SDC-92-314

SDC
SOLENOIDAL DETECTOR NOTES

SUBSTRATE RESISTIVITY MEASUREMENTS

September1992

E.F. Barasch and T.B. Kasprowicz
Texas A&M University

SDC-92-314
1 Sept. 1992

Substrate Resistivity Measurements.

by E.F. Barasch & T.B. Kasprowicz
Texas A&M University
College Station, Tx 77843-4242

Preparation of Substrate.

•Surface Resistance Test

The substrates were generally cut to 3 inches on a side and thus sufficiently large for easy handling. They were manipulated by limiting bare hand contact to the edges or by using clean room gloves when there was a chance of getting skin oils onto the bare surface in between the electrodes. Generally speaking no chemicals were used to clean surfaces and it was noted that the pinstriping tape used to mask out the electrodes tended to remove contaminants and thus clean the surface. Visual inspection under an 80 power light microscope revealed no residues from the masking tape except in the case of polyimide film where residue splotches were evident. In some cases the electrodes were created using a shadow mask and evaporated Aluminum. When shadow masked samples were compared with samples of identical materials wherein which the electrodes were made using pinstriping tape, resistances were mostly unchanged. Commercial silver print for PC boards was used in conjunction with the pinstriping tape and electrodes made in this fashion were covered with red Glyptol to suppress discharge before the tape was removed. Two types of pinstriping tape were used. 3M Brand Fine Line Striping tape and the product produced by Finesse Pinstriping of Queens, New York. The 3M Brand tape is a 1 inch wide masking tape that is pre-scored into identical 1/16 inch wide strips that can be selected at will for selective lift-off once the tape has been applied to the surface. The Finesse tape is a two-layer tape in which the open "roads" for paint application are visible under a clear over tape. Once the tape has been battened down, the over tape is removed and the under tape remains on the surface. The 3-M tape is easier to use and should be available from a local Automobile paint supply shop. Wires are connected distally with blobs of Ecocoat silver acrylic one-part epoxy supplied by Emerson and Cummings and connected to the electrodes via silverprint. The electrodes were generally 2 inches long separated by 1/16 inch gap which gives one a 32nd of a square of susbtrate in series with the electrodes. The sample is allowed to dry for 4-12 hours before testing.

•Volume Resistivity Test

The substrate is handled as above. The tape is then put on so that one produces 1-1.25cm^2 electrodes on opposite sides of the thin dimension of the substrate. Leads are attached via silver acrylic to the painted-on electrodes and the sample is allowed to dry for 4-12hrs.

Testing of Substrate.

The prepared substrate is placed in a Faraday cage with appropriate electrical feedthroughs (SHV or stripped back wire). RG59 is used for all the cabling. The output current is then fed to a Keithley picoammeter. Voltage is supplied by a Droege-type high voltage, low current supply limited by a limiting capacitor to protect the picoammeter. The voltage

applied to the substrate generally in increments of 500V up to 2500V. We use higher voltages than that mandated by ASTM D-257 (1000 V). The current is measured and the surface or volume resistance is calculated in Ω/sq or Ω-cm repectively. In neither case are these ASTM D-257 tests which require a grounded backplane in the case of surface resistivity measurements or a guard ring around the hot lead in the case of volume resistivity tests and 50% R.H. We believe that the ASTM D-257 test quenches currents that might very well be important in the physics of Gas Micro Strip Detectors and that 50% R.H. not an appropriate requirement if the end use is in dry gas.

Substrates that are ohmic in air are tested in a dry nitrogen box with UHP N_2. The dry nitrogen box contains a grounded field cage with vacuum bulkhead SHV feedthroughs. The gas is flowed through the box in $\frac{1}{4}$ stainless steel tubes. A bubbler filled with TKO-19+ supplies the appropriate flow monitor. The rate of the gas is held so that the volume of the box is replaced at least every hour (1 SCFH). For substrates that are ohmic and very stable in N_2, a time rate study is done. The substrate is monitored over the course of hours or even days until the resistance has reached an asymptotic limit.

A variety of substrates were subject to neutron exposure of $10^{11}\frac{n}{cm^2}$ at 1MeV and retested with the standard procedure. The individual data tables indicate which samples were irradiated and which were tested in air and/or N_2. All tests were completed in air unless otherwise indicated in the data charts. Moreover, the data charts indicate when there has been instablity that is not represented in the plot(s) of each sample. Neither Tedlar nor Cellulose Acetate did well after the neutron exposure.

Resistivity Master Table

Company	Sample Name	Resistance @1000V (Ω/sq)		Ohmic (0→2.5KV)	Notes & Comments
		Air	Dry N_2		
Advanced Mat.	Stat-kon AS-F	4e11		no	Polyethylene
AKZO (DSM)	ABS/Copolyether	5e11		yes	TP
Americhem	Nylon	5e6		yes	polyanaline loaded
BF Goodrich	161-289-37-2	2e13		yes	Polyurethane
BF Goodrich	161-289-37-2*	1e13		yes	Polyurethane
BF Goodrich	161-289-37-3	5e11		yes	Polyurethane
BF Goodrich	161-289-37-3*	4e11		yes	Polyurethane
BF Goodrich	161-289-37-4	1e10		yes	Polyurethane
BF Goodrich	161-289-37-4*	8e10		yes	Polyurethane
Corning	Na_2CO_3 glass	6e15		yes	
Corning	Murano(50%FeO/50%P_2O_5)	5e10	5e10	yes	Glass w/ Large grain size
Corning	Murano(55%FeO/45%P_2O_5)	5e10		yes	Glass
Deerfield	PS8010	4e13		yes	Polyurethane
Dupont	Hytrel	4e12		yes	Difficult to metalize
Dupont	+Kapton HY	1e15		no	TS
Dupont	Kapton MT	5e15		yes	TS
Dupont	Kapton SXC230	1e6		yes	@60V, TS, Carbon loaded
Dupont	Kapton 150XC	8e6	4e7	yes	@150V-air,@400V-N_2,TS,Carbon loaded
Dupont	Kapton 200FPC	4e16		no	TS
Dupont	Kapton 200HN	8e16		yes	TS
Dupont	Kapton FPC-2T	1e16		no	TS
Dupont	Kapton H806	5e14		no	TS
Dupont	Kapton HA	4e16		yes	TS
Dupont	Kapton HN806	3e15		yes	TS
Dupont	Kapton HNHMW	7e15		yes	TS
Dupont	Kapton TAB-E	1e17		yes	TS
Dupont	Kapton HPP-F	2e15		yes	TS
Dupont	Tedlar 100BG30TR	4e15		no	Polyvinyl Flouride (PVF)
Dupont	Tedlar SE40BG2	5e15		yes	PVF
Dupont	Tedlar TTR10BG3	2e16		yes	PVF
Dupont	White Tedlar	1e16		yes	PVF+TiO_2,200μm detector,(2)
Dupont	White Tedlar*	9e15		no	PVF+TiO_2
Goodfellows	PVDF (non-piezo)	1e16		yes	
Goodfellows	PVDF (non-piezo)*	2e16		yes	

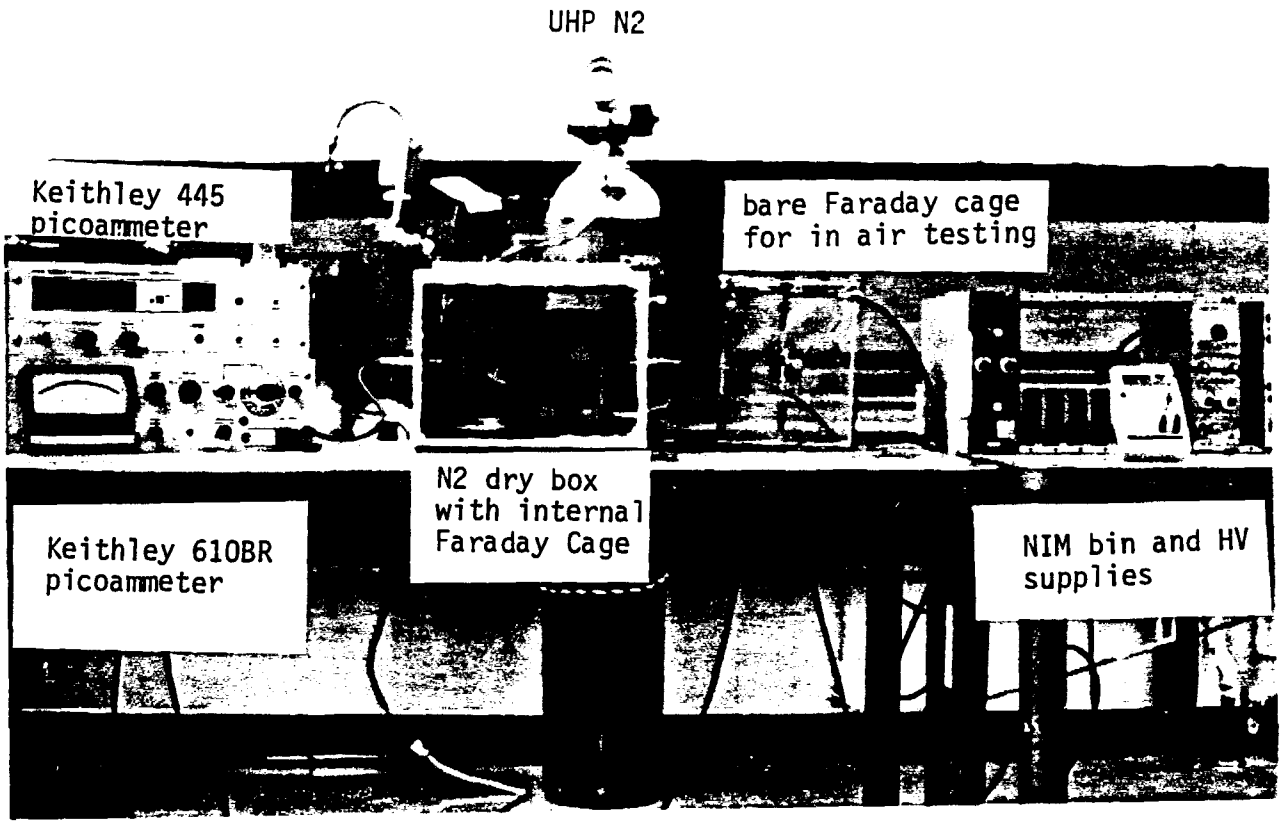
Resistivity Master Table Continued

Company	Sample Name	Resistance @1000V (Ω/sq)		Ohmic (0→2.5KV)	Notes & Comments
		Air	Dry N_2		
ICI	Rx-91191	7e10		yes	Stainless steel loaded,TP
ICI	Rx-91191*	4e11		yes	Stainless steel loaded,TP
ICI	Rx-91193	2e10		yes	Stainless steel loaded,TP
ICI	Rx-91195	4e10		yes	Stainless steel loaded,TP
ICI	Rx-91195*	2e10		yes	Stainless steel loaded,TP
ICI	Polypropylene	6e14		yes	TP
KYOCERA	Ceramic	7e14	3e16	yes	200μm detector,(1)
LNP	Rx-91592	7e14		yes	ABS/Copolyether,TP
LNP	Rx-91616	3e12		yes	ABS/Copolyether,TP
LNP	Rx-91653	3e11		yes	ABS/Copolyether,TP
LNP	Rx-91657	2e11	5e12	yes	ABS/Copoly.,TP,200μm detector,high rate tests
LNP	Rx-91662	3e12		yes	ABS/Copolyether,TP
LNP	Rx-91703	3e10		yes	ABS/Copolyether,TP
LNP	Rx-91704	3e10		yes	ABS/Copolyether,TP
LNP	Rx-91710	6e11		yes	ABS/Copolyether,TP
LNP	Rx-91712	5e10		yes	ABS/Copolyether,TP
LNP	Rx-92042	2e12		yes	Polyester/Copolyether,(2),TP
Mobay	Texin 4215	2e13		yes	Polyurethane+Polycarbonate
Mobay	Texin 445-D	6e12		yes	Polyurethane
Mobay	Texin 480AR	4e13		yes	Polyurethane
Mobay	Texin 480AR*	2e13		yes	Polyurethane
Mobay	Texin 970-D	1e16		no	Polyurethane
Mobay	Texin DP-7-1047	1.5e15		yes	Polyurethane
Mobay	TMM10	1e16		yes	Polyurethane
Montreal Poly.	a:Si on Kapton	2e11		yes	TS
MPI	Mylar	2e10		no	Treated with e− beam
MRC	Ceramic	7e14	1e16	no	
Pyrex	rolled glass	5e16		yes	
Pyrex	rolled glass*	8e14		no	
Rogers/ICI	Upilex-S	4e16		yes	200&100μm detector,(1,2),TS
Rogers/ICI	Upilex-S*	7e15		yes	Polyimide,TS
Schott	Pestov glass	2e12	2e12	yes	Fe/V,200μm detector,(2)
Schott	Tempax glass	3e15	4e15	yes	Borosilicate,200μm detector
Schott	Tempax glass*	1e15		yes	Borosilicate
Sheldahl	Ge on Kapton#1	3e9		yes	Germanium, TS

Resistivity Master Table Continued 2

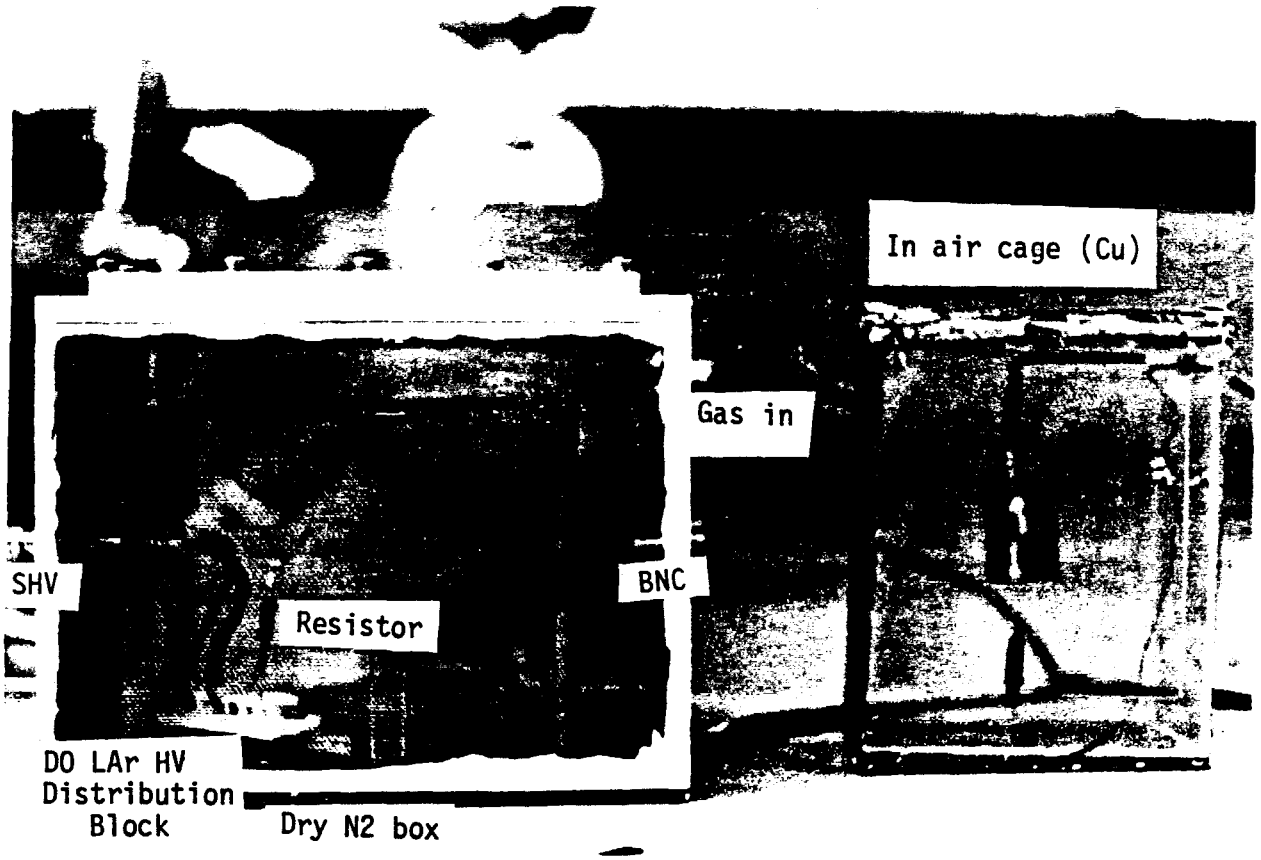
Company	Sample Name	Resistance @1000V (Ω/sq)		Ohmic (0→2.5KV)	Notes & Comments
		Air	Dry N_2		
Sheldahl	Ge on Kapton#2	2e13		yes	Germanium, TS
Spire	Kapton(implanted)	4e13		yes	1e15 Ar^+, 200μm detector,(3),TS
Spire	Kapton(implanted)	8e9	8e9	yes	2.3e16 Ar^+, TS
Spire	Kapton(implanted)	1e11	7e11	yes	3e16 Ar^+, TS
Spire	Kapton(implanted)	1e14	1e14	yes	4e16 Ar^+,(3), TS
Spire	Upilex-S(implanted)	1e11		yes	1e15 Ar^+,(1,2),TS, too noisy
U.Florida	Polydimethylsiloxane	7e13		yes	Gel
Lustro	Cellulose Acetate	2e15		yes	Difficult to metalize
Lustro	Cellulose Acetate*	2e15		no	
Commercial	Nylon 46	3e15		yes	

