worst situations occur when the spacecraft power system uses a negative ground. In such a configuration, large surfaces are negative and must collect slow moving ions to balance the current from electron collection which now occurs only from relatively small areas of positive surface. In the worst case, parts of the spacecraft will be biased with respect to the ionosphere to a level very near the maximum voltage used on the solar arrays.

SAMPIE is managed by the Space Experiments Division of NASA's Lewis Research Center[3] with development and fabrication performed by Sverdrup Technology under contract to NASA.

The key instrument in the current collection measurements is the electrometer. The task of the electrical engineering team was to provide capabilities normally found in a large, heavy laboratory instrument on a single circuit card. The design details of the instrument will be reported in the future[4]. Here we discuss the direct comparison of SAMPIE's prototype electrometer with a state of the art laboratory instrument, the Keithley model 237. The acceptance criterion was agreement within 10% over the bias range specified for SAMPIE, -600V to +300V.

TEST FACILITY AND PROCEDURES

Testing was done in the Plasma Interaction Facility (PIF) at the Lewis Research Center. The plasma chamber used was a Tenney Corporation space simulation chamber offering a cylindrical volume six feet in diameter by six feet long. A thirty six inch diffusion pump provides an initial pumpdown to approximately 5×10^{-7} torr. Plasma is generated by a tungsten filament source with a continuous flow of Argon. Pressure in the tank during operation of the plasma source was approximately 5×10^{-5} torr.

The necessary test is conceptually quite simple. The electrometer to be tested applies a bias voltage to a 3/4" spherical Langmuir probe and measures the resulting collected current. The measurements were made from -600 volts to +300 volts in 25 volt increments. A total of ten complete data sets were taken from each instrument. Data sets were taken alternately from each instrument to help minimize any effects of changing experimental conditions. Alternating the instruments and averaging ten sets of data willl smooth random fluctuations. Additional precautions are necessary to account for systematic drifts in plasma density caused by conditions in the plasma source. Filament sources generally degrade as the tungsten evaporates and the resistance slowly increases. The result is a slow increase in filament temperature and a resulting increase in measured plasma density. To account for this, the experimental procedure used two separate Langmuir probes, designated as the data probe and the monitor probe. These probes were located about three feet apart and were positioned so that each was about four feet from the plasma source. Figure 1 shows a schematic representation of the experimental layout.

The prototype electrometer was controlled by a laboratory PC while the Keithley was operated from its front panel controls. A data run began by recording the current measured by the monitor probe. A voltage is programmed into the electrometer which returns the measured current. Every five data points, the monitor probe is read.

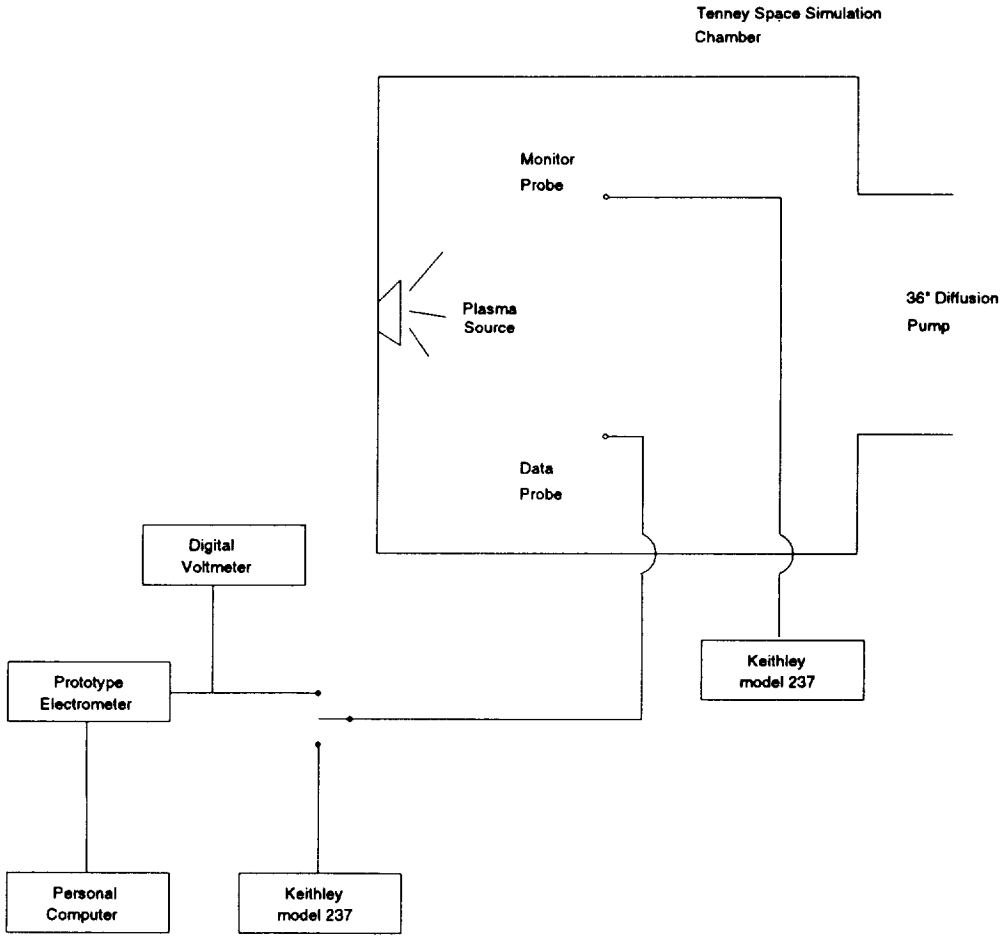

Figure 1 - Block diagram of the Test Facility and layout

A complication exists in the design of the prototype. The desired test procedure used voltages in 25 volt increments beginning at -600V. While the Keithley has no problem with this, the prototype uses an 8-bit analog to digital conversion which divides the voltage range into 256 equal parts. As a result, the voltages available differ from the desired input by as much as a 1.5 volt. The resulting voltage impressed on the probe by the prototype board was measured with a digital voltmeter. When taking data with the Keithley, the actual voltages provided by the prototype were programmed in. Table I shows these voltages.

Table I - Nominal vs. Actual bias voltages

Volts nominal	Volts Actual	Volts nominal	Volts Actual	Volts nominal	Volts Actual
-600	-600.99	-300	-298.69	25	24.35
-575	-573.45	-275	-273.97	50	49.14
-550	-548.73	-250	-249.20	75	73.80
-525	-524.01	-225	-224.45	100	98.35
-500	-499.26	-200	-199.80	125	125.67
-475	-474.57	-175	-175.08	150	150.27
-450	-449.85	-150	-150.35	175	175.14
-425	-425.09	-125	-125.72	200	199.75
-400	-400.40	-100	-98.51	225	224.50
-375	-375.67	-75	-73.84	250	249.23
-350	-350.98	-50	-49.04	275	274.00
-325	-323.42	-25	-24.30	300	298.72

The correction for source drift was applied by normalizing all collection current values to a monitor probe value of 1 milliamp. An example of a data set for the prototype, shown in table II, illustrates the procedure.