Legend	
Symbol	Meaning
TS	Thermoset
TP	Thermoplastic
*	Post irradiation measurement
(1)	Metalized with Au
(2)	Metalized with Al
(3)	Metalized with Ti + Au
+	Kaptons in general were too resistive to measure in dry N_2



Texas A&M Substrate Resistivity Rig

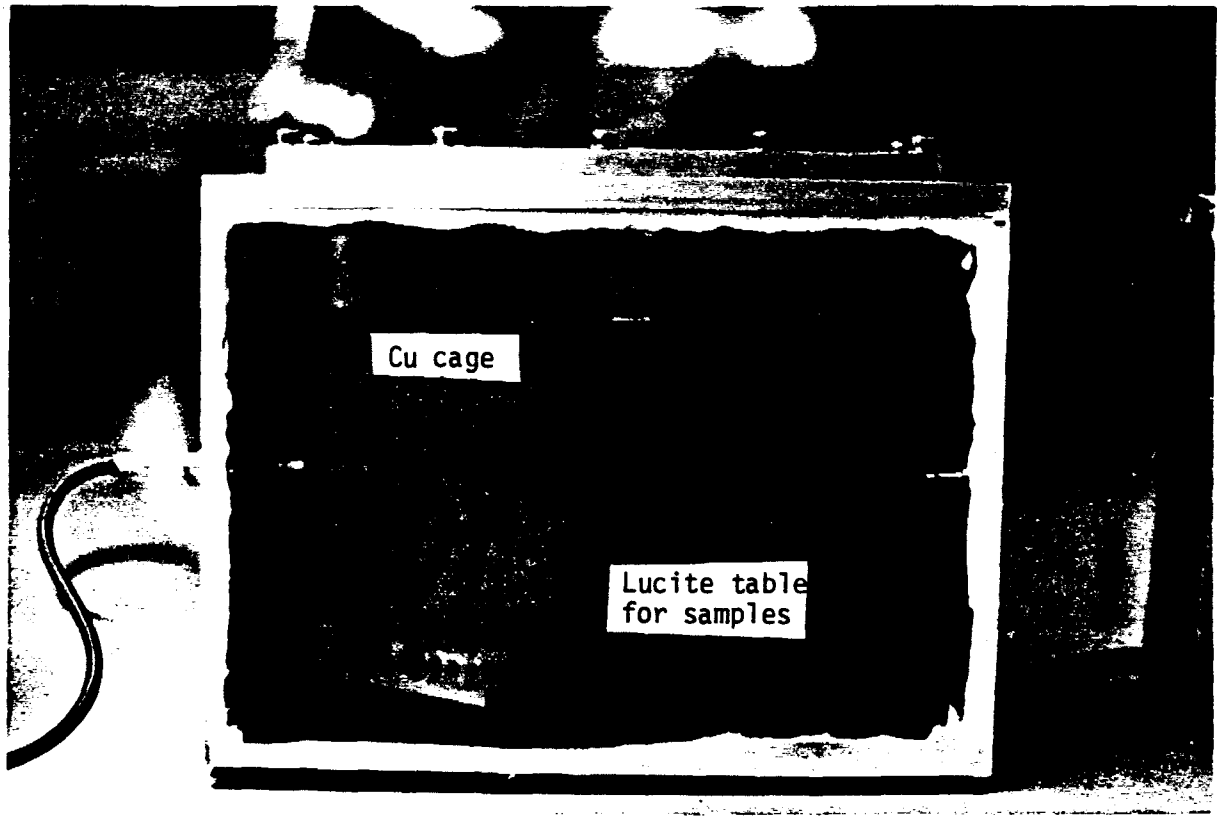
Figure 1.



Test Enclosures

Figure 2.

N2 enclosure



in air enclosure

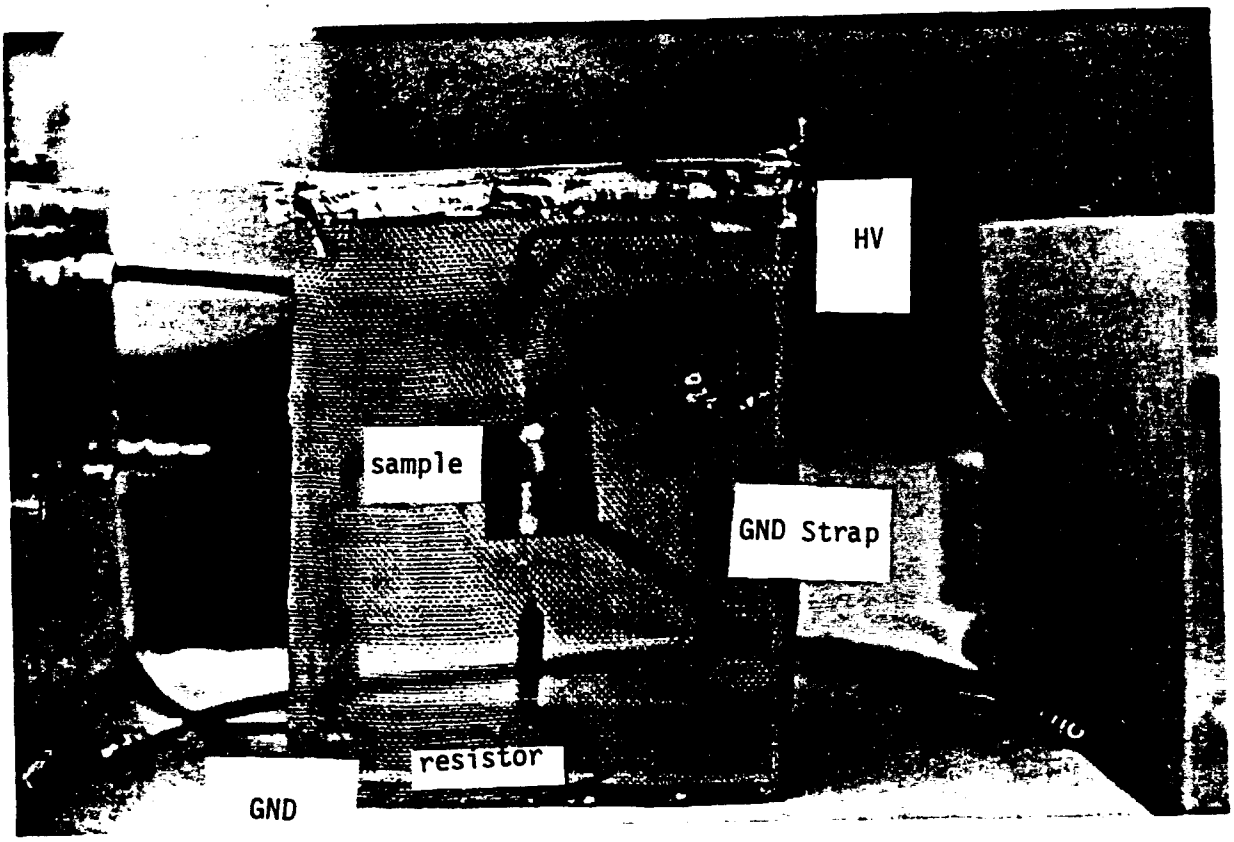
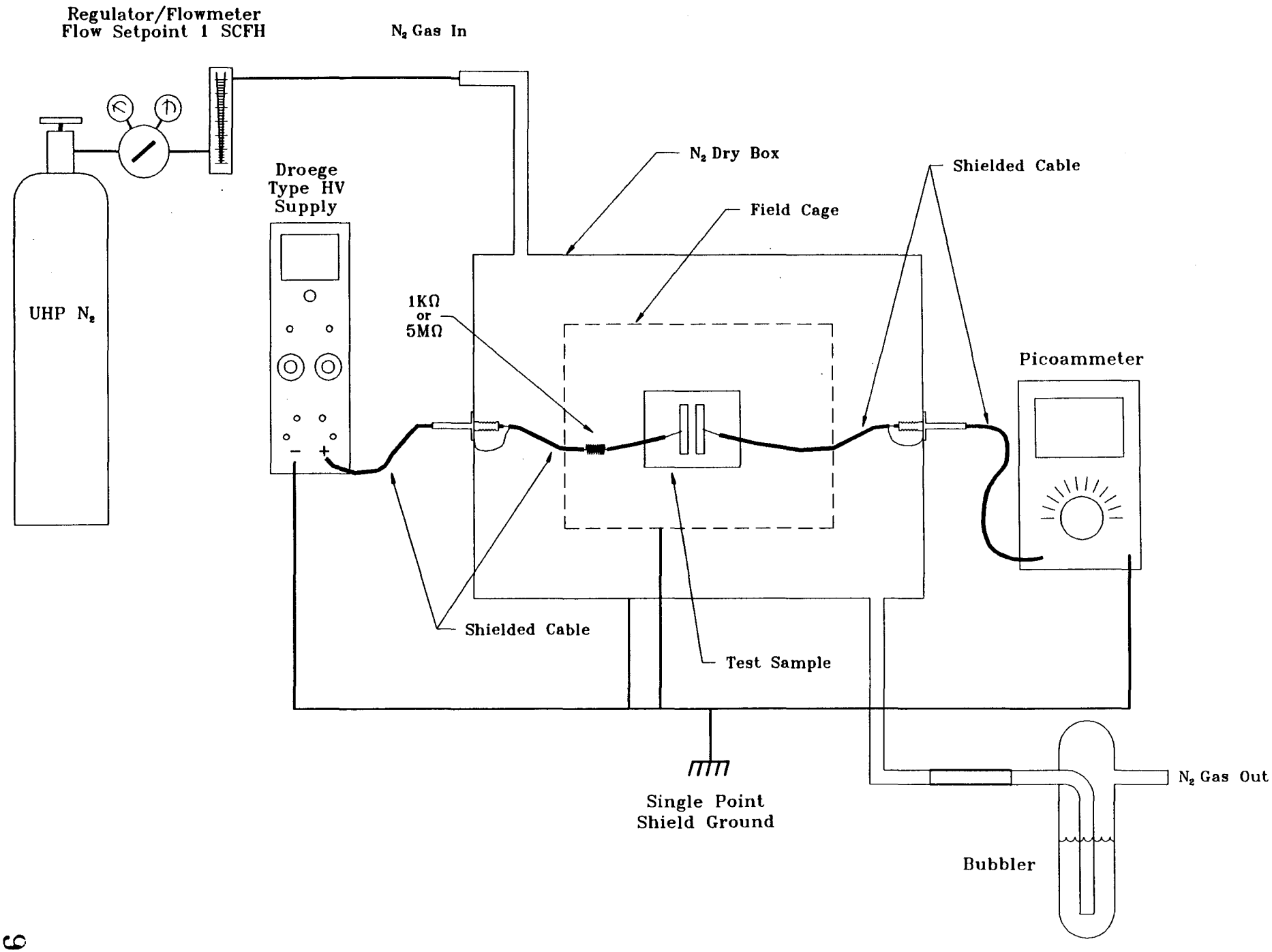
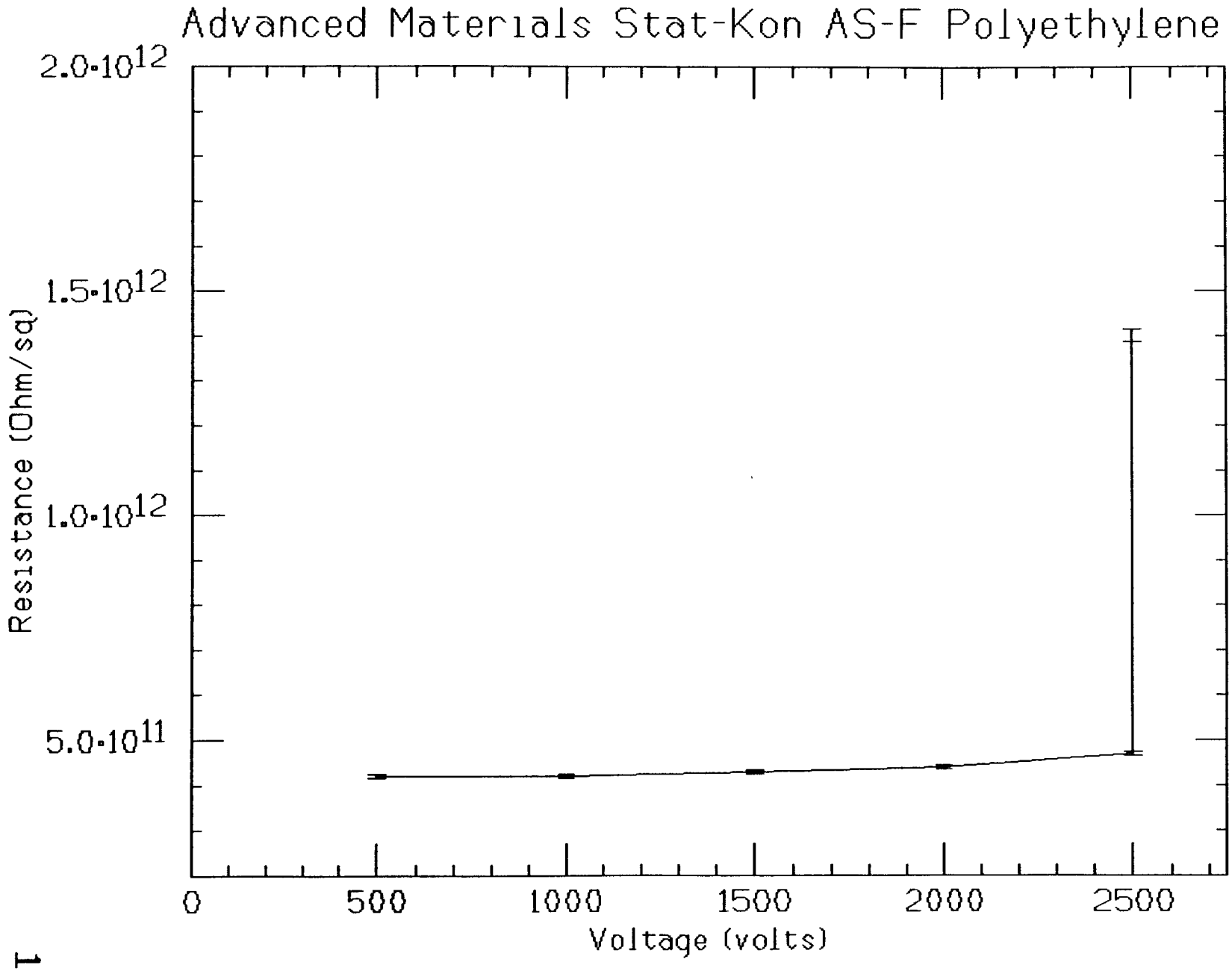
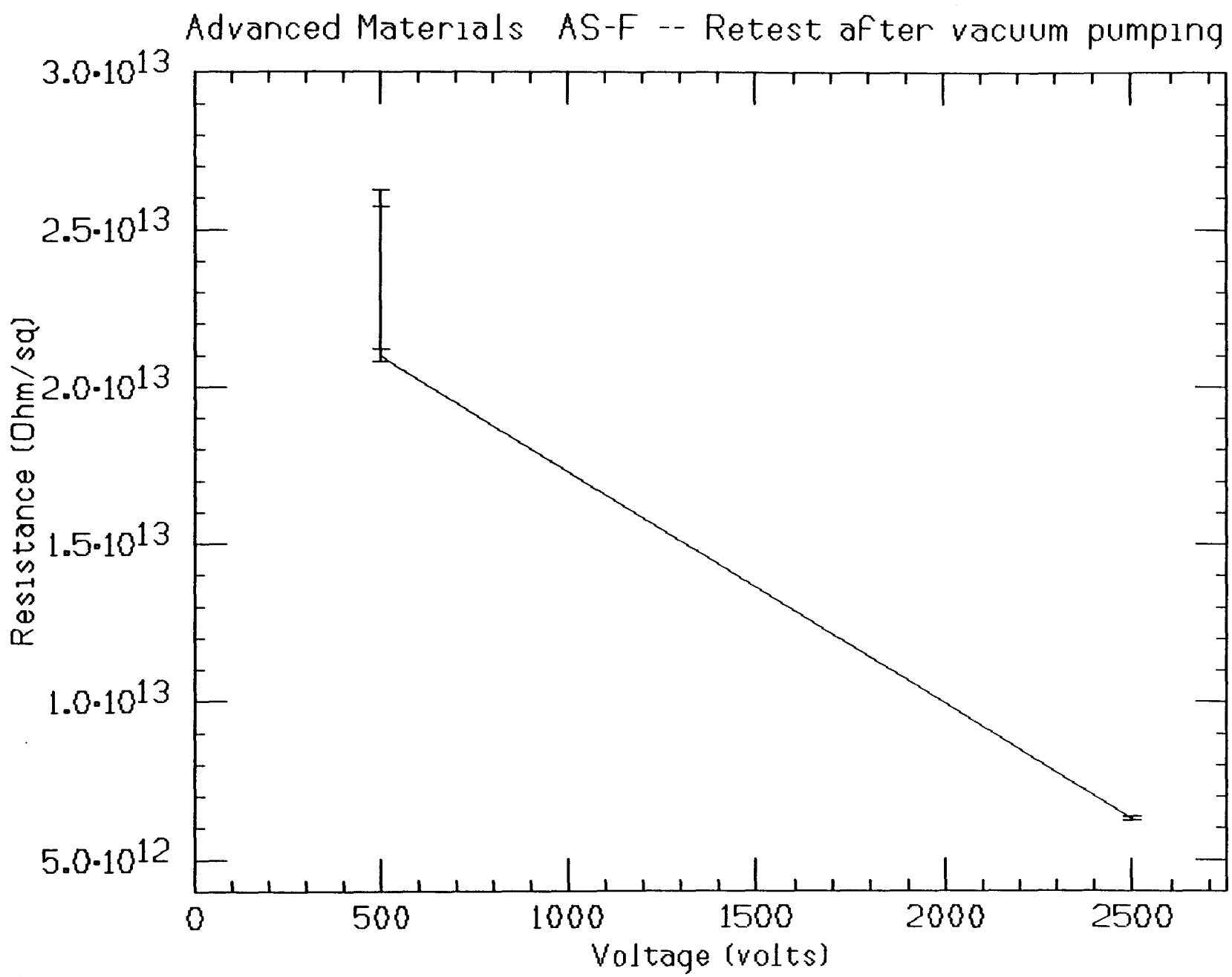


Figure 3.

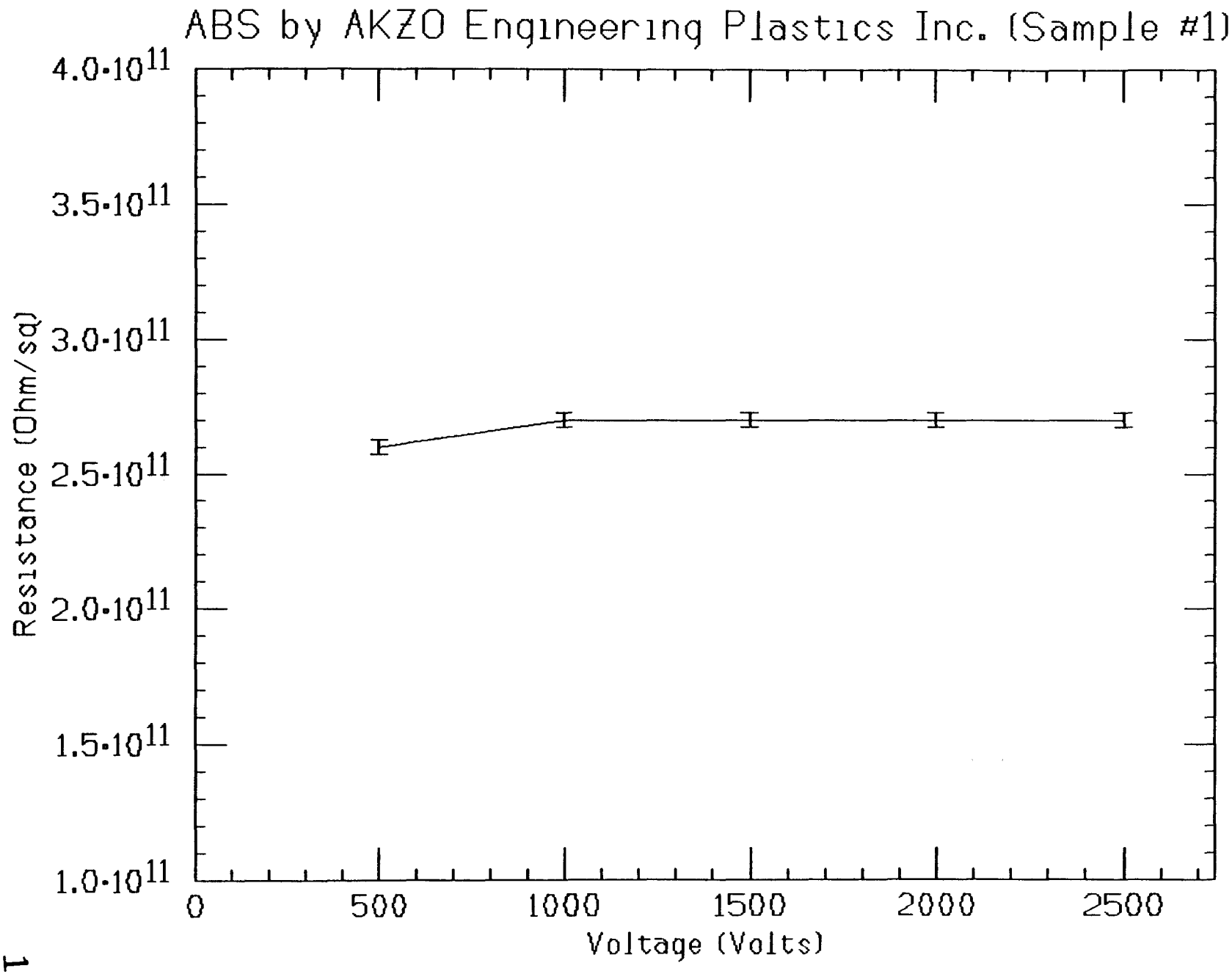

Regulator/Flowmeter
Flow Setpoint 1 SCFH
N_2 Gas In
UHP N_2
Droege
Type HV
Supply
N_2 Dry Box
Field Cage
Shielded Cable
1KΩ
or
5MΩ
Picoammeter
Shielded Cable
Test Sample
Single Point
Shield Ground
N_2 Gas Out
Bubbler

Advanced Materials Stat-kon AS-F Polyethylene $\frac{5}{8}$inch electrode length X $\frac{1}{16}$inch gap X $\frac{5}{32}$inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
6-5-91				**100KΩ resistor in series**
18:58	+500	1.2e-8	4.2e11	
19:00	+1000	2.4e-8	4.2e11	
19:01	+1500	3.5e-8	4.3e11	
19:02	+2000	4.5e-8	4.4e11	
19:03	+2500	5.3e-8	4.7e11	**heated w/ heat gun (2ft away), stablizes**
19:05	+2500	2.6e-8	9.6e11	**after several seconds.**
19:06	+2500	2.5e-8	1e12	
19:08	+2500	2.6e-8	9.6e11	**Voltage left on overnight.**
6-6-91				
11:25	+2500	1.8e-8	1.4e12	**Jumpy ±.2e-8Amps.**
11:26	+2000	1.1e-8	1.8e12	
17:36	+2000	1.4e-8	1.4e12	**HV off**
6-10-91	**Vacuum pump for two cycles, 1st cycle-24hrs. vac, then 48hrs to air. 2nd cycle-8hrs vac,then retest. Sample heated severly with heat gun to boil off toluene to trace, slight softening of paint.**			
17:58	+500	1.9e-10	2.6e13	**Current going up steadily.**
18:00	+500	2.5e-10	2.1e13	
18:01	+2500	4e-9	6.3e12	**+1e-9Amp pulses.**
6-11-91	**8:36 Power supply tripped off at sometime overnight**			


Advanced Materials Stat-Kon AS-F Polyethylene
2.0·10^12
1.5·10^12
1.0·10^12
5.0·10^11
Resistance (Ohm/sq)
0
500
1000
1500
2000
2500
Voltage (volts)


Advanced Materials AS-F -- Retest after vacuum pumping
3.0·10^13
2.5·10^13
2.0·10^13
1.5·10^13
1.0·10^13
5.0·10^12
Resistance (Ohm/sq)
0
500
1000
1500
2000
2500
Voltage (volts)

ABS by AKZO Engineering Plastics Inc. (Sample #1) 2inch electrode length X $\frac{1}{16}$inch gap X $\frac{1}{8}$inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
12-5-91				
13:30	+500	6.15e-8	2.6e11	**Very stable throughout.**
13:45	+500	6e-8	2.7e11	
13:46	+1000	1.2e-7	2.7e11	
13:50	+1000	1.2e-7	2.7e11	
13:51	+1500	1.82e-7	2.7e11	
13:55	+1500	1.81e-7	2.7e11	
13:56	+2000	2.45e-7	2.7e11	
14:00	+2000	2.4e-7	2.7e11	
14:01	+2500	3e-7	2.7e11	
14:07	+2500	2.9e-7	2.7e11	


ABS by AKZO Engineering Plastics Inc. (Sample #1)
Resistance (Ohm/sq)
4.0·10^11
3.5·10^11
3.0·10^11
2.5·10^11
2.0·10^11
1.5·10^11
1.0·10^11
0
500
1000
1500
2000
2500
Voltage (Volts)

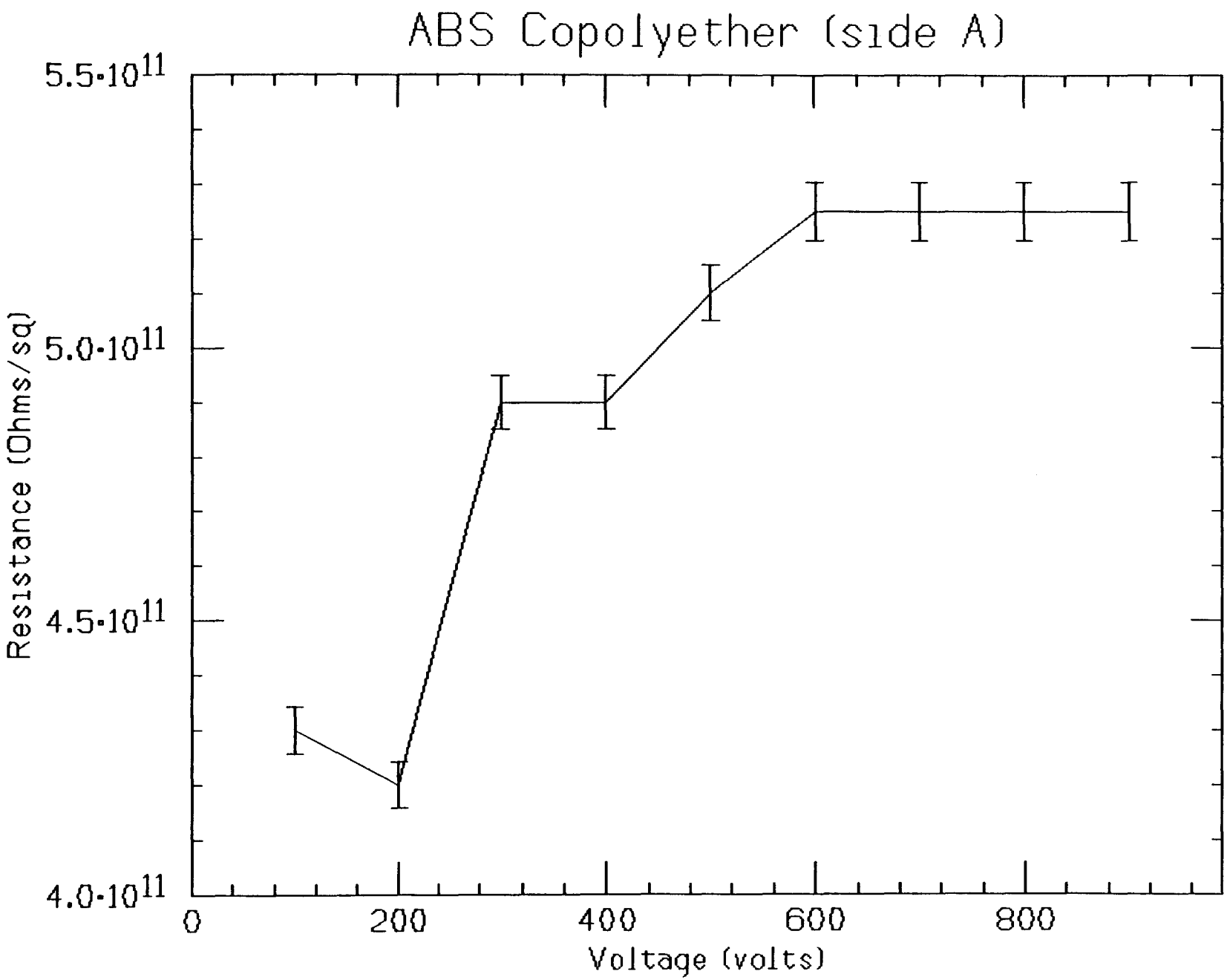
ABS by AKZO Engineering Plastics Inc. (Sample #2) 2inch electrode length X $\frac{1}{16}$inch gap X $\frac{1}{8}$inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
12-9-91				
13:30	+501	6.7e-8	2.4e11	**Very stable throughout.**
13:45	+501	6.8e-8	2.4e11	
13:46	+1001	1.4e-7	2.3e11	
13:50	+1001	1.4e-7	2.3e11	
13:51	+1502	2.1e-7	2.3e11	
13:55	+1502	2.1e-7	2.3e11	
13:56	+2000	2.8e-7	2.3e11	
14:00	+2000	2.8e-7	2.3e11	
14:01	+2500	3.5e-7	2.3e11	
14:07	+2500	3.5e-7	2.3e11	