Table II - Data Set P01

Volts Nominal	P01 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	P01 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	P01 Raw mA	Monitor Probe mA	Drift Corrected mA
-600	11.20	***0.715***	15.66	-300	5.87	***0.722***	8.13	25	0.09	***0.729***	0.12
-575	10.60	0.715	14.83	-275	5.47	0.725	7.54	50	0.19	0.729	0.26
-550	10.30	0.715	14.41	-250	4.96	0.728	6.81	75	0.30	0.730	0.42
-525	9.56	0.715	13.37	-225	4.55	0.731	6.22	100	0.39	***0.730***	0.53
-500	9.15	***0.715***	12.80	-200	4.28	***0.735***	5.82	125	0.48	0.731	0.66
-475	8.80	0.715	12.31	-175	3.80	0.733	5.18	150	0.57	0.731	0.78
-450	8.56	0.716	11.96	-150	3.28	0.731	4.49	175	0.66	0.732	0.90
-425	7.93	0.716	11.08	-125	2.76	0.729	3.79	200	0.73	***0.733***	1.00
-400	7.55	***0.716***	10.54	-100	2.21	***0.728***	3.04	225	0.83	0.733	1.13
-375	7.04	0.717	9.82	-75	1.70	0.728	2.34	250	0.89	0.734	1.21
-350	6.72	0.719	9.35	-50	1.18	0.728	1.62	275	0.99	0.735	1.34
-325	6.13	0.721	8.50	-25	0.09	0.728	0.62	300	1.05	***0.735***	1.43

The values bold italics in the monitor probe column are measured values, the others are interpolated. The correction to the data was made by multiplying the raw data by the inverse of the

monitor probe value, normalizing each point to a monitor value of 1 milliamp. Plasma conditions corresponding to a monitor probe current of 1 milliamp are shown in table III. The procedure effectively normalizes all data to the plasma density indicated.

Table III - Plasma Parameters

Electron Density	$2.6 \times 10^5 / cm^3$
Electron Temp	1.72 eV
Ion Temp	.193 eV
Plasma Potential	4.08 eV

It should be noted that no data was taken for an applied bias of zero volts. This point is unstable for two reasons. First, it lies within the plasma potential, that is, an applied bias of zero means the probe is at earth ground which is different from plasma ground. The probe will therefore be slightly negative with respect to plasma and will tend to collect ions. Second, even though the mean electron temperature is approximately 2 eV, the tail of the maxwellian energy distribution contains a significant number of electrons with sufficient thermal energy to overcome the small bias the probe has with respect to plasma. Electrons which happen to be moving in the right direction will therefore impact the probe and contribute to the current. The interplay of these two currents and the associated electron and ion sheaths appeared to be very unstable. This was checked by setting the Keithley to zero volts and programming the instrument to repeatedly measure and report the current in an infinite loop. The observed result was a reading that fluctuated wildly and apparently randomly. Since this data point is of little interest in any anticipated application of the instrument, it was omitted.

RESULTS

A total of ten complete data sets were taken. Mean, standard deviation, and standard error were then calculated. Table IV presents a summary of the data from the prototype. Table V gives the same information for the Keithley 237. Table VI shows the mean and standard error for both instruments as well as for the ratio of the two. The raw data from all individual runs is presented in the appendix.

Table IV - Data summary for the prototype instrument

Volts Nominal	Volts Actual	P01 μA	P02 μA	P03 μA	P04 μA	P05 μA	P06 μA	P07 μA	P08 μA	P09 μA	P10 μA
-600	-600.99	15.66	15.42	14.86	14.97	14.64	14.02	14.10	13.36	13.57	13.11
-575	-573.45	14.83	14.71	13.93	13.99	13.50	12.94	12.67	12.82	13.13	12.38
-550	-548.73	14.41	14.11	13.13	13.22	12.77	12.65	12.38	12.36	12.35	11.72
-525	-524.01	13.37	12.86	11.86	12.57	12.14	12.06	11.62	12.09	11.65	11.15
-500	-499.26	12.80	12.52	12.20	11.69	11.62	11.68	11.24	11.55	11.13	10.82
-475	-474.57	12.31	12.31	11.72	10.92	10.91	11.09	10.76	11.18	10.87	10.41
-450	-449.85	11.96	11.87	10.99	10.58	10.30	10.40	10.38	10.73	10.26	10.08
-425	-425.09	11.08	10.92	10.16	10.10	10.18	9.81	10.10	9.64	9.83	9.43
-400	-400.40	10.54	10.48	10.01	9.96	9.83	9.58	9.52	9.01	9.22	9.34
-375	-375.67	9.82	9.88	9.33	9.37	9.02	9.24	8.94	8.85	8.87	8.85
-350	-350.98	9.35	9.22	8.73	8.72	8.68	8.53	8.44	8.00	8.31	8.28
-325	-323.42	8.50	8.46	8.10	7.93	8.02	7.91	7.87	7.80	7.97	7.75
-300	-298.69	8.13	8.24	7.37	7.59	7.49	7.39	7.35	7.23	7.28	6.93
-275	-273.97	7.54	7.58	7.21	7.20	6.90	6.95	6.87	6.74	6.78	6.64
-250	-249.20	6.81	6.81	6.59	6.41	6.41	6.32	6.24	6.22	6.19	6.11
-225	-224.45	6.22	6.11	5.91	5.77	5.85	5.81	5.79	5.70	5.66	5.53
-200	-199.80	5.82	5.79	5.49	5.47	5.37	5.33	5.23	5.16	5.23	5.11
-175	-175.08	5.18	5.08	4.88	4.94	4.75	4.83	4.75	4.64	4.63	4.56
-150	-150.35	4.49	4.48	4.32	4.26	4.24	4.13	4.11	4.14	4.15	4.08
-125	-125.72	3.79	3.71	3.68	3.49	3.49	3.53	3.41	3.45	3.44	3.42
-100	-98.51	3.04	3.13	2.97	2.95	2.91	2.91	2.98	2.90	2.90	2.86
-75	-73.84	2.34	2.42	2.23	2.25	2.26	2.16	2.19	2.16	2.24	2.16
-50	-49.04	1.62	1.73	1.57	1.57	1.54	1.52	1.55	1.59	1.54	1.51
-25	-24.30	0.62	0.67	0.69	0.63	0.62	0.67	0.67	0.63	0.69	0.72
		mA	mA	mA	mA	mA	mA	mA	mA	mA	mA
25	24.35	0.12	0.12	0.13	0.12	0.12	0.13	0.13	0.12	0.13	0.13
50	49.14	0.26	0.27	0.28	0.27	0.27	0.27	0.27	0.27	0.27	0.28
75	73.80	0.42	0.41	0.41	0.41	0.40	0.41	0.41	0.41	0.41	0.41
100	98.35	0.53	0.54	0.53	0.53	0.52	0.53	0.53	0.53	0.54	0.53
125	125.67	0.66	0.67	0.67	0.67	0.66	0.67	0.66	0.66	0.67	0.66
150	150.27	0.78	0.78	0.78	0.78	0.78	0.78	0.77	0.78	0.78	0.78
175	175.14	0.90	0.90	0.89	0.89	0.89	0.88	0.90	0.89	0.90	0.90
200	199.75	1.00	1.01	1.00	1.00	1.00	1.00	1.00	1.00	1.02	0.97
225	224.50	1.13	1.11	1.12	1.12	1.11	1.13	1.07	1.06	1.08	1.07
250	249.23	1.21	1.21	1.17	1.20	1.14	1.20	1.19	1.18	1.24	1.23
275	274.00	1.34	1.34	1.30	1.28	1.30	1.32	1.35	1.35	1.32	1.31
300	298.72	1.43	1.42	1.42	1.41	1.39	1.47	1.45	1.41	1.40	1.41