ABS by AKZO Engineering Plastics Inc. (Sample #3) 2inch electrode length X $\frac{1}{16}$inch gap X $\frac{1}{8}$inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
12-9-91				
13:35	+501	1.5e-7	1.1e11	**Very stable throughout.**
13:36	+501	1.5e-7	1.1e11	
13:37	+1001	3e-7	1.1e11	
13:40	+1001	2.8e-7	1.1e11	
13:41	+1500	4.2e-7	1.1e11	
13:45	+1500	4e-7	1.1e11	
13:46	+2000	5.3e-7	1.2e11	
13:52	+2000	5e-7	1.2e11	
13:55	+2500	6.4e-7	1.3e11	
14:00	+2500	6e-7	1.3e11	**Signs of breakdown ±.1e-7Amps**

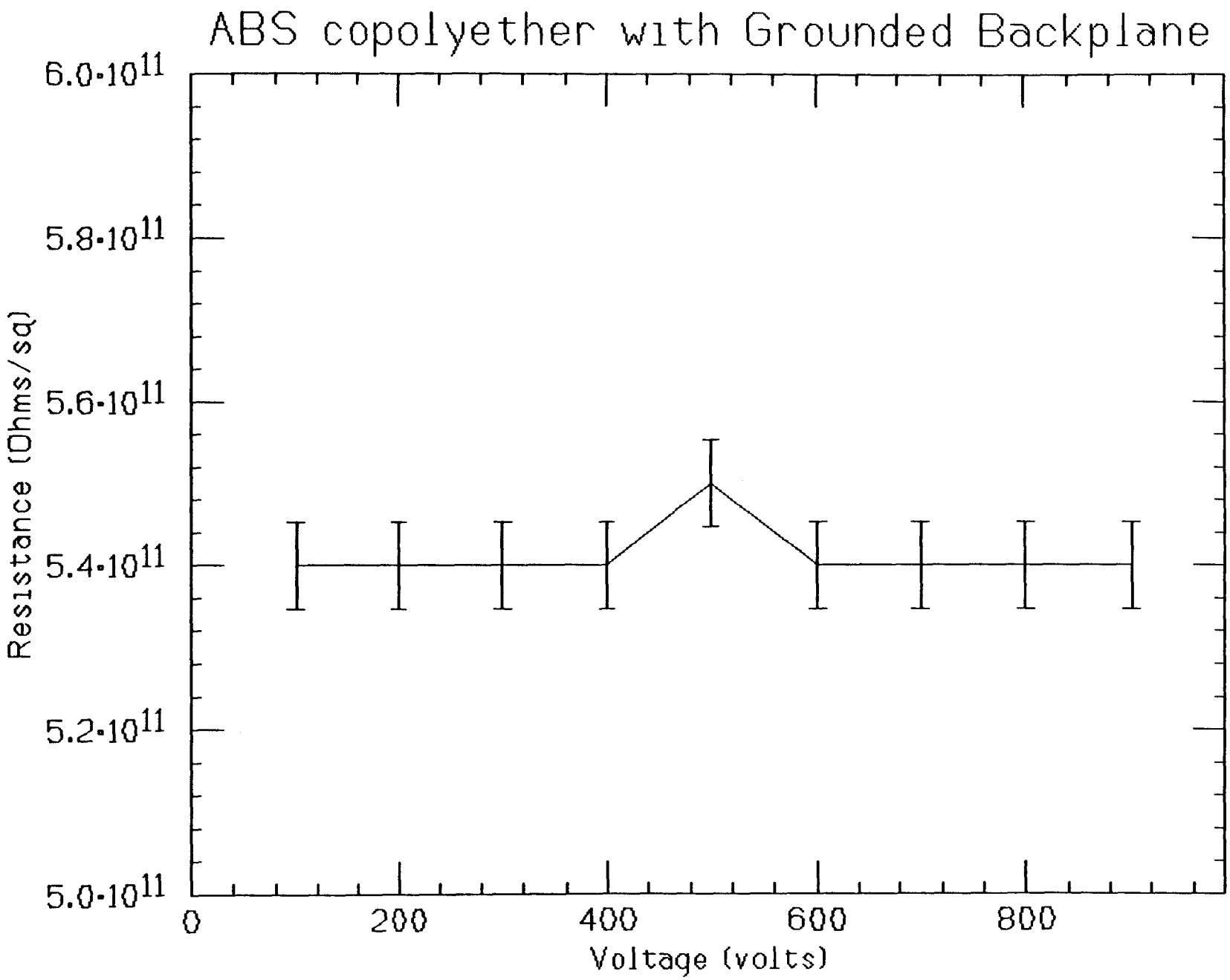
ABS Copolyether (side A)

1.75inch electrode length X $\frac{1}{16}$inch gap X $\frac{1}{8}$inch substrate thickness

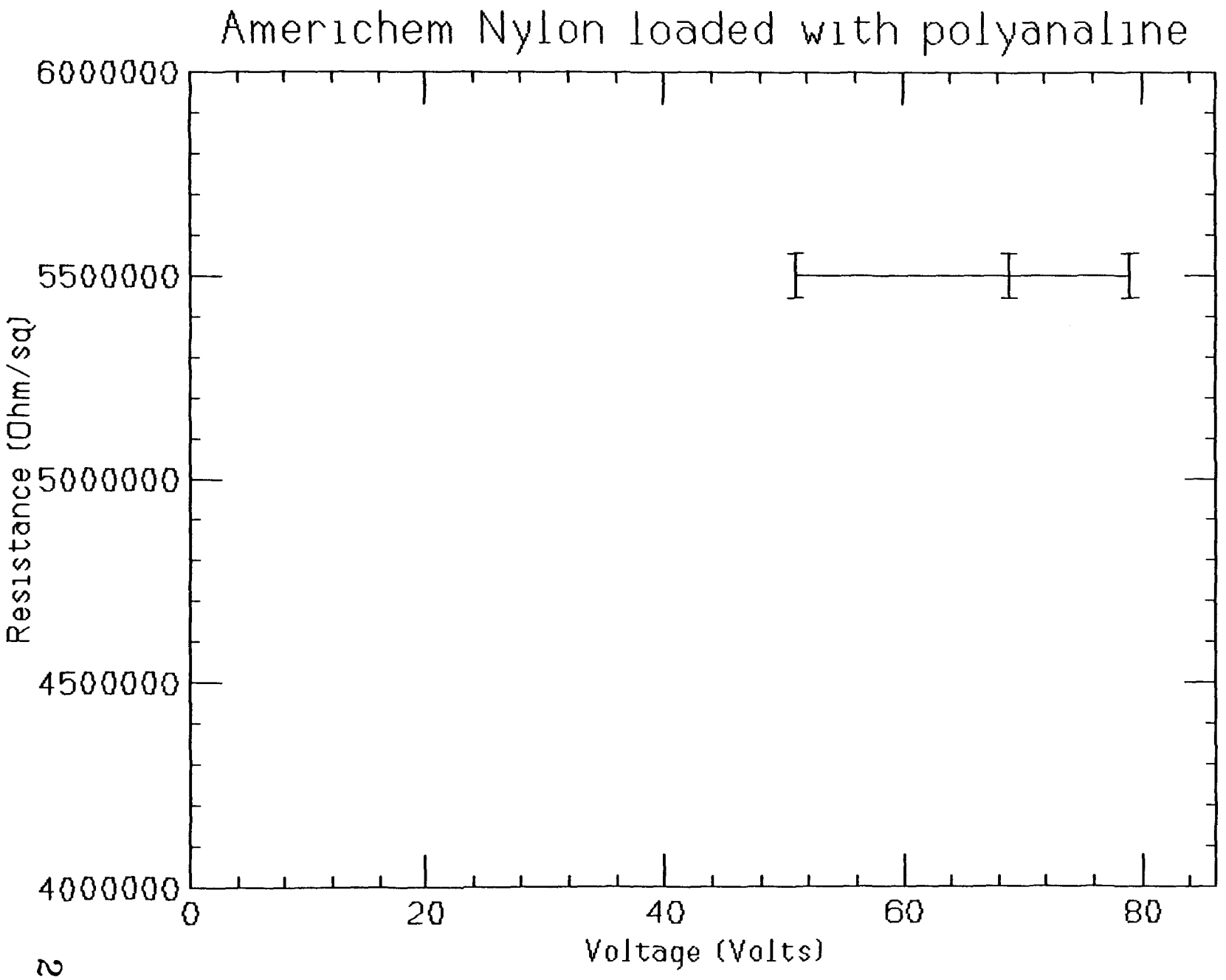
Date & Time	Voltage (volts)	Current (Amps)	Resistance (Ohms/sq)	Notes & Comments
2-26-92				
14:10	-100	6.5e-9	4.3e11	**Stable throughout**
14:15	-100	6.3e-9	4.4e11	
14:16	-201	1.15e-8	4.2e11	
14:20	-300	1.7e-8	4.9e11	
14:23	-400	2.2e-8	4.9e11	
14:25	-500	2.7e-8	5.1e11	
14:27	-601	3.2e-8	5.25e11	
14:30	-700	3.7e-8	5.25e11	
14:32	-800	4.2e-8	5.25e11	
14:35	-900	4.75e-8	5.25e11	
Sample removed and grounded back plane was painted on.				


ABS Copolyether (side A)
5.5·10^11
5.0·10^11
4.5·10^11
4.0·10^11
Resistance (Ohms/sq)
0
200
400
600
800
Voltage (volts)

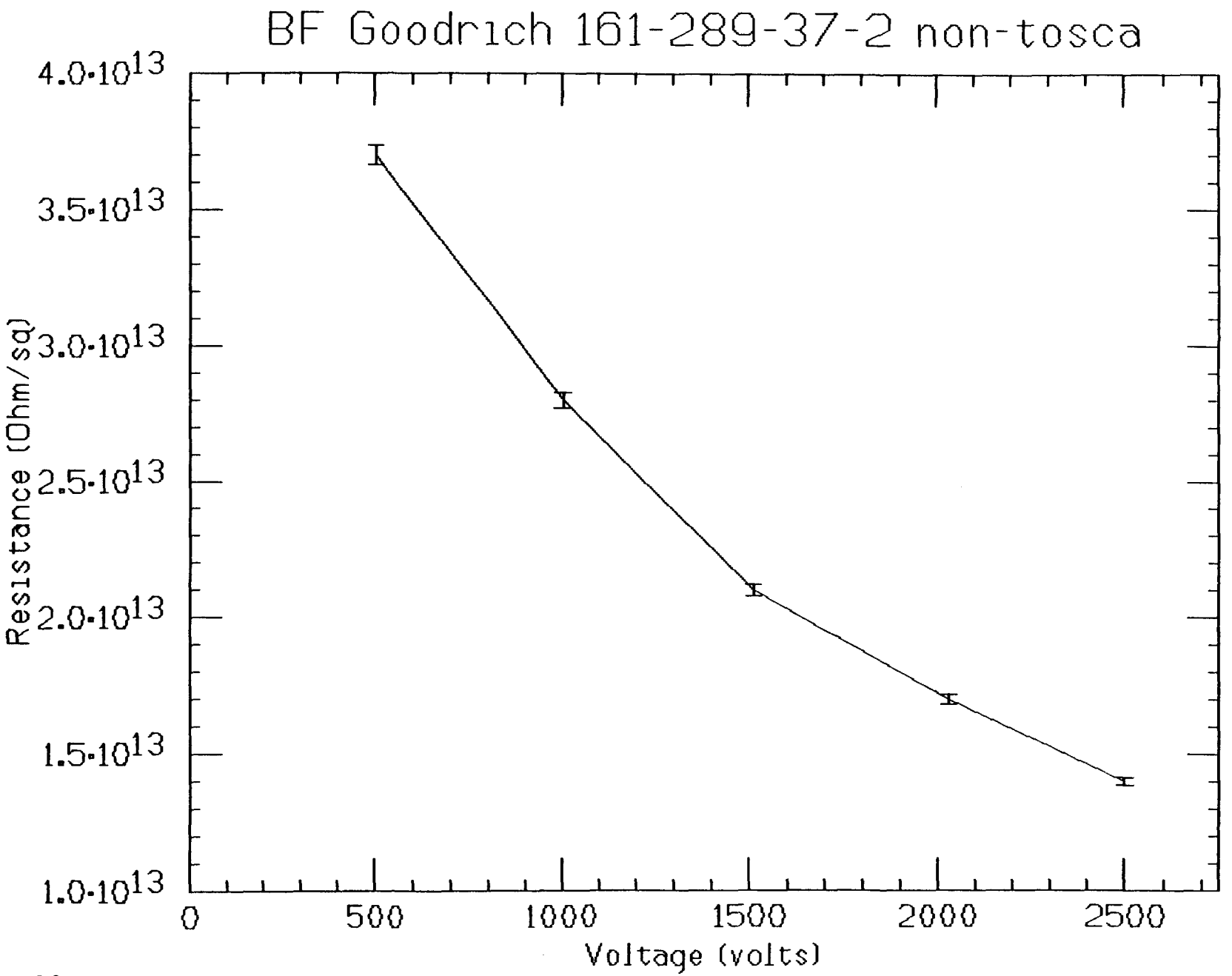
ABS Copolyether with Grounded Backplane 1.75inch electrode length X $\frac{1}{16}$inch gap X $\frac{1}{8}$inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
2-27-92				
14:00	-100	6.4e-9	5.4e11	**Stable throughout.**
14:15	-201	1.05e-8	5.4e11	
14:20	-201	1.05e-8	5.4e11	
14:21	-300	1.55e-8	5.4e11	
14:25	-400	2.05e-8	5.4e11	
14:27	-500	2.55e-8	5.4e11	
14:30	-601	3.1e-8	5.5e11	
14:32	-700	3.6e-8	5.4e11	
14:35	-800	4.1e-8	5.4e11	
14:40	-901	4.65e-8	5.4e11	
15:00	-901	4.7e-8	5.4e11	


ABS copolyether with Grounded Backplane
6.0·10^11
5.8·10^11
5.6·10^11
5.4·10^11
5.2·10^11
5.0·10^11
Resistance (Ohms/sq)
0
200
400
600
800
Voltage (volts)

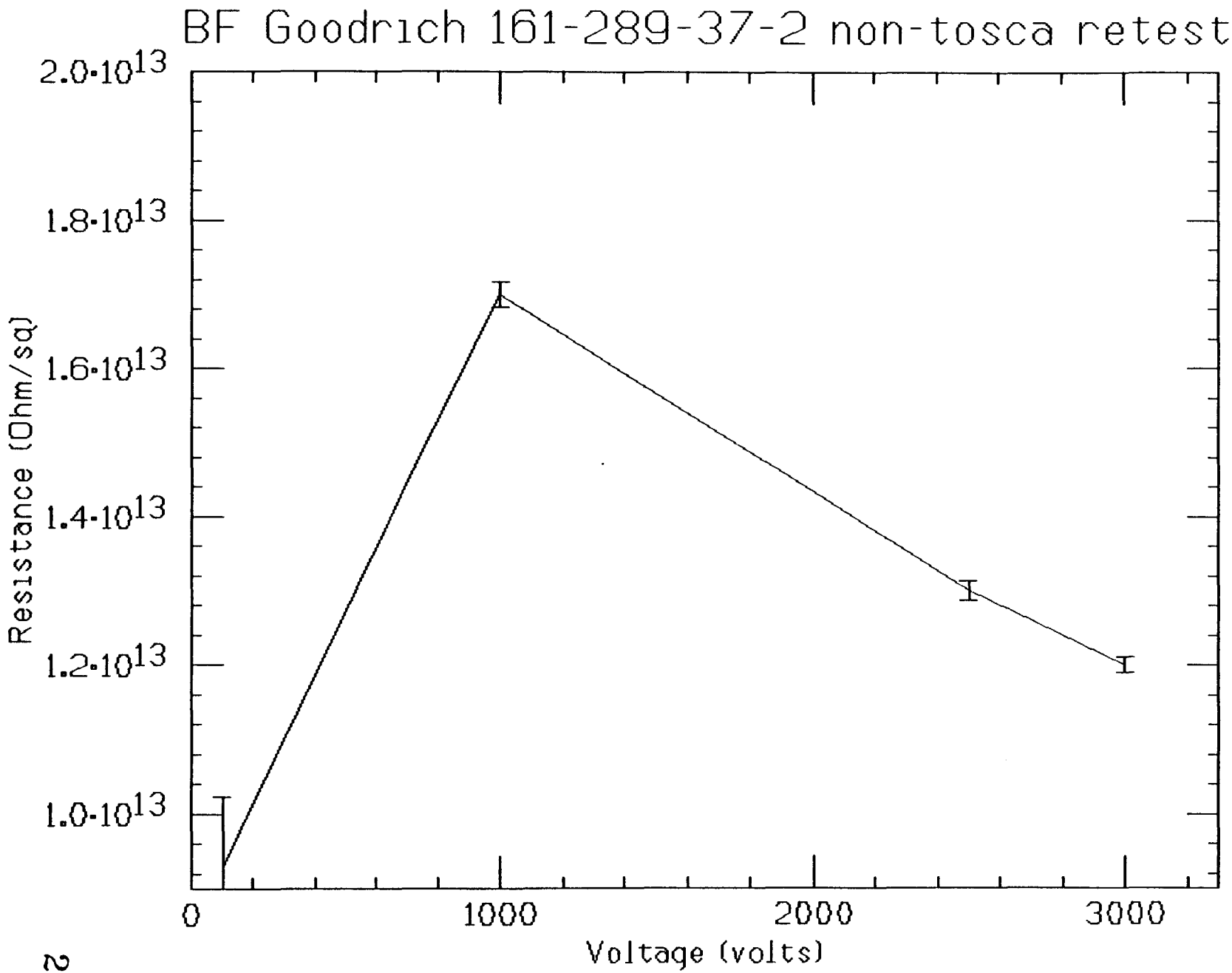
Americhem Nylon loaded with polyanaline 2inch electrode length X $\frac{1}{16}$inch gap X .018inch substrate thickness				
Date & Time	**Voltage (Volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
6-5-91				**100KΩ Resistor is series**
18:48	+51	3e-4	5.5e6	
18:50	+69	4.4e-4	5.5e6	
18:51	+79	5.5e-4	5.5e6	


Americhem Nylon loaded with polyanaline
6000000
5500000
5000000
4500000
4000000
Resistance (Ohm/sq)
0
20
40
60
80
Voltage (Volts)

BF Goodrich 161-289-37-2 non-tosca 1.75inch electrode length X $\frac{1}{16}$inch gap X .125inch substrate thickness				
Date & Time	**Voltage (Volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
8-21-91				
18:35	+502	5.7e-10	2.5e13	Current falling slowly.
18:41	+502	3.8e-10	3.7e13	
18:43	+1004	1.3e-9	2.2e13	Current falling very slowly.
18:45	+1004	1.02e-9	2.8e13	Stable
18:46	+1512	2.2e-9	1.9e13	
18:48	+1512	2e-9	2.1e13	
18:49	+1512	2e-9	2.1e13	
18:50	+2030	3.3e-9	1.7e13	
18:55	+2030	3.4e-9	1.7e13	
18:58	+2500	4.8e-9	1.5e13	
19:10	+2500	5e-9	1.4e13	
21:15	+2500	4.95e-9	1.4e13	Stable

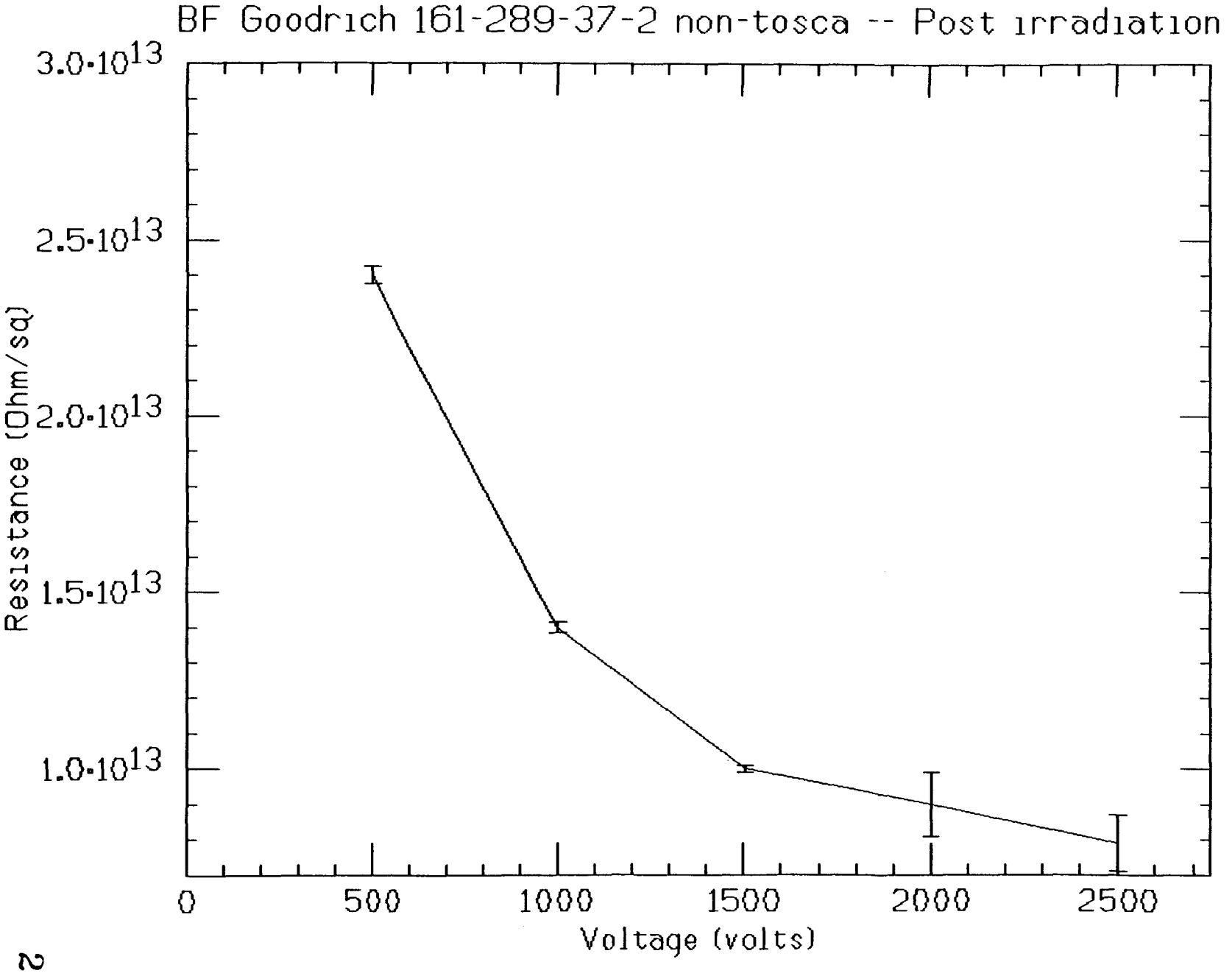

BF Goodrich 161-289-37-2 non-tosca
Resistance (Ohm/sq)
4.0·10^13
3.5·10^13
3.0·10^13
2.5·10^13
2.0·10^13
1.5·10^13
1.0·10^13
0
500
1000
1500
2000
2500
Voltage (volts)

BFGoodrich 161-289-37-2 non-tosca retest 1.75inch electrode length X $\frac{1}{16}$inch gap X .035inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
9-2-91				**Previous test had loose connection.**
13:02	+2500	5.2e-9	1.3e13	
13:25	+3000	6.8e-9	1.2e13	
13:30	+3000	6.8e-9	1.2e13	
13:36	+1000	1.6e-9	1.7e13	
13:44	+1000	1.6e-9	1.7e13	
15:15	+100	3e-10	9.3e12	**Allowed 1.5hrs for RC decay.**

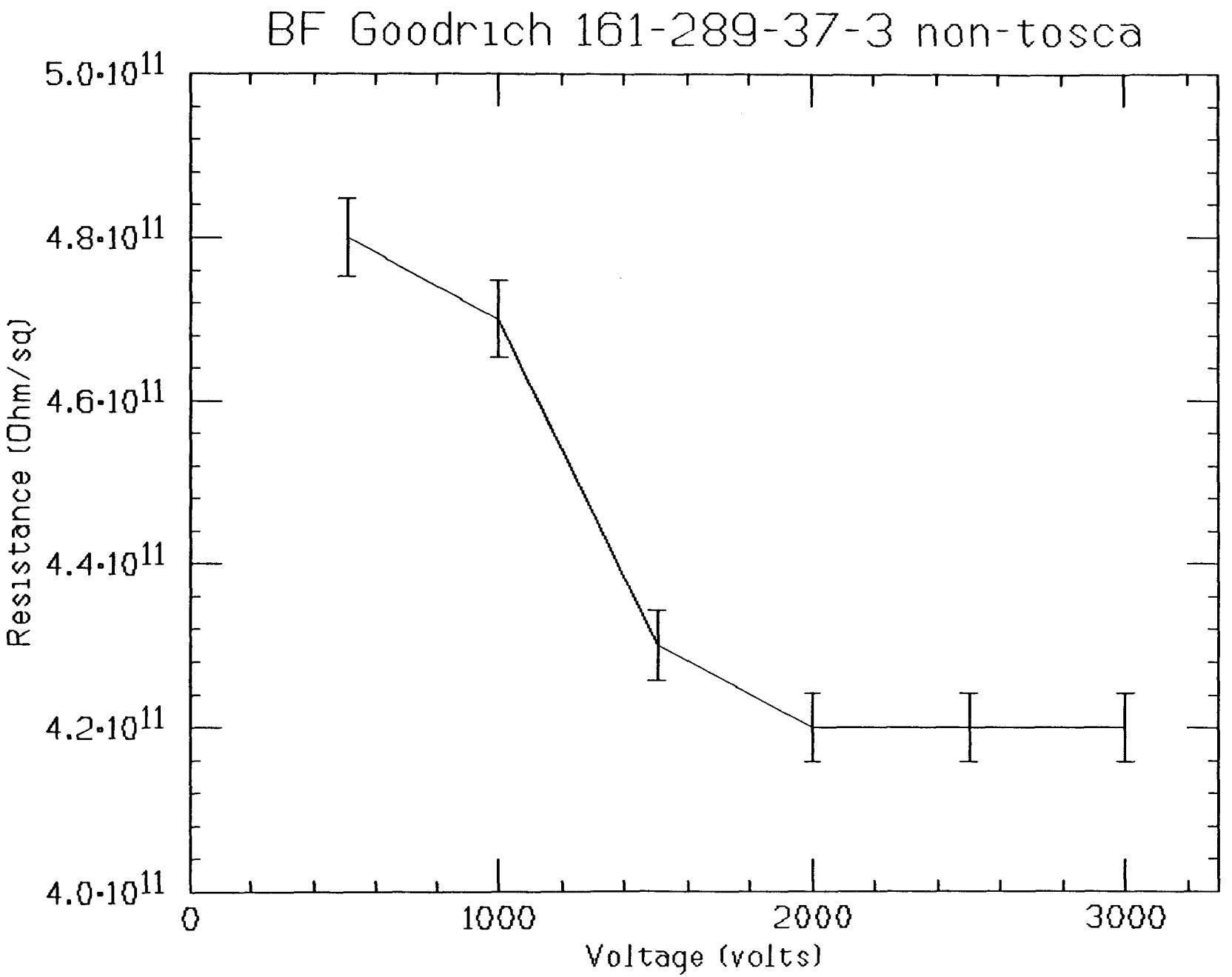

BF Goodrich 161-289-37-2 non-tosca retest
2.0·10^13
1.8·10^13
1.6·10^13
1.4·10^13
1.2·10^13
1.0·10^13
Resistance (Ohm/sq)
0
1000
2000
3000
Voltage (volts)

Retest after $10^{11} \frac{n}{cm^2}$ irradiation.
BFGoodrich 161-289-37-2 non-tosca
1.5inch electrode length X $\frac{1}{16}$inch gap X $\frac{1}{8}$inch thickness

Date & Time	Voltage (volts)	Current (Amps)	Resistance (Ohms/sq)	Notes & Comments
9-17-91				
10:48	+500	5.6e-10	2e13	
10:53	+500	5e-10	2.4e13	
10:54	+1002	1.6e-9	1.5e13	
11:02	+1002	1.7e-9	1.4e13	
11:03	+1503	3.2e-9	1.1e13	
11:10	+1503	3.4e-9	1e13	
11:11	+2000	5.2e-9	9e12	
11:17	+2000	5.3e-9	9e12	
11:18	+2500	7.4e-9	8e12	
11:23	+2500	7.5e-9	8e12	
11:30	+2500	7.6e-9	7.9e12	