Table V - Data summary for the Kiethley 237

Volts Nominal	Volts Actual	K01 μA	K02 μA	K03 μA	K04 μA	K05 μA	K06 μA	K07 μA	K08 μA	K09 μA	K10 μA
-600	-600.99	14.83	14.68	14.44	14.27	14.30	14.27	14.02	13.72	13.68	13.12
-575	-573.45	14.15	13.77	13.44	13.30	13.27	13.20	12.99	12.83	12.74	12.24
-550	-548.73	13.51	13.10	12.78	12.66	12.65	12.62	12.43	12.21	12.14	11.76
-525	-524.01	12.97	12.46	12.21	12.11	12.14	11.94	11.87	11.68	11.62	11.20
-500	-499.26	12.48	11.95	11.65	11.58	11.63	11.55	11.20	11.15	11.11	10.80
-475	-474.57	11.90	11.41	11.21	11.04	11.00	10.97	10.74	10.62	10.60	10.32
-450	-449.85	11.35	10.88	10.67	10.57	10.48	10.49	10.19	10.09	10.09	9.84
-425	-425.09	10.78	10.32	10.16	10.02	9.97	9.90	9.72	9.65	9.57	9.36
-400	-400.40	10.30	9.78	9.69	9.52	9.60	9.48	9.25	9.20	9.15	8.96
-375	-375.67	9.71	9.24	9.04	9.03	9.01	8.95	8.73	8.68	8.63	8.48
-350	-350.98	9.14	8.69	8.54	8.50	8.47	8.44	8.26	8.17	8.18	8.00
-325	-323.42	7.84	8.11	7.98	7.96	7.91	7.86	7.70	7.65	7.64	7.48
-300	-298.69	7.99	7.61	7.51	7.43	7.42	7.33	7.22	7.16	7.08	7.02
-275	-273.97	7.41	7.07	6.96	6.91	6.88	6.78	6.74	6.67	6.61	6.54
-250	-249.20	6.81	6.54	6.42	6.36	6.35	6.26	6.22	6.18	6.07	6.06
-225	-224.45	6.23	5.99	5.87	5.85	5.82	5.74	5.70	5.68	5.66	5.58
-200	-199.80	5.70	5.46	5.36	5.34	5.31	5.24	5.22	5.19	5.13	5.08
-175	-175.08	5.09	4.87	4.79	4.77	4.74	4.68	4.67	4.63	4.59	4.56
-150	-150.35	4.47	4.28	4.21	4.20	4.17	4.13	4.11	4.09	4.02	4.03
-125	-125.72	3.86	3.70	3.63	3.61	3.58	3.55	3.54	3.52	3.48	3.45
-100	-98.51	3.14	3.04	3.03	2.96	2.93	2.89	2.89	2.86	2.84	2.83
-75	-73.84	2.41	2.32	2.33	2.28	2.25	2.24	2.24	2.21	2.21	2.21
-50	-49.04	1.61	1.55	1.57	1.53	1.52	1.52	1.52	1.50	1.50	1.51
-25	-24.30	0.68	0.64	0.65	0.64	0.64	0.64	0.64	0.65	0.66	0.67
		mA	mA	mA	mA	mA	mA	mA	mA	mA	mA
25	24.35	0.12	0.12	0.13	0.12	0.12	0.13	0.13	0.13	0.13	0.13
50	49.14	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27
75	73.80	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
100	98.35	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53
125	125.67	0.66	0.66	0.66	0.66	0.65	0.66	0.66	0.66	0.66	0.66
150	150.27	0.77	0.77	0.77	0.77	0.77	0.78	0.77	0.77	0.77	0.77
175	175.14	0.88	0.88	0.88	0.88	0.88	0.89	0.88	0.89	0.88	0.88
200	199.75	0.99	0.98	0.99	0.99	0.98	0.99	0.98	0.98	0.99	0.99
225	224.50	1.09	1.09	1.09	1.10	1.09	1.10	1.09	1.10	1.10	1.09
250	249.23	1.19	1.19	1.19	1.19	1.19	1.20	1.19	1.20	1.20	1.20
275	274.00	1.29	1.29	1.29	1.29	1.29	1.30	1.30	1.30	1.30	1.30
300	298.72	1.39	1.38	1.41	1.39	1.39	1.40	1.40	1.40	1.41	1.40

Table VI - Final Statistics

		Prototype			Kiethley			Prototype/Kiethley		
Volts Nominal	Volts Actual	Mean μA	Standard Error	Fractional Error	Mean μA	Standard Error	Fractional Error	Mean	Standard Error	Fractional Error
-600	-600.99	14.37	0.276	0.019	14.13	0.162	0.011	1.017	0.023	0.022
-575	-573.45	13.49	0.269	0.020	13.19	0.170	0.013	1.022	0.024	0.024
-550	-548.73	12.91	0.263	0.020	12.59	0.157	0.012	1.026	0.025	0.024
-525	-524.01	12.14	0.205	0.017	12.02	0.153	0.013	1.010	0.021	0.021
-500	-499.26	11.72	0.196	0.017	11.51	0.151	0.013	1.019	0.022	0.021
-475	-474.57	11.25	0.206	0.018	10.98	0.144	0.013	1.024	0.023	0.022
-450	-449.85	10.75	0.209	0.019	10.46	0.140	0.013	1.028	0.024	0.024
-425	-425.09	10.12	0.165	0.016	9.94	0.129	0.013	1.018	0.021	0.021
-400	-400.40	9.75	0.162	0.017	9.49	0.122	0.013	1.027	0.022	0.021
-375	-375.67	9.22	0.122	0.013	8.95	0.112	0.013	1.030	0.019	0.018
-350	-350.98	8.63	0.131	0.015	8.44	0.102	0.012	1.022	0.020	0.019
-325	-323.42	8.03	0.081	0.010	7.81	0.061	0.008	1.028	0.013	0.013
-300	-298.69	7.50	0.127	0.017	7.38	0.090	0.012	1.017	0.021	0.021
-275	-273.97	7.04	0.104	0.015	6.86	0.080	0.012	1.027	0.019	0.019
-250	-249.20	6.41	0.080	0.012	6.33	0.072	0.011	1.013	0.017	0.017
-225	-224.45	5.84	0.065	0.011	5.81	0.060	0.010	1.004	0.015	0.015
-200	-199.80	5.40	0.078	0.014	5.30	0.057	0.011	1.018	0.018	0.018
-175	-175.08	4.83	0.064	0.013	4.74	0.049	0.010	1.018	0.017	0.017
-150	-150.35	4.24	0.047	0.011	4.17	0.042	0.010	1.017	0.015	0.015
-125	-125.72	3.54	0.042	0.012	3.59	0.037	0.010	0.986	0.016	0.016
-100	-98.51	2.95	0.025	0.008	2.94	0.032	0.011	1.004	0.014	0.014
-75	-73.84	2.24	0.027	0.012	2.27	0.021	0.009	0.987	0.015	0.015
-50	-49.04	1.57	0.020	0.013	1.53	0.011	0.007	1.026	0.015	0.015
-25	-24.30	0.66	0.011	0.017	0.65	0.004	0.006	1.015	0.018	0.018
		mA			mA					
25	24.35	0.13	0.002	0.014	0.13	0.001	0.011	0.998	0.017	0.018
50	49.14	0.27	0.001	0.005	0.27	0.001	0.003	1.008	0.006	0.006
75	73.80	0.41	0.001	0.004	0.40	0.000	0.001	1.014	0.004	0.004
100	98.35	0.53	0.002	0.003	0.53	0.000	0.001	1.004	0.003	0.003
125	125.67	0.66	0.001	0.002	0.66	0.001	0.001	1.009	0.002	0.002
150	150.27	0.78	0.001	0.001	0.77	0.001	0.001	1.010	0.002	0.002
175	175.14	0.89	0.002	0.002	0.88	0.001	0.001	1.014	0.002	0.002
200	199.75	1.00	0.004	0.004	0.99	0.001	0.001	1.013	0.004	0.004
225	224.50	1.10	0.008	0.007	1.09	0.001	0.001	1.006	0.007	0.007
250	249.23	1.20	0.009	0.008	1.19	0.002	0.001	1.002	0.008	0.008
275	274.00	1.32	0.007	0.005	1.30	0.002	0.001	1.018	0.006	0.006
300	298.72	1.42	0.007	0.005	1.40	0.003	0.002	1.016	0.006	0.005

Since the electron and ion current differ by three orders of magnitude, they will be plotted separately. Figure 2 shows the electron current for the two instruments and figure 3 shows the ion current.