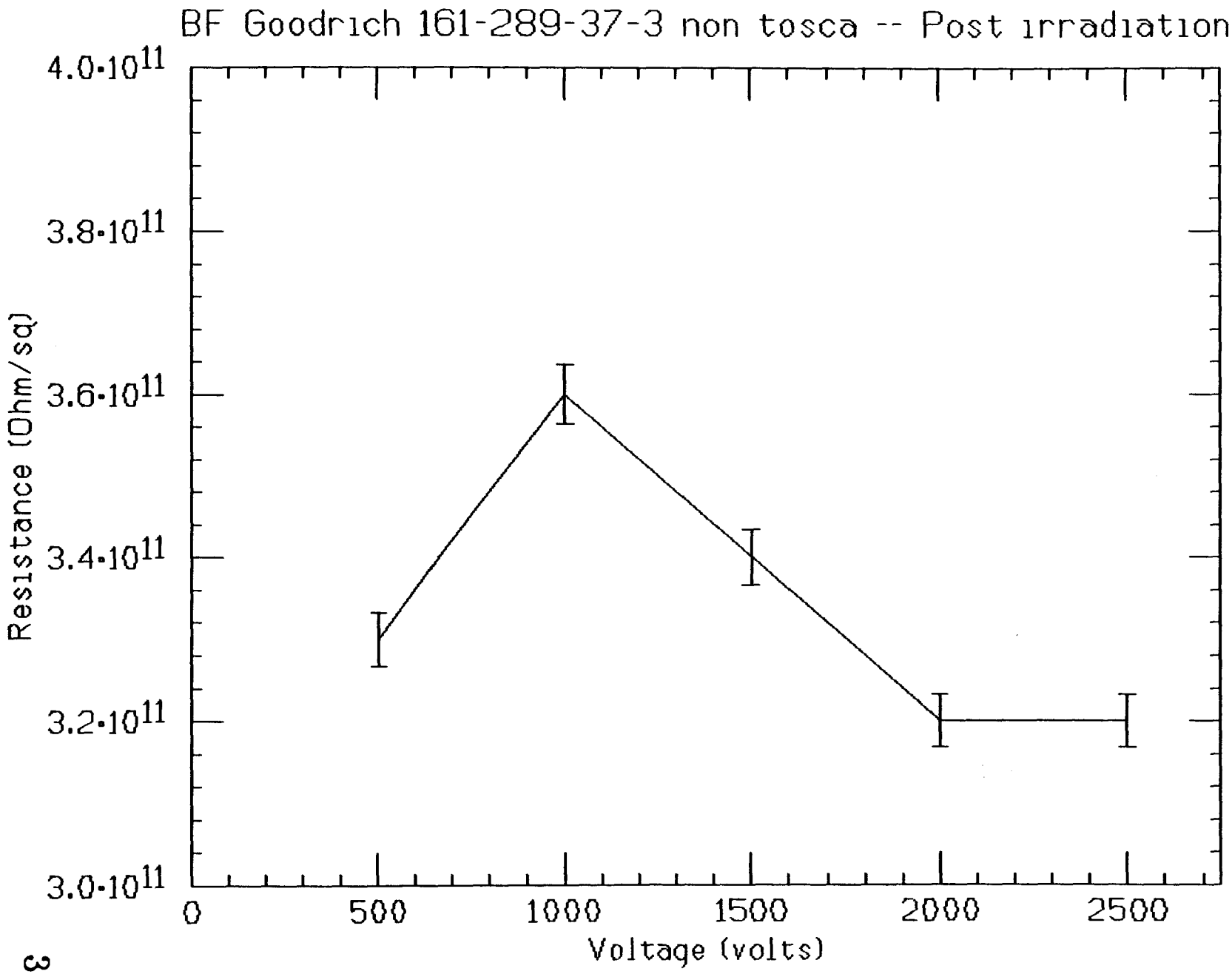

BF Goodrich 161-289-37-2 non-tosca -- Post irradiation
3.0·10^13
2.5·10^13
2.0·10^13
1.5·10^13
1.0·10^13
Resistance (Ohm/sq)
0
500
1000
1500
2000
2500
Voltage (volts)

BFGoodrich 161-289-37-3 non-tosca 2inch electrode length X $\frac{1}{16}$inch gap X .125inch substrate thickness				
Date & Time	**Voltage (Volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
9-2-91				
13:07	+505	3.4e-8	4.8e11	**Stable**
13:10	+1000	6.85e-8	4.7e11	
13:12	+1000	6.85e-8	4.7e11	
13:13	+1503	1.13e-7	4.3e11	
13:15	+2000	1.51e-7	4.2e11	
13:17	+2500	1.9e-7	4.2e11	
13:18	+3000	2.3e-7	4.2e11	

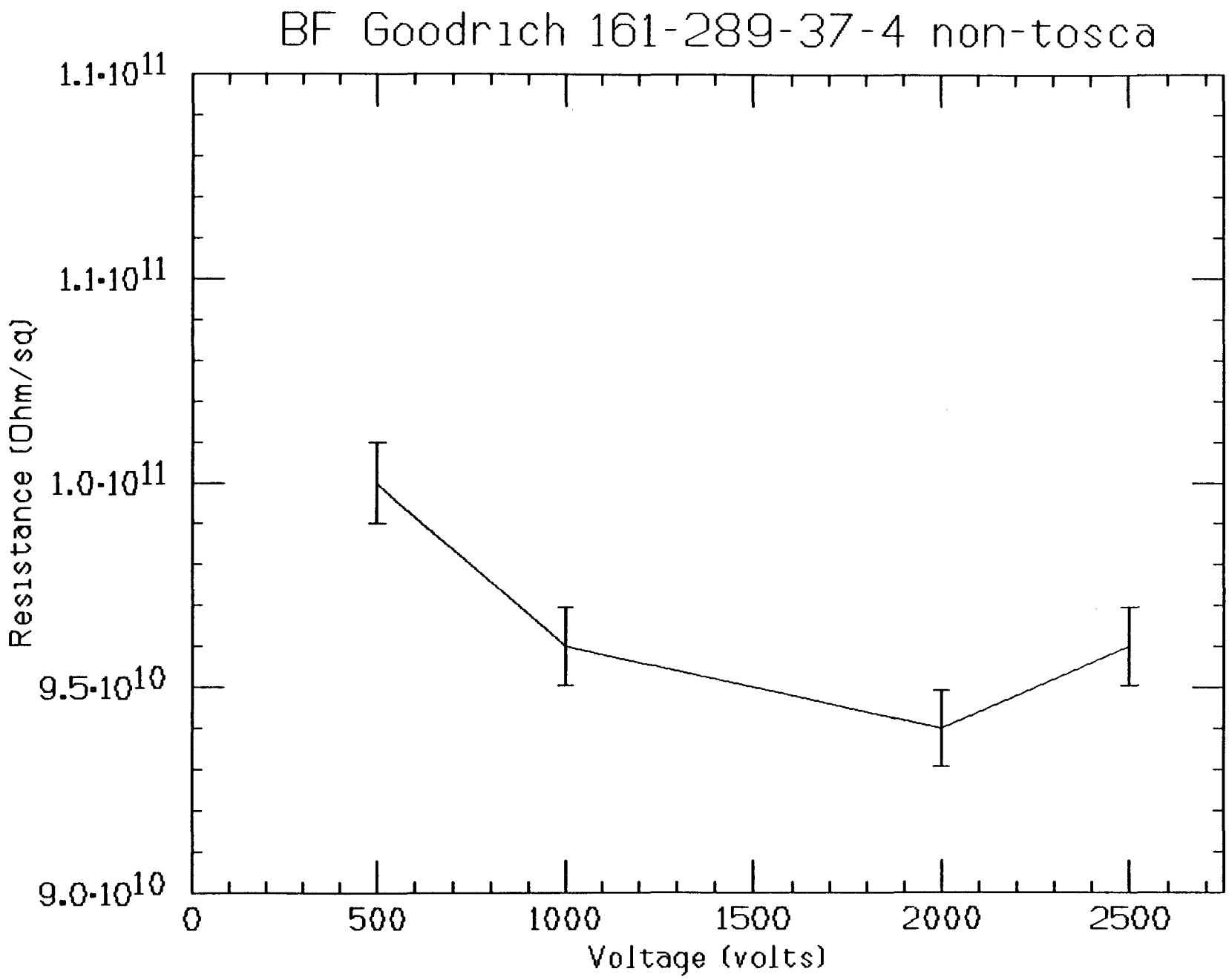

BF Goodrich 161-289-37-3 non-tosca
5.0·10^11
4.8·10^11
4.6·10^11
4.4·10^11
4.2·10^11
4.0·10^11
Resistance (Ohm/sq)
0
1000
2000
3000
Voltage (volts)

Retest after $10^{11} \frac{n}{cm^2}$ irradiation.
BFGoodrich 161-289-37-3 non tosca
2inch electrode length X $\frac{1}{16}$inch gap X $\frac{1}{16}$inch thickness

Date & Time	Voltage (volts)	Current (Amps)	Resistance (Ohms/sq)	Notes & Comments
9-17-91				
11:37	+502	5e-8	3.2e11	
11:42	+502	4.8e-8	3.3e11	
11:44	+1002	9e-8	3.6e11	
11:48	+1002	9e-8	3.6e11	
11:49	+1501	1.4e-7	3.4e11	
11:56	+1501	1.4e-7	3.4e11	
11:56	+2000	2e-7	3.2e11	
12:05	+2000	2e-7	3.2e11	
12:06	+2000	2.5e-7	3.2e11	
12:15	+2000	2.5e-7	3.2e11	


BF Goodrich 161-289-37-3 non tosca -- Post irradiation
4.0·10^11
3.8·10^11
3.6·10^11
3.4·10^11
3.2·10^11
3.0·10^11
Resistance (Ohm/sq)
0
500
1000
1500
2000
2500
Voltage (volts)

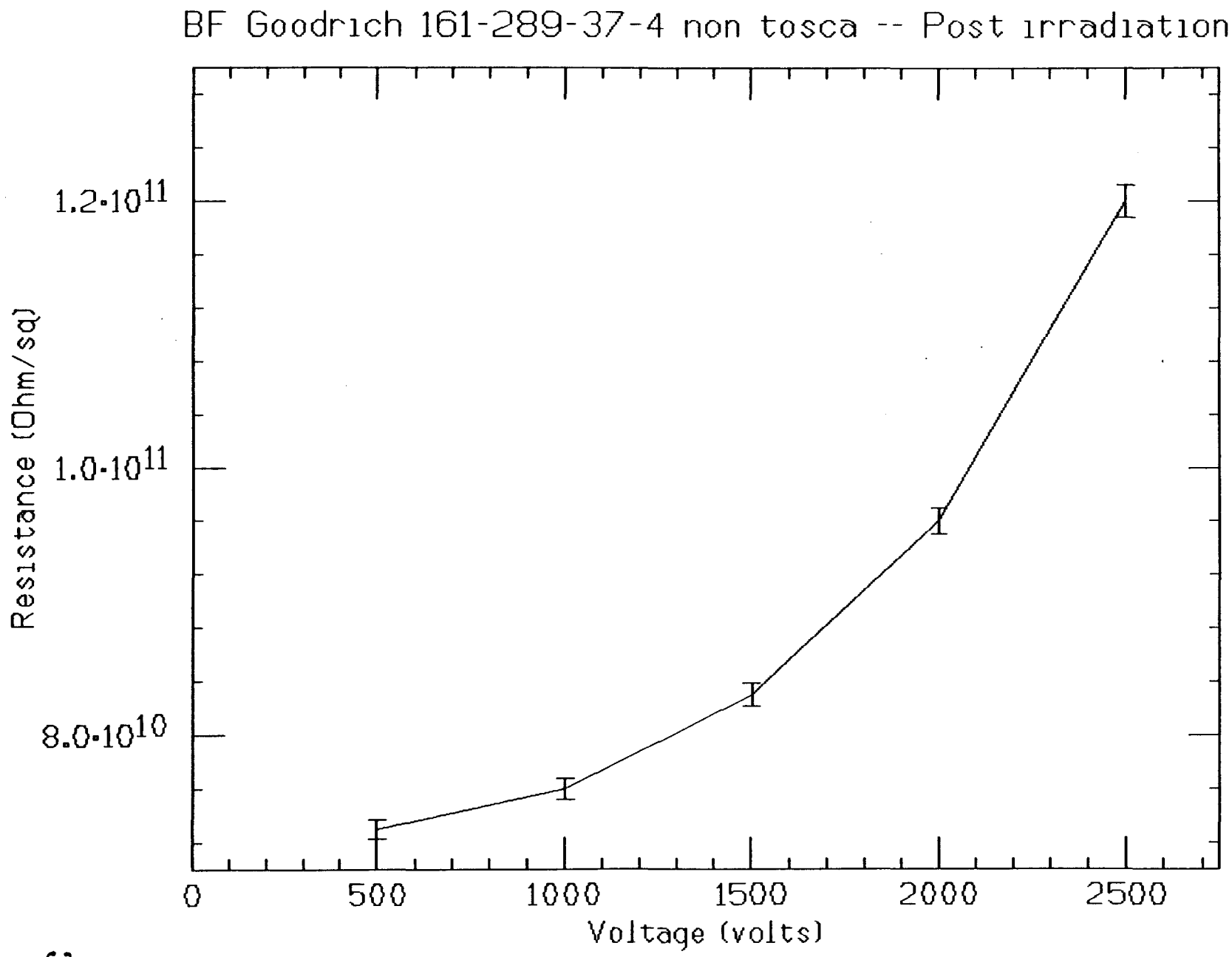
BFGoodrich 161-289-37-4 non tosca 2.5inch electrode length X $\frac{1}{16}$inch gap X $\frac{1}{8}$inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
8-26-91				
11:25	+500	2.2e-11	9.1e14	**Current flux ±.1e-11Amps.**
11:32	+1000	2.4e-11	1.7e15	**±.5e-12Amps.**
11:39	+1000	2e-11	2e15	
11:42	+1000	1.8e-11	2.2e15	
11:43	+2000	2.8e-11	2.8e15	
15:20	+2000	9.3e-12	8.6e15	
15:21	+3000	3e-11	4e15	**Stable current**
15:25	+3000	2.4e-11	5e15	
15:26	+3000	1.9e-11	6.3e15	


BF Goodrich 161-289-37-4 non-tosca
Resistance (Ohm/sq)
1.1·10^11
1.1·10^11
1.0·10^11
9.5·10^10
9.0·10^10
0
500
1000
1500
2000
2500
Voltage (volts)

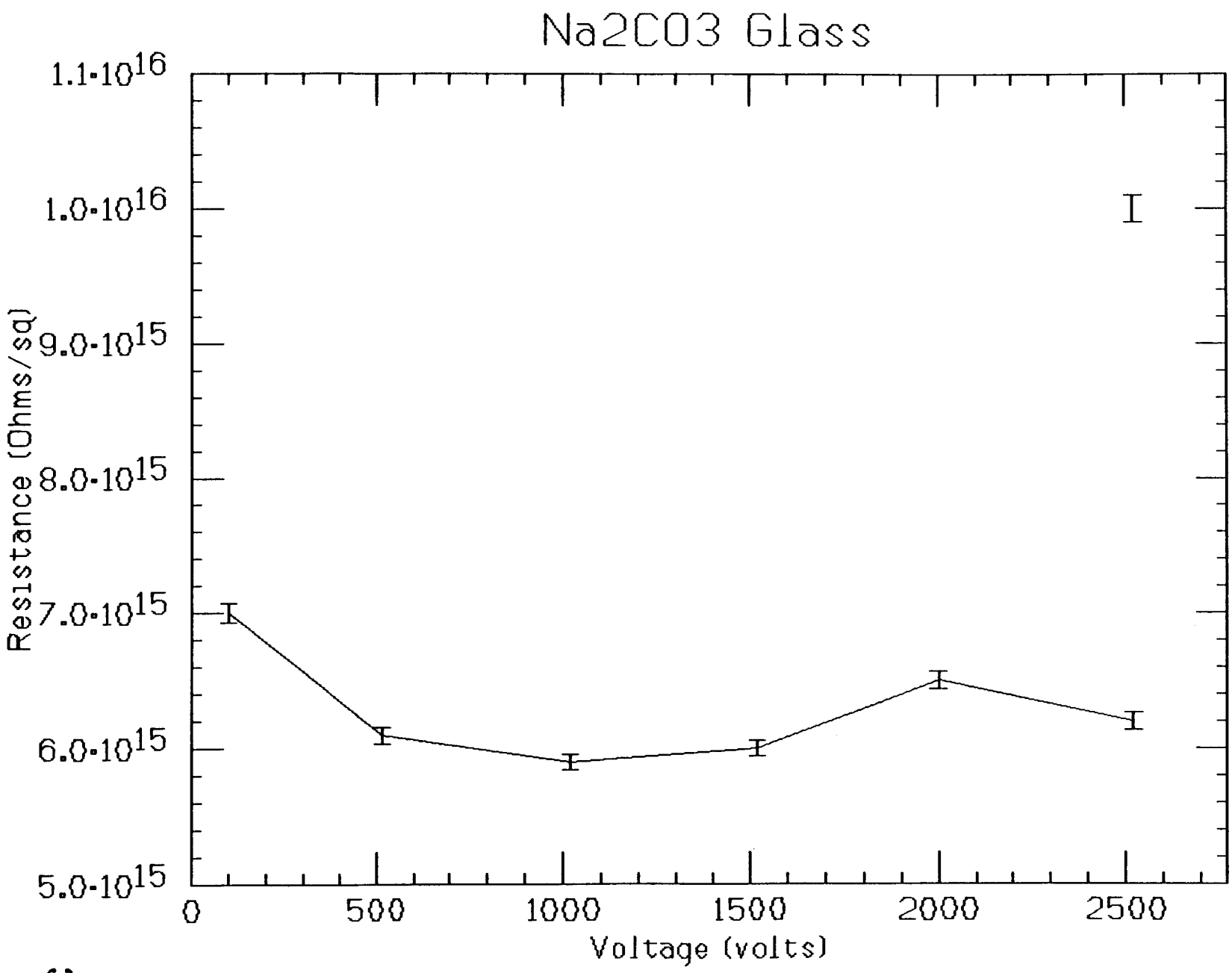
BFGoodrich 161-289-37-4 non-tosca retest 3inch electrode length X $\frac{1}{16}$inch gap X .125inch substrate thickness				
Date &	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
9-2-91				
14:30	+500	2.5e-7	9.6e10	
14:33	+500	2.4e-7	1e11	
14:34	+1000	5e-7	9.6e10	
14:35	+2000	1.06e-7	9.1e10	
14:36	+2500			**Sparked**
14:37	+2000	1.02e-6	9.4e10	
14:37	+2500	1.25e-6	9.6e10	**Rock steady**