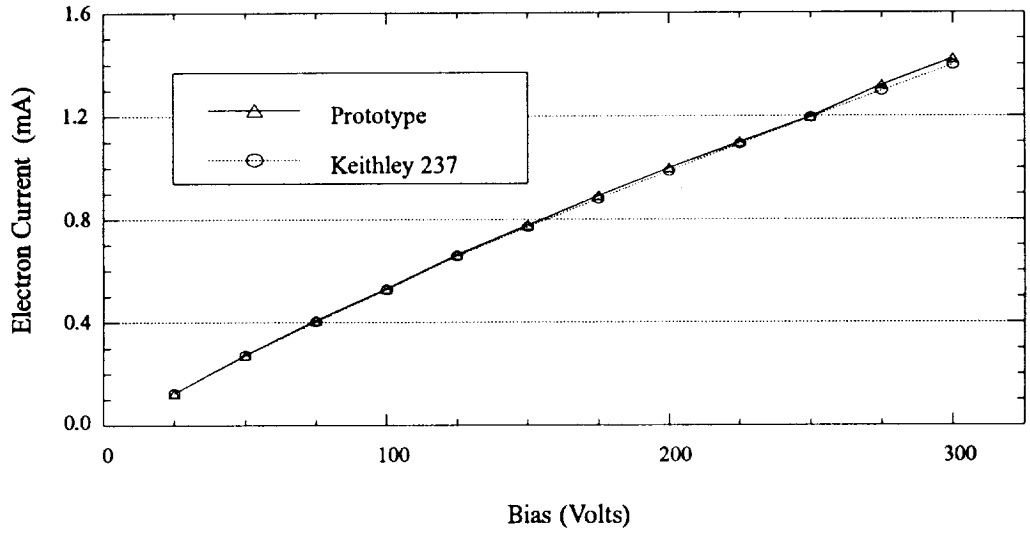

Figure 2 - Electron Current vs Applied Bias

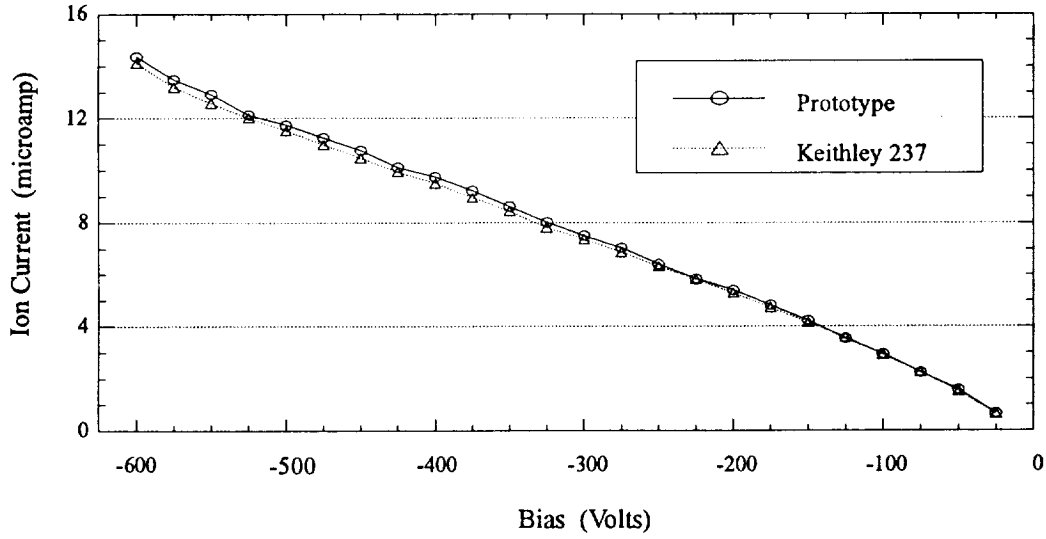

Figure 3 - Ion Current vs Applied Bias

Although standard errors were calculated for the above data, error bars were so small that they produced a cluttered appearance when added to the graphs and were therefore omitted. A more useful comparison is to plot the ratio of the mean currents at each bias voltage. This is displayed in figure 4.

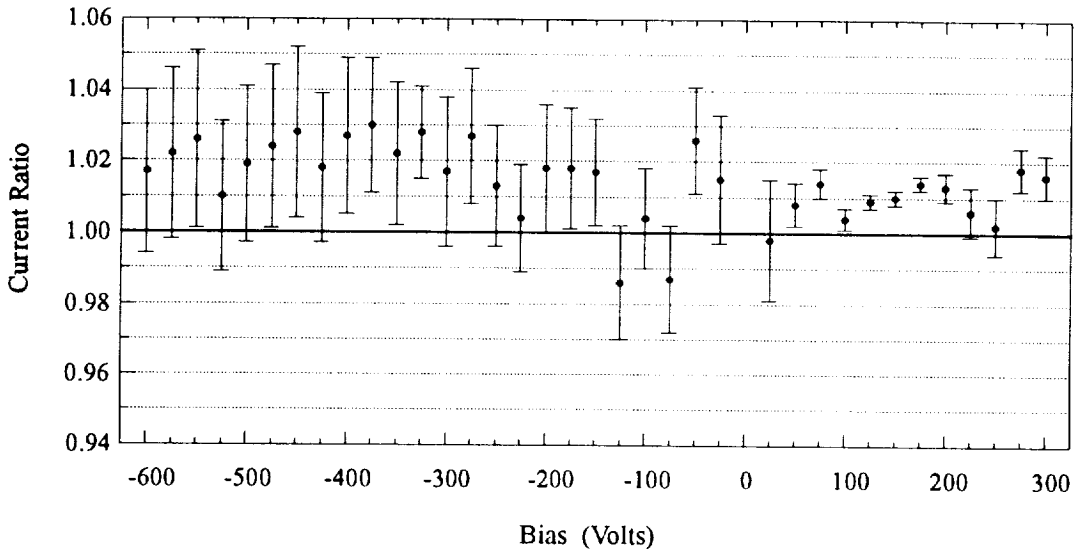

Figure 4 - Current Ratio (Prototype/Keithley) vs Applied Bias

The error bars shown indicate the standard error of the mean. The uncertainties for the two data sets was calculated by the spreadsheet used to reduce the data. For each value of applied bias, this value is simply the standard deviation divided by the square root of the number of observations (10). For the final ratio, the fractional error is first calculated as the root-mean-square of the individual fractional errors. The standard error is then the product of the fractional error and the ratio of the means.

DISCUSSION

As stated above, the requirement for acceptability was for the prototype to agree to within 10% or better with the laboratory instrument. For ion current, agreement is seen to be generally better than 3% and for electron current better than 2%. The results for ion current are believed to be conservative in that a systematic error is apparent in the data which could be eliminated were the experiments to be repeated. Examination of ion currents in tables IV and V show that there is a systematic, almost monotonic drift to lower currents as subsequent runs were taken. This trend is not apparent in electron currents taken at positive voltages which appear to be random from one run to the next. The reason for this is almost certainly related to the manner in which the source drift correction was made. Recall that a separate monitor probe was used to normalize the currents to constant plasma conditions and that this probe was always read at +100 volts. Inherent in such a procedure is the assumption that any change in plasma conditions affects ion and electron densities by the same amount, i.e., that the plasma is always in an overall neutral condition. While it is hard to see how this could not be so, the data can be interpreted as suggesting that a normalization based on electron density does not completely remove changes in ion density. Other possible explainations might involve small differences in the plasma potential for the two bias polarities or the effects of unknown resitances somewhere in the circuits. In any event, this systematic drift is undoubtedly responsible for the larger error bars associated with the ion currents and can reasonably be expected to have influenced the mean values as well. Were the experiments

to be repeated, separate measurements of the monitor probe at +100 volts and at -100 volts would eliminate this difficulty. In any case, the prototype considerably exceeds minimum requirements and SAMPIE's project schedule does not permit time to redo the tests. The final flight model will undergo similar, although not as exhaustive, testing when it is integrated into the SAMPIE package.

REFERENCES

1. Hillard, G.B. and Ferguson, D.C., "The Solar Array Module Plasma Interaction Experiment: Technical Requirements Document", NASA TM-105660, May, 1992.

2. Hillard, G.B. and Ferguson, D.C., "The Solar Array Module Plasma Interaction Experiment (SAMPIE): Science and Technology Objectives", submitted to Journal of Spacecraft and Rockets.

3. Wald, L.W. and Hillard G.B., "The Solar Array Module Plasma Interactions Experiment (SAMPIE): A Shuttle-Based Plasma Interactions Experiment", the Proceedings of the 26th Intersociety Energy Conversion Engineering Conference, Boston, MA August 4-9, Vol 1 p385, 1991.

4. Bozich, R.C. et. al., to be published

APPENDIX - Raw Data

Data runs for the prototype are designated with a capital P and a sequential number. Runs for the Keithley 237 begin with a K.

Data Set P01

Volts Nominal	P01 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	P01 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	P01 Raw mA	Monitor Probe mA	Drift Corrected mA
-600	11.20	0.716	15.66	-300	5.87	0.722	8.13	25	0.09	0.729	0.12
-575	10.60	0.715	14.83	-275	5.47	0.725	7.54	50	0.19	0.729	0.26
-550	10.30	0.715	14.41	-250	4.96	0.728	6.81	75	0.30	0.730	0.42
-525	9.56	0.715	13.37	-225	4.55	0.731	6.22	100	0.39	0.730	0.53
-500	9.15	0.715	12.80	-200	4.28	0.735	5.82	125	0.48	0.731	0.66
-475	8.80	0.715	12.31	-175	3.80	0.733	5.18	150	0.57	0.731	0.78
-450	8.56	0.716	11.96	-150	3.28	0.731	4.49	175	0.66	0.732	0.90
-425	7.93	0.716	11.08	-125	2.76	0.729	3.79	200	0.73	0.733	1.00
-400	7.55	0.716	10.54	-100	2.21	0.728	3.04	225	0.83	0.733	1.13
-375	7.04	0.717	9.82	-75	1.70	0.728	2.34	250	0.89	0.734	1.21
-350	6.72	0.719	9.35	-50	1.18	0.728	1.62	275	0.99	0.735	1.34
-325	6.13	0.721	8.50	-25	0.09	0.728	0.62	300	1.05	0.735	1.43

Data Set P02

Volts Nominal	P02 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	P02 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	P02 Raw mA	Monitor Probe mA	Drift Corrected mA
-600	11.50	0.746	15.42	-300	6.33	0.768	8.24	25	0.09	0.794	0.12
-575	11.00	0.748	14.71	-275	5.83	0.769	7.58	50	0.22	0.798	0.27
-550	10.60	0.751	14.11	-250	5.25	0.771	6.81	75	0.33	0.803	0.41
-525	9.68	0.753	12.86	-225	4.72	0.773	6.11	100	0.44	0.808	0.54
-500	9.45	0.755	12.52	-200	4.48	0.774	5.79	125	0.54	0.808	0.67
-475	9.33	0.758	12.31	-175	3.94	0.775	5.08	150	0.63	0.808	0.78
-450	9.03	0.761	11.87	-150	3.48	0.776	4.48	175	0.73	0.808	0.90
-425	8.33	0.763	10.92	-125	2.88	0.777	3.71	200	0.82	0.808	1.01
-400	8.01	0.764	10.48	-100	2.44	0.78	3.13	225	0.90	0.81	1.11
-375	7.56	0.765	9.88	-75	1.89	0.78	2.42	250	0.99	0.813	1.21
-350	7.06	0.766	9.22	-50	1.35	0.78	1.73	275	1.09	0.816	1.34
-325	6.49	0.767	8.46	-25	0.531	0.79	0.67	300	1.16	0.818	1.42

Data Set P03

Volts Nominal	P03 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	P03 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	P03 Raw mA	Monitor Probe mA	Drift Corrected mA
-600	13.00	0.876	14.86	-300	6.49	0.881	7.37	25	0.11	0.889	0.13
-575	12.20	0.876	13.93	-275	6.36	0.882	7.21	50	0.25	0.89	0.28
-550	11.50	0.876	13.13	-250	5.81	0.882	6.59	75	0.36	0.891	0.41
-525	10.40	0.877	11.86	-225	5.22	0.883	5.91	100	0.47	0.892	0.53
-500	10.70	0.877	12.20	-200	4.85	0.884	5.49	125	0.60	0.893	0.67
-475	10.30	0.879	11.72	-175	4.31	0.884	4.88	150	0.70	0.893	0.78
-450	9.68	0.881	10.99	-150	3.82	0.885	4.32	175	0.80	0.894	0.89
-425	8.97	0.883	10.16	-125	3.26	0.886	3.68	200	0.89	0.895	1.00
-400	8.86	0.885	10.01	-100	2.63	0.887	2.97	225	1.00	0.896	1.12
-375	8.25	0.884	9.33	-75	1.98	0.887	2.23	250	1.05	0.897	1.17
-350	7.71	0.883	8.73	-50	1.39	0.887	1.57	275	1.17	0.898	1.30
-325	7.14	0.882	8.10	-25	0.61	0.888	0.69	300	1.28	0.899	1.42

Data Set P04

Volts Nominal	P04 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	P04 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	P04 Raw mA	Monitor Probe mA	Drift Corrected mA
-600	13.70	0.915	14.97	-300	7.00	0.922	7.59	25	0.11	0.929	0.12
-575	12.80	0.915	13.99	-275	6.65	0.923	7.20	50	0.25	0.93	0.27
-550	12.10	0.915	13.22	-250	5.92	0.924	6.41	75	0.38	0.931	0.41
-525	11.50	0.915	12.57	-225	5.34	0.925	5.77	100	0.49	0.931	0.53
-500	10.70	0.915	11.69	-200	5.06	0.925	5.47	125	0.62	0.932	0.67
-475	10.00	0.916	10.92	-175	4.57	0.925	4.94	150	0.73	0.933	0.78
-450	9.70	0.917	10.58	-150	3.94	0.925	4.26	175	0.83	0.934	0.89
-425	9.27	0.918	10.10	-125	3.23	0.925	3.49	200	0.94	0.935	1.00
-400	9.15	0.919	9.96	-100	2.73	0.925	2.95	225	1.05	0.936	1.12
-375	8.62	0.92	9.37	-75	2.08	0.926	2.25	250	1.12	0.937	1.20
-350	8.03	0.921	8.72	-50	1.46	0.927	1.57	275	1.20	0.938	1.28
-325	7.31	0.922	7.93	-25	0.59	0.928	0.63	300	1.32	0.938	1.41