Retest after $10^{11} \frac{n}{cm^2}$ irradiation.
BFGoodrich 161-289-37-4 non tosca
3inch electrode length X $\frac{1}{16}$inch gap X $\frac{1}{16}$inch thickness

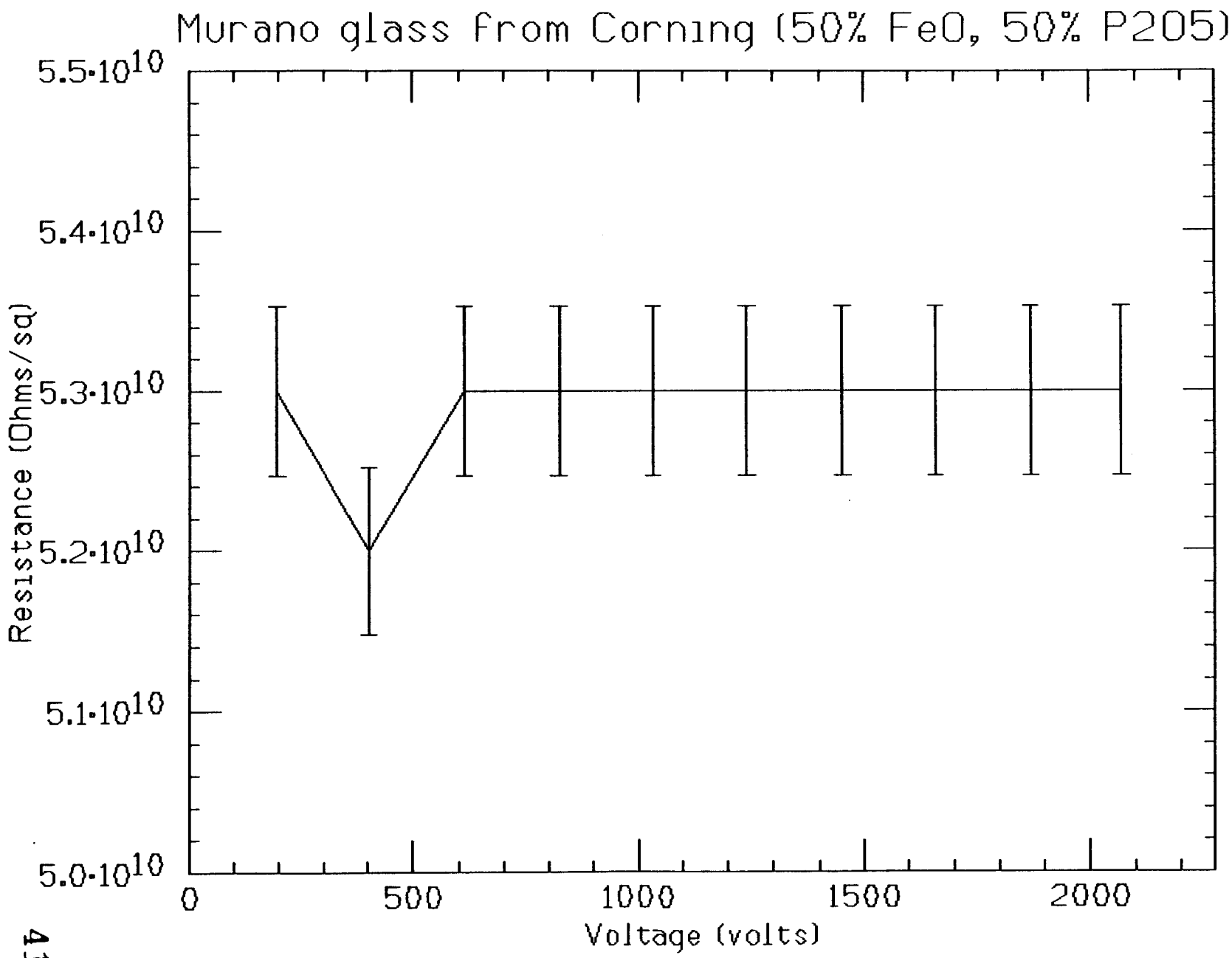
Date & Time	Voltage (volts)	Current (Amps)	Resistance (Ohms/sq)	Notes & Comments
9-18-91				
12:00	+500	3.3e-7	7.3e10	Very stable
12:05	+500	3.2e-7	7.3e10	
12:06	+1002	6.6e-7	7.3e10	
12:10	+1002	6.3e-7	7.6e10	
12:11	+1501	9.3e-7	7.7e10	
12:15	+1501	8.7e-7	8.3e10	
12:16	+2000	1.2e-6	8e10	
12:25	+2000	1e-6	9.6e10	
12:26	+2500	1.25e-6	9.6e10	Tripped once while going to 2.5KV
12:40	+2500	1e-6	1.2e11	

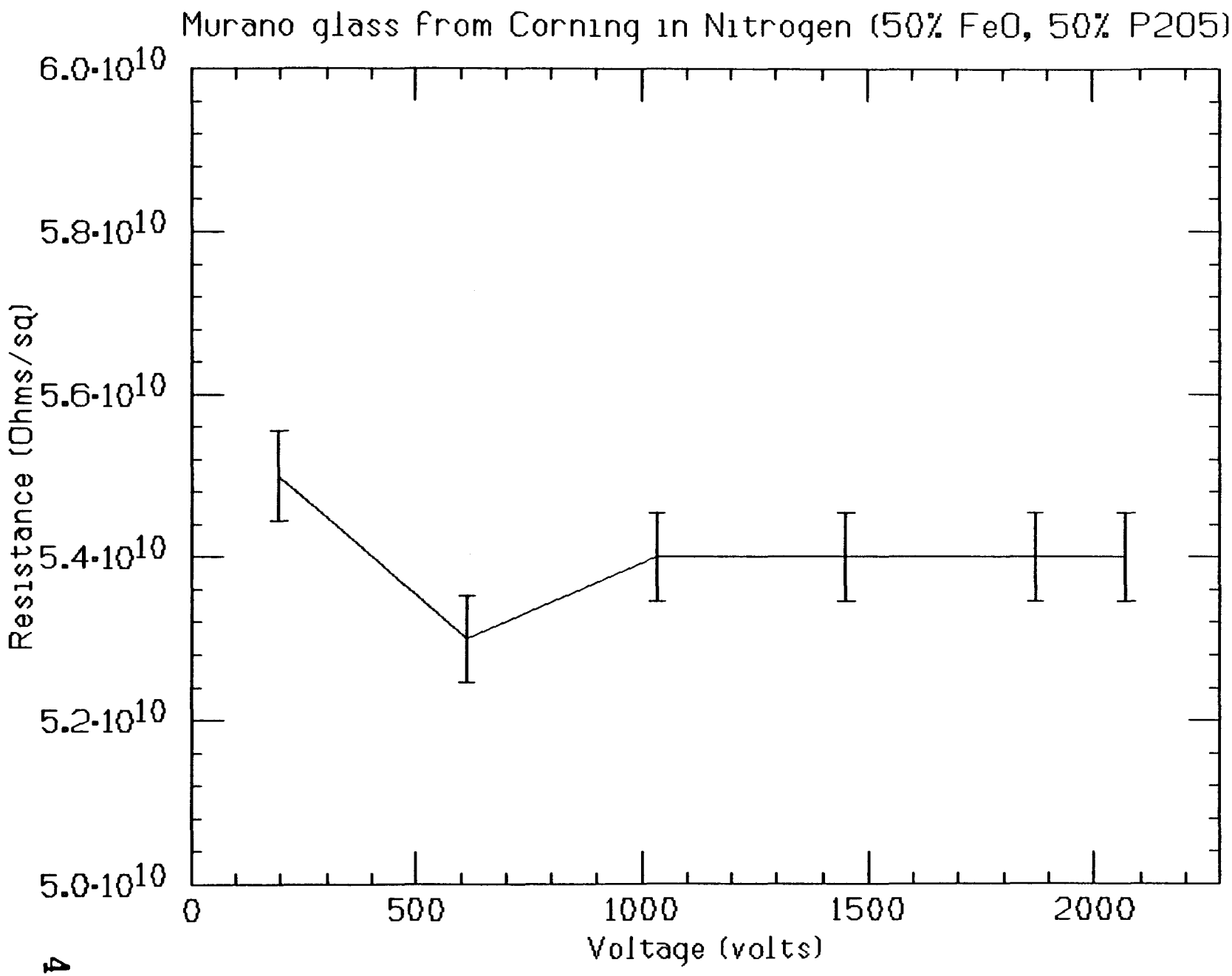

BF Goodrich 161-289-37-4 non tosca -- Post irradiation
Resistance (Ohm/sq)
1.2·10^11
1.0·10^11
8.0·10^10
0
500
1000
1500
2000
2500
Voltage (volts)

Na_2CO_3 glass 2inch electrode length X $\frac{1}{16}$inch gap X .02inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
8-1-91				
13:10	+100	4.6e-13	7e15	**Sensitive to capacitance**
13:12	+516	4e-12	4.1e15	
13:14	+516	2.7e-12	6.1e15	
13:15	+1019	5.5e-12	5.9e15	
13:18	+1520	8.1e-12	6e15	
13:19	+2000	9.9e-12	6.5e15	
13:25	+2520	1.2e-11	6.2e15	
13:26	+2520	1.23e-11	6.6e15	
13:45	+2520	1.3e-11	6.2e15	**Not Stable**
15:25	+2520	8e-12	1e16	
17:30	+2520	7.6e-12	1.1e16	**±.1e-12Amps**

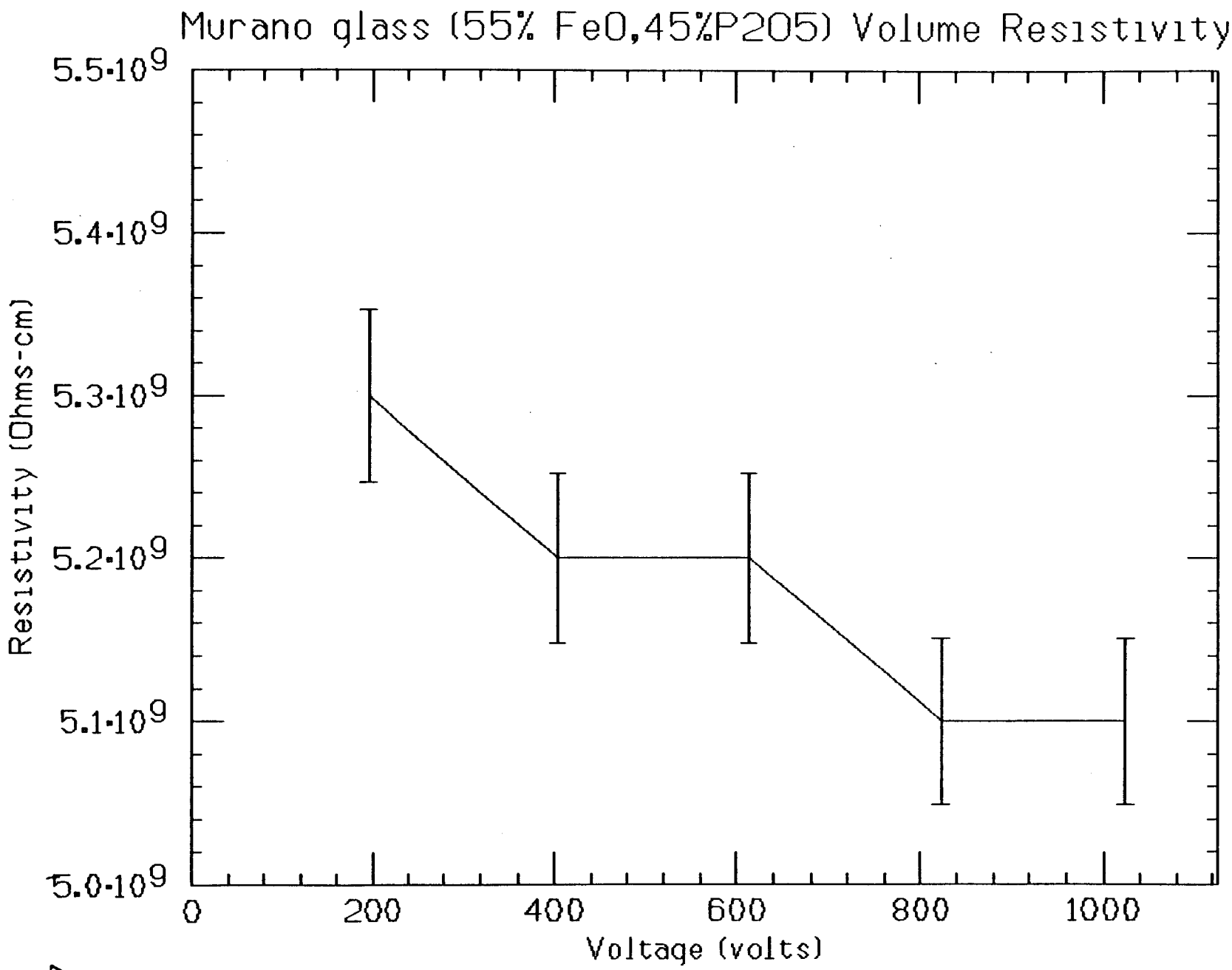

Na2CO3 Glass
1.1·10^16
1.0·10^16
9.0·10^15
8.0·10^15
7.0·10^15
6.0·10^15
5.0·10^15
Resistance (Ohms/sq)
0
500
1000
1500
2000
2500
Voltage (volts)