Data Set P05

Volts Nominal	P05 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	P05 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	P05 Raw mA	Monitor Probe mA	Drift Corrected mA
-600	14.10	0.963	14.64	-300	7.19	0.96	7.49	25	0.12	0.964	0.12
-575	13.00	0.963	13.50	-275	6.62	0.96	6.90	50	0.26	0.965	0.27
-550	12.30	0.963	12.77	-250	6.15	0.96	6.41	75	0.39	0.966	0.40
-525	11.70	0.964	12.14	-225	5.61	0.959	5.85	100	0.50	0.966	0.52
-500	11.20	0.964	11.62	-200	5.15	0.959	5.37	125	0.64	0.967	0.66
-475	10.50	0.962	10.91	-175	4.56	0.959	4.75	150	0.75	0.968	0.78
-450	9.90	0.961	10.30	-150	4.07	0.959	4.24	175	0.86	0.968	0.89
-425	9.74	0.957	10.18	-125	3.35	0.96	3.49	200	0.97	0.969	1.00
-400	9.39	0.955	9.83	-100	2.79	0.96	2.91	225	1.08	0.97	1.11
-375	8.62	0.956	9.02	-75	2.17	0.961	2.26	250	1.11	0.971	1.14
-350	8.32	0.958	8.68	-50	1.48	0.962	1.54	275	1.26	0.971	1.30
-325	7.69	0.959	8.02	-25	0.60	0.963	0.62	300	1.35	0.972	1.39

Data Set P06

Volts Nominal	P06 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	P06 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	P06 Raw mA	Monitor Probe mA	Drift Corrected mA
-600	14.30	1.02	14.02	-300	7.54	1.02	7.39	25	0.13	1.02	0.13
-575	13.20	1.02	12.94	-275	7.09	1.02	6.95	50	0.28	1.02	0.27
-550	12.90	1.02	12.65	-250	6.45	1.02	6.32	75	0.42	1.02	0.41
-525	12.30	1.02	12.06	-225	5.93	1.02	5.81	100	0.54	1.03	0.53
-500	11.80	1.01	11.68	-200	5.44	1.02	5.33	125	0.69	1.03	0.67
-475	11.20	1.01	11.09	-175	4.93	1.02	4.83	150	0.80	1.03	0.78
-450	10.50	1.01	10.40	-150	4.21	1.02	4.13	175	0.91	1.03	0.88
-425	9.91	1.01	9.81	-125	3.60	1.02	3.53	200	1.03	1.03	1.00
-400	9.68	1.01	9.58	-100	2.97	1.02	2.91	225	1.16	1.03	1.13
-375	9.33	1.01	9.24	-75	2.20	1.02	2.16	250	1.24	1.03	1.20
-350	8.62	1.01	8.53	-50	1.55	1.02	1.52	275	1.36	1.03	1.32
-325	7.99	1.01	7.91	-25	0.68	1.02	0.67	300	1.51	1.03	1.47

Data Set P07

Volts Nominal	P07 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	P07 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	P07 Raw mA	Monitor Probe mA	Drift Corrected mA
-600	14.80	1.05	14.10	-300	7.79	1.06	7.35	25	0.14	1.06	0.13
-575	13.30	1.05	12.67	-275	7.28	1.06	6.87	50	0.29	1.06	0.27
-550	13.00	1.05	12.38	-250	6.61	1.06	6.24	75	0.43	1.06	0.41
-525	12.20	1.05	11.62	-225	6.14	1.06	5.79	100	0.57	1.07	0.53
-500	11.80	1.05	11.24	-200	5.54	1.06	5.23	125	0.71	1.07	0.66
-475	11.30	1.05	10.76	-175	5.04	1.06	4.75	150	0.83	1.07	0.77
-450	10.90	1.05	10.38	-150	4.36	1.06	4.11	175	0.96	1.07	0.90
-425	10.60	1.05	10.10	-125	3.61	1.06	3.41	200	1.07	1.07	1.00
-400	10.00	1.05	9.52	-100	3.16	1.06	2.98	225	1.15	1.07	1.07
-375	9.39	1.05	8.94	-75	2.32	1.06	2.19	250	1.27	1.07	1.19
-350	8.86	1.05	8.44	-50	1.64	1.06	1.55	275	1.44	1.07	1.35
-325	8.26	1.05	7.87	-25	0.71	1.06	0.67	300	1.55	1.07	1.45

Data Set P08

Volts Nominal	P08 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	P08 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	P08 Raw mA	Monitor Probe mA	Drift Corrected mA
-600	14.70	1.10	13.36	-300	8.03	1.11	7.23	25	0.14	1.12	0.12
-575	14.10	1.10	12.82	-275	7.48	1.11	6.74	50	0.31	1.12	0.27
-550	13.60	1.10	12.36	-250	6.90	1.11	6.22	75	0.46	1.12	0.41
-525	13.30	1.10	12.09	-225	6.33	1.11	5.70	100	0.59	1.12	0.53
-500	12.70	1.10	11.55	-200	5.73	1.11	5.16	125	0.74	1.12	0.66
-475	12.30	1.10	11.18	-175	5.15	1.11	4.64	150	0.87	1.12	0.78
-450	11.80	1.10	10.73	-150	4.60	1.11	4.14	175	0.99	1.12	0.89
-425	10.60	1.10	9.64	-125	3.83	1.11	3.45	200	1.13	1.13	1.00
-400	9.91	1.10	9.01	-100	3.22	1.11	2.90	225	1.20	1.13	1.06
-375	9.74	1.10	8.85	-75	2.40	1.11	2.16	250	1.33	1.13	1.18
-350	8.80	1.10	8.00	-50	1.76	1.11	1.59	275	1.52	1.13	1.35
-325	8.58	1.10	7.80	-25	0.70	1.11	0.63	300	1.59	1.13	1.41

Data Set P09

Volts Nominal	P09 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	P09 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	P09 Raw mA	Monitor Probe mA	Drift Corrected mA
-600	15.60	1.15	13.57	-300	8.37	1.15	7.28	25	0.15	1.16	0.13
-575	15.10	1.15	13.13	-275	7.80	1.15	6.78	50	0.32	1.16	0.27
-550	14.20	1.15	12.35	-250	7.12	1.15	6.19	75	0.47	1.16	0.41
-525	13.40	1.15	11.65	-225	6.51	1.15	5.66	100	0.62	1.16	0.54
-500	12.80	1.15	11.13	-200	6.02	1.15	5.23	125	0.78	1.16	0.67
-475	12.50	1.15	10.87	-175	5.32	1.15	4.63	150	0.91	1.16	0.78
-450	11.80	1.15	10.26	-150	4.77	1.15	4.15	175	1.04	1.16	0.90
-425	11.30	1.15	9.83	-125	3.96	1.15	3.44	200	1.19	1.17	1.02
-400	10.60	1.15	9.22	-100	3.34	1.15	2.90	225	1.26	1.17	1.08
-375	10.20	1.15	8.87	-75	2.58	1.15	2.24	250	1.45	1.17	1.24
-350	9.56	1.15	8.31	-50	1.77	1.15	1.54	275	1.55	1.17	1.32
-325	9.17	1.15	7.97	-25	0.80	1.15	0.69	300	1.64	1.17	1.40

Data Set P10

Volts Nominal	P10 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	P10 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	P10 Raw mA	Monitor Probe mA	Drift Corrected mA
-600	16.00	1.22	13.11	-300	8.52	1.23	6.93	25	0.17	1.23	0.13
-575	15.10	1.22	12.38	-275	8.17	1.23	6.64	50	0.34	1.23	0.28
-550	14.30	1.22	11.72	-250	7.51	1.23	6.11	75	0.51	1.23	0.41
-525	13.60	1.22	11.15	-225	6.80	1.23	5.53	100	0.66	1.24	0.53
-500	13.20	1.22	10.82	-200	6.28	1.23	5.11	125	0.82	1.24	0.66
-475	12.70	1.22	10.41	-175	5.61	1.23	4.56	150	0.96	1.24	0.78
-450	12.30	1.22	10.08	-150	5.02	1.23	4.08	175	1.11	1.24	0.90
-425	11.50	1.22	9.43	-125	4.21	1.23	3.42	200	1.20	1.24	0.97
-400	11.40	1.22	9.34	-100	3.52	1.23	2.86	225	1.33	1.24	1.07
-375	10.80	1.22	8.85	-75	2.66	1.23	2.16	250	1.52	1.24	1.23
-350	10.10	1.22	8.28	-50	1.86	1.23	1.51	275	1.62	1.24	1.31
-325	9.46	1.22	7.75	-25	0.89	1.23	0.72	300	1.75	1.24	1.41

Data Set K01

Volts Nominal	K01 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	K01 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	K01 Raw mA	Monitor Probe mA	Drift Corrected mA
-600	10.90	0.735	14.83	-300	5.87	0.735	7.99	25	0.09	0.737	0.12
-575	10.40	0.735	14.15	-275	5.46	0.737	7.41	50	0.20	0.737	0.27
-550	9.93	0.735	13.51	-250	5.03	0.739	6.81	75	0.30	0.738	0.40
-525	9.53	0.735	12.97	-225	4.62	0.741	6.23	100	0.39	0.738	0.53
-500	9.17	0.735	12.48	-200	4.23	0.742	5.70	125	0.49	0.739	0.66
-475	8.75	0.735	11.90	-175	3.77	0.741	5.09	150	0.57	0.739	0.77
-450	8.34	0.735	11.35	-150	3.31	0.74	4.47	175	0.65	0.74	0.88
-425	7.92	0.735	10.78	-125	2.85	0.739	3.86	200	0.73	0.74	0.99
-400	7.57	0.735	10.30	-100	2.32	0.738	3.14	225	0.81	0.741	1.09
-375	7.14	0.735	9.71	-75	1.78	0.738	2.41	250	0.88	0.741	1.19
-350	6.72	0.735	9.14	-50	1.19	0.737	1.61	275	0.96	0.742	1.29
-325	6.26	0.798	7.84	-25	0.50	0.736	0.68	300	1.03	0.743	1.39

Data Set K02

Volts Nominal	K02 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	K02 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	K02 Raw mA	Monitor Probe mA	Drift Corrected mA
-600	12.10	0.824	14.68	-300	6.49	0.853	7.61	25	0.11	0.865	0.12
-575	11.40	0.828	13.77	-275	6.04	0.854	7.07	50	0.23	0.866	0.27
-550	10.90	0.832	13.10	-250	5.59	0.855	6.54	75	0.35	0.867	0.40
-525	10.40	0.835	12.46	-225	5.13	0.856	5.99	100	0.46	0.868	0.53
-500	10.00	0.837	11.95	-200	4.68	0.857	5.46	125	0.57	0.869	0.66
-475	9.57	0.839	11.41	-175	4.18	0.858	4.87	150	0.67	0.87	0.77
-450	9.15	0.841	10.88	-150	3.68	0.859	4.28	175	0.76	0.871	0.88
-425	8.70	0.843	10.32	-125	3.18	0.86	3.70	200	0.86	0.872	0.98
-400	8.26	0.845	9.78	-100	2.62	0.861	3.04	225	0.95	0.873	1.09
-375	7.83	0.847	9.24	-75	2.00	0.862	2.32	250	1.04	0.874	1.19
-350	7.38	0.849	8.69	-50	1.34	0.863	1.55	275	1.13	0.875	1.29
-325	6.90	0.851	8.11	-25	0.56	0.864	0.64	300	1.21	0.876	1.38

Data Set K03

Volts Nominal	K03 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	K03 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	K03 Raw mA	Monitor Probe mA	Drift Corrected mA
-600	13.00	0.9	14.44	-300	6.72	0.895	7.51	25	0.12	0.91	0.13
-575	12.10	0.9	13.44	-275	6.24	0.896	6.96	50	0.24	0.91	0.27
-550	11.50	0.9	12.78	-250	5.76	0.897	6.42	75	0.37	0.91	0.40
-525	11.00	0.901	12.21	-225	5.27	0.898	5.87	100	0.48	0.91	0.53
-500	10.50	0.901	11.65	-200	4.81	0.898	5.36	125	0.60	0.911	0.66
-475	10.10	0.901	11.21	-175	4.30	0.898	4.79	150	0.70	0.912	0.77
-450	9.62	0.902	10.67	-150	3.78	0.898	4.21	175	0.80	0.912	0.88
-425	9.16	0.902	10.16	-125	3.26	0.898	3.63	200	0.90	0.913	0.99
-400	8.74	0.902	9.69	-100	2.72	0.898	3.03	225	1.00	0.914	1.09
-375	8.14	0.9	9.04	-75	2.09	0.898	2.33	250	1.09	0.915	1.19
-350	7.67	0.898	8.54	-50	1.41	0.899	1.57	275	1.18	0.916	1.29
-325	7.15	0.896	7.98	-25	0.59	0.9	0.65	300	1.29	0.917	1.41

Data Set K04

Volts Nominal	K04 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	K04 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	K04 Raw mA	Monitor Probe mA	Drift Corrected mA
-600	13.40	0.939	14.27	-300	7.04	0.948	7.43	25	0.12	0.956	0.12
-575	12.50	0.94	13.30	-275	6.55	0.948	6.91	50	0.26	0.956	0.27
-550	11.90	0.94	12.66	-250	6.04	0.949	6.36	75	0.39	0.957	0.40
-525	11.40	0.941	12.11	-225	5.55	0.949	5.85	100	0.51	0.958	0.53
-500	10.90	0.941	11.58	-200	5.07	0.95	5.34	125	0.63	0.959	0.66
-475	10.40	0.942	11.04	-175	4.54	0.951	4.77	150	0.74	0.96	0.77
-450	9.97	0.943	10.57	-150	3.99	0.951	4.20	175	0.85	0.962	0.88
-425	9.46	0.944	10.02	-125	3.44	0.952	3.61	200	0.95	0.964	0.99
-400	8.99	0.944	9.52	-100	2.82	0.952	2.96	225	1.06	0.965	1.10
-375	8.53	0.945	9.03	-75	2.17	0.953	2.28	250	1.15	0.966	1.19
-350	8.04	0.946	8.50	-50	1.46	0.954	1.53	275	1.25	0.967	1.29
-325	7.54	0.947	7.96	-25	0.62	0.954	0.64	300	1.35	0.968	1.39

Data Set K05

Volts Nominal	K05 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	K05 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	K05 Raw mA	Monitor Probe mA	Drift Corrected mA
-600	13.90	0.972	14.30	-300	7.23	0.975	7.42	25	0.12	0.983	0.12
-575	12.90	0.972	13.27	-275	6.71	0.976	6.88	50	0.27	0.985	0.27
-550	12.30	0.972	12.65	-250	6.20	0.977	6.35	75	0.40	0.986	0.40
-525	11.80	0.972	12.14	-225	5.69	0.978	5.82	100	0.52	0.988	0.53
-500	11.30	0.972	11.63	-200	5.19	0.978	5.31	125	0.65	0.988	0.65
-475	10.70	0.973	11.00	-175	4.64	0.979	4.74	150	0.76	0.988	0.77
-450	10.20	0.973	10.48	-150	4.08	0.979	4.17	175	0.87	0.988	0.88
-425	9.71	0.974	9.97	-125	3.51	0.98	3.58	200	0.97	0.988	0.98
-400	9.35	0.974	9.60	-100	2.87	0.98	2.93	225	1.08	0.989	1.09
-375	8.78	0.974	9.01	-75	2.21	0.981	2.25	250	1.18	0.99	1.19
-350	8.26	0.975	8.47	-50	1.49	0.981	1.52	275	1.28	0.991	1.29
-325	7.71	0.975	7.91	-25	0.63	0.982	0.64	300	1.38	0.992	1.39

Data Set K06

Volts Nominal	K06 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	K06 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	K06 Raw mA	Monitor Probe mA	Drift Corrected mA
-600	14.70	1.03	14.27	-300	7.62	1.04	7.33	25	0.13	1.04	0.13
-575	13.60	1.03	13.20	-275	7.05	1.04	6.78	50	0.28	1.04	0.27
-550	13.00	1.03	12.62	-250	6.51	1.04	6.26	75	0.42	1.04	0.40
-525	12.30	1.03	11.94	-225	5.97	1.04	5.74	100	0.55	1.04	0.53
-500	11.90	1.03	11.55	-200	5.45	1.04	5.24	125	0.69	1.04	0.66
-475	11.30	1.03	10.97	-175	4.87	1.04	4.68	150	0.81	1.04	0.78
-450	10.80	1.03	10.49	-150	4.29	1.04	4.13	175	0.92	1.04	0.89
-425	10.20	1.03	9.90	-125	3.69	1.04	3.55	200	1.04	1.05	0.99
-400	9.76	1.03	9.48	-100	3.01	1.04	2.89	225	1.15	1.05	1.10
-375	9.22	1.03	8.95	-75	2.33	1.04	2.24	250	1.26	1.05	1.20
-350	8.69	1.03	8.44	-50	1.58	1.04	1.52	275	1.37	1.05	1.30
-325	8.10	1.03	7.86	-25	0.67	1.04	0.64	300	1.47	1.05	1.40

Data Set K07

Volts Nominal	K07 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	K07 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	K07 Raw mA	Monitor Probe mA	Drift Corrected mA
-600	15.00	1.07	14.02	-300	7.80	1.08	7.22	25	0.14	1.08	0.13
-575	13.90	1.07	12.99	-275	7.28	1.08	6.74	50	0.30	1.08	0.27
-550	13.30	1.07	12.43	-250	6.72	1.08	6.22	75	0.44	1.09	0.40
-525	12.70	1.07	11.87	-225	6.16	1.08	5.70	100	0.58	1.09	0.53
-500	12.10	1.08	11.20	-200	5.64	1.08	5.22	125	0.72	1.09	0.66
-475	11.60	1.08	10.74	-175	5.04	1.08	4.67	150	0.84	1.09	0.77
-450	11.00	1.08	10.19	-150	4.44	1.08	4.11	175	0.96	1.09	0.88
-425	10.50	1.08	9.72	-125	3.82	1.08	3.54	200	1.08	1.1	0.98
-400	9.99	1.08	9.25	-100	3.12	1.08	2.89	225	1.20	1.1	1.09
-375	9.43	1.08	8.73	-75	2.42	1.08	2.24	250	1.31	1.1	1.19
-350	8.92	1.08	8.26	-50	1.64	1.08	1.52	275	1.43	1.1	1.30
-325	8.32	1.08	7.70	-25	0.70	1.08	0.64	300	1.54	1.1	1.40

Data Set K08

Volts Nominal	K08 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	K08 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	K08 Raw mA	Monitor Probe mA	Drift Corrected mA
-600	15.50	1.13	13.72	-300	8.09	1.13	7.16	25	0.15	1.14	0.13
-575	14.50	1.13	12.83	-275	7.54	1.13	6.67	50	0.31	1.14	0.27
-550	13.80	1.13	12.21	-250	6.98	1.13	6.18	75	0.46	1.14	0.40
-525	13.20	1.13	11.68	-225	6.42	1.13	5.68	100	0.60	1.14	0.53
-500	12.60	1.13	11.15	-200	5.86	1.13	5.19	125	0.75	1.14	0.66
-475	12.00	1.13	10.62	-175	5.23	1.13	4.63	150	0.88	1.14	0.77
-450	11.40	1.13	10.09	-150	4.62	1.13	4.09	175	1.01	1.14	0.89
-425	10.90	1.13	9.65	-125	3.98	1.13	3.52	200	1.13	1.15	0.98
-400	10.40	1.13	9.20	-100	3.26	1.14	2.86	225	1.26	1.15	1.10
-375	9.81	1.13	8.68	-75	2.52	1.14	2.21	250	1.38	1.15	1.20
-350	9.23	1.13	8.17	-50	1.71	1.14	1.50	275	1.49	1.15	1.30
-325	8.64	1.13	7.65	-25	0.74	1.14	0.65	300	1.61	1.15	1.40

Data Set K09

Volts Nominal	K09 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	K09 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	K09 Raw mA	Monitor Probe mA	Drift Corrected mA
-600	16.00	1.17	13.68	-300	8.36	1.18	7.08	25	0.16	1.21	0.13
-575	14.90	1.17	12.74	-275	7.80	1.18	6.61	50	0.33	1.21	0.27
-550	14.20	1.17	12.14	-250	7.22	1.19	6.07	75	0.49	1.21	0.40
-525	13.60	1.17	11.62	-225	6.74	1.19	5.66	100	0.64	1.21	0.53
-500	13.00	1.17	11.11	-200	6.16	1.2	5.13	125	0.80	1.21	0.66
-475	12.40	1.17	10.60	-175	5.51	1.2	4.59	150	0.94	1.21	0.77
-450	11.80	1.17	10.09	-150	4.86	1.21	4.02	175	1.07	1.22	0.88
-425	11.20	1.17	9.57	-125	4.21	1.21	3.48	200	1.21	1.22	0.99
-400	10.70	1.17	9.15	-100	3.44	1.21	2.84	225	1.34	1.22	1.10
-375	10.10	1.17	8.63	-75	2.67	1.21	2.21	250	1.47	1.22	1.20
-350	9.57	1.17	8.18	-50	1.82	1.21	1.50	275	1.59	1.22	1.30
-325	8.94	1.17	7.64	-25	0.80	1.21	0.66	300	1.72	1.22	1.41

Data Set K10

Volts Nominal	K10 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	K10 Raw μA	Monitor Probe mA	Drift Corrected μA	Volts Nominal	K10 Raw mA	Monitor Probe mA	Drift Corrected mA
-600	16.40	1.25	13.12	-300	8.77	1.25	7.02	25	0.17	1.26	0.13
-575	15.30	1.25	12.24	-275	8.18	1.25	6.54	50	0.35	1.26	0.27
-550	14.70	1.25	11.76	-250	7.57	1.25	6.06	75	0.51	1.26	0.40
-525	14.00	1.25	11.20	-225	6.97	1.25	5.58	100	0.67	1.26	0.53
-500	13.50	1.25	10.80	-200	6.35	1.25	5.08	125	0.83	1.26	0.66
-475	12.90	1.25	10.32	-175	5.70	1.25	4.56	150	0.98	1.26	0.77
-450	12.30	1.25	9.84	-150	5.04	1.25	4.03	175	1.12	1.27	0.88
-425	11.70	1.25	9.36	-125	4.35	1.26	3.45	200	1.26	1.27	0.99
-400	11.20	1.25	8.96	-100	3.57	1.26	2.83	225	1.39	1.27	1.09
-375	10.60	1.25	8.48	-75	2.78	1.26	2.21	250	1.52	1.27	1.20
-350	10.00	1.25	8.00	-50	1.90	1.26	1.51	275	1.65	1.27	1.30
-325	9.35	1.25	7.48	-25	0.84	1.26	0.67	300	1.78	1.27	1.40

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13. ABSTRACT (***Maximum 200 words***)

The Solar Array Module Plasma Interaction Experiment (SAMPIE) has two key instruments at the heart of its data acquisition capability. One of these, the electrometer, is designed to measure both ion and electron current from most of the samples included in the experiment. The accuracy requirement, specified by the project's Principal Investigator, is for agreement within 10% with a calibrated laboratory instrument. Plasma chamber testing was performed to assess the capabilities of the prototype design. Agreement was determined to be within 2% for electron collection and within 3% for ion collection.

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