Murano glass (50% FeO,50% P_2O_5) 1.125inch electrode length X $\frac{1}{16}$inch gap X $\frac{1}{16}$inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
5-21-92	Tested in air			
16:21	+195	6.6e-8	5.3e10	5MΩ blocking resistor.
16:22	+404	1.4e-7	5.2e10	
16:23	+614	2.1e-7	5.3e10	
16:24	+823	2.8e-7	5.3e10	
16:25	+1034	3.5e-7	5.3e10	
16:26	+1242	4.2e-7	5.3e10	
16:27	+1452	4.9e-7	5.3e10	
16:28	+1661	5.6e-7	5.3e10	
16:29	+1871	6.3e-7	5.3e10	
16:30	+2070	7e-7	5.3e10	
5-21-92	Tested in UHP nitrogen			
16:45	+195	6.4e-8	5.5e10	
16:46	+614	2.1e-7	5.3e10	
16:47	+1034	3.45e-7	5.4e10	
16:48	+1452	4.86e-7	5.4e10	
16:49	+1871	6.25e-7	5.4e10	
16:50	+2070	6.95e-7	5.4e10	


Murano glass from Corning (50% FeO, 50% P2O5)
5.5·10^10
5.4·10^10
5.3·10^10
5.2·10^10
5.1·10^10
5.0·10^10
Resistance (Ohms/sq)
0
500
1000
1500
2000
Voltage (volts)


Murano glass from Corning in Nitrogen (50% FeO, 50% P205)
6.0·10^10
5.8·10^10
5.6·10^10
5.4·10^10
5.2·10^10
5.0·10^10
Resistance (Ohms/sq)
0
500
1000
1500
2000
Voltage (volts)

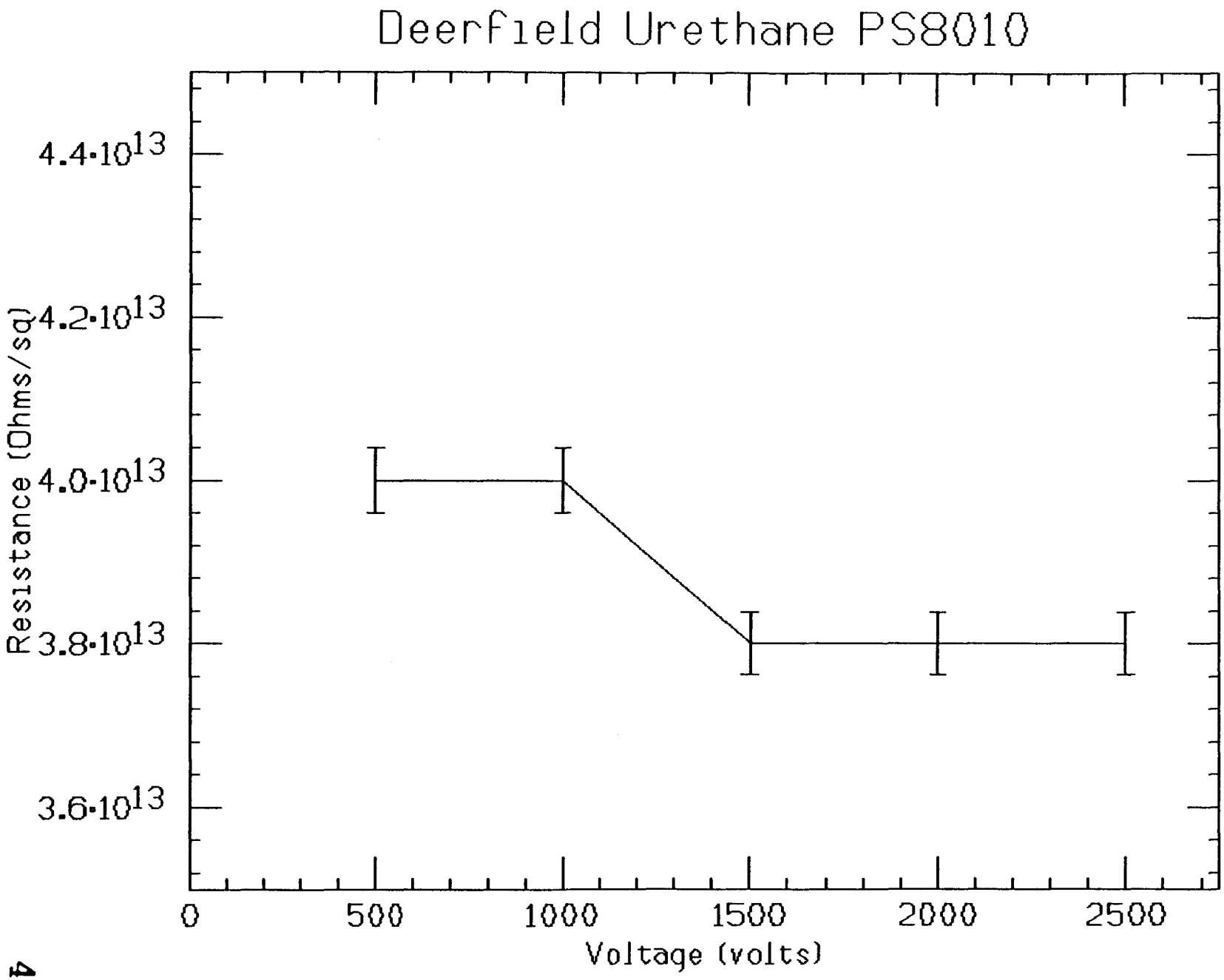
Murano glass (55% FeO,45% P_2O_5) Volume Resistivity Test .155inch^2 electrode area X .04inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistivity (Ohm-cm)**	**Notes & Comments**
5-26-92				
19:50	+195	3.7e-7	5.3e9	
19:55	+404	7.76e-7	5.2e9	
19:55	+614	1.19e-6	5.2e9	
19:56	+823	1.6e-6	5.1e9	
19:56	+1024	2.01e-6	5.1e9	


Murano glass (55% FeO,45%P2O5) Volume Resistivity
5.5·10^9
5.4·10^9
5.3·10^9
5.2·10^9
5.1·10^9
5.0·10^9
Resistivity (Ohms-cm)
0
200
400
600
800
1000
Voltage (volts)

Deerfield Urethane PS8010

2inch electrode length X $\frac{1}{16}$inch gap X .008inch substrate thickness

Date & Time	Voltage (volts)	Current (Amps)	Resistance (Ohms/sq)	Notes & Comments
11-20-91				
14:30	+500	3.9e-10	4e13	Stable
14:32	+1000	7.9e-10	4e13	
14:40	+1501	1.25e-9	3.8e13	
14:42	+2000	1.7e-9	3.8e13	
14:45	+2000	1.7e-9	3.8e13	
14:46	+2500	2.1e-9	3.8e13	
14:50	+2500	2.1e-9	3.8e13	

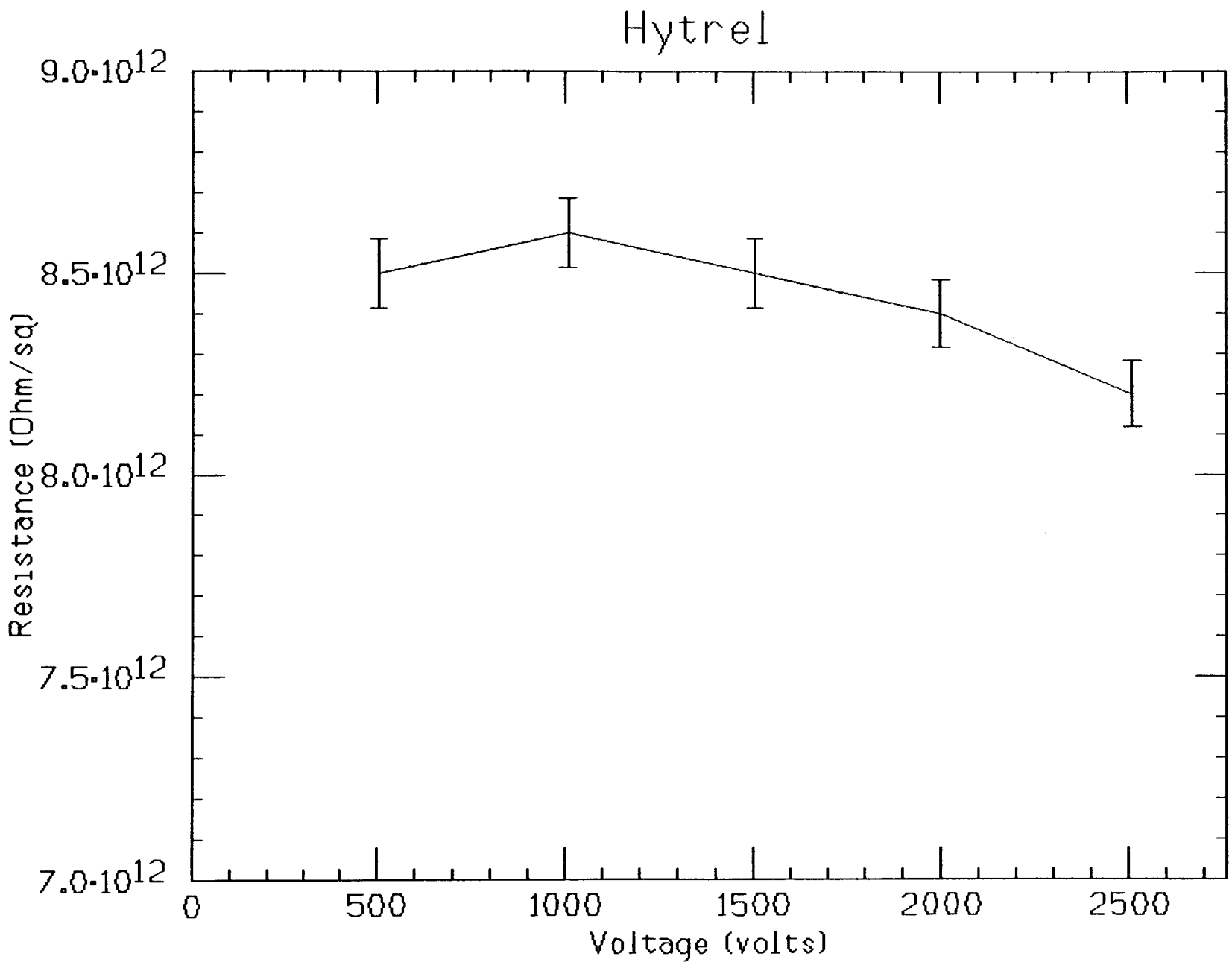

Deerfield Urethane PS8010
Resistance (Ohms/sq)
4.4·10^13
4.2·10^13
4.0·10^13
3.8·10^13
3.6·10^13
0
500
1000
1500
2000
2500
Voltage (volts)

Hytrel

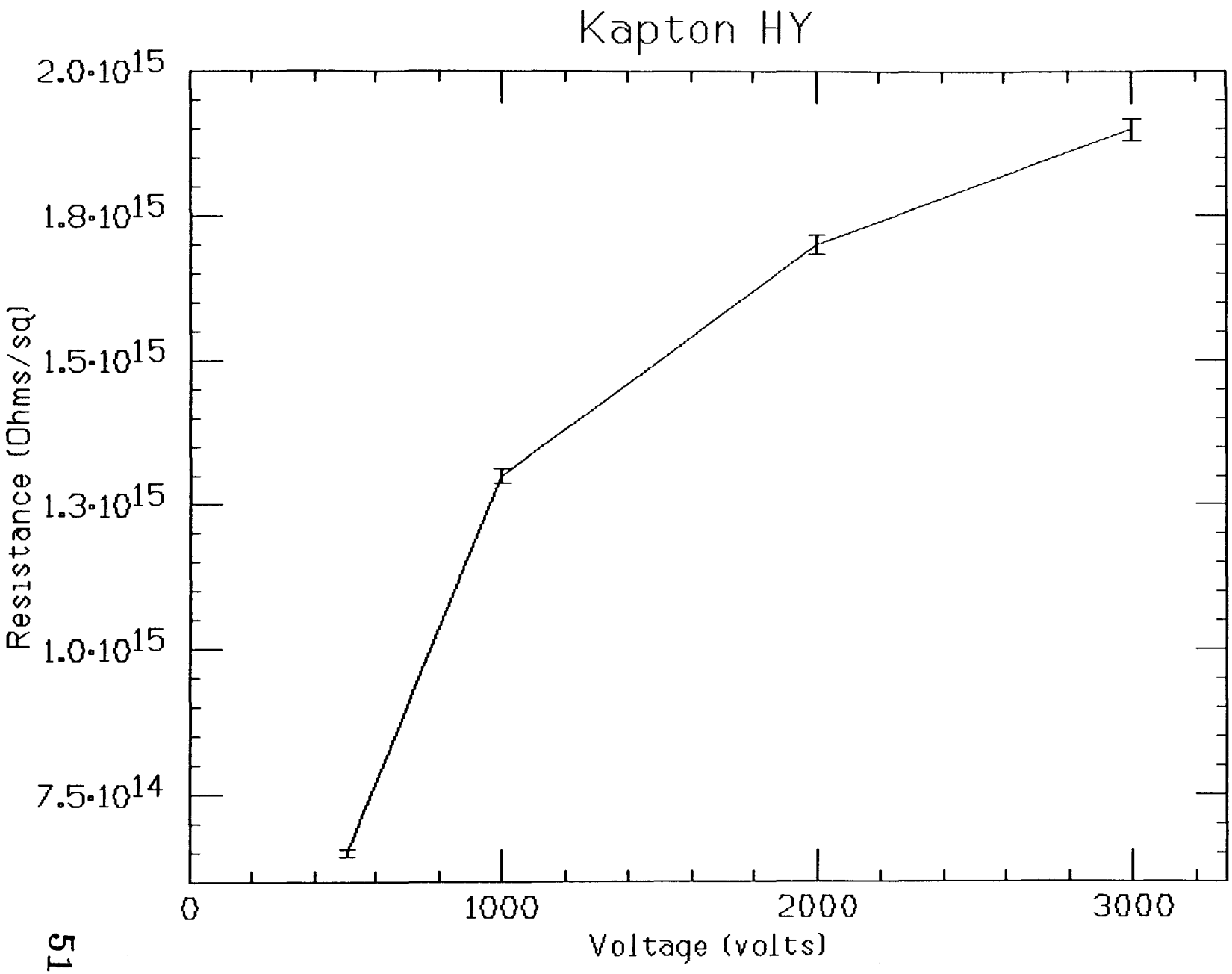
3inch electrode length X $\frac{1}{16}$inch gap X .02 inch substrate thickness

Date & Time	Voltage (volts)	Current (Amps)	Resistance (Ohms/sq)	Notes & Comments
6-11-91				
19:45	+505	2.85e-9	8.5e12	No fluctuations.
19:48	+1007	5.65e-9	8.6e12	
19:49	+1505	8.5e-9	8.5e12	
19:50	+2000	1.14e-8	8.4e12	
19:52	+2510	1.47e-8	8.2e12	
6-12-91				Exposure to ambient HVbay light
10:12	+1000	6.2e-9	7.7e12	Re-zero ammeter
10:15	+1000	6e-9	8e12	
6-13-91				
9:37	+1000	6e-9	8e12	Stable
17:18	+1000	6e-9	8e12	
6-17-91				
17:04	+1000	9.1e-9	5.3e12	Current dropping slowly
17:10	+1000	9.1e-9	5.3e12	
17:17	+1000	9e-9	5.3e12	
17:22	+1000	8.9e-9	5.4e12	
17:32	+1000	8.7e-9	5.5e12	
6-18-91				
10:46	+1000	9.2e-9	5.2e12	Stable
10:50	+1000	9.2e-9	5.2e12	
6-25-91				
9:20	+1000	1e-8	4.8e12	Stable
6-26-91				
14:41	+1000	1.3e-8	3.7e12	
14:45	+1000	1.3e-8	3.7e12	
6-27-91				
12:43	+1000	1.2e-8	4e12	
12:48	+1000	1.2e-8	4e12	
6-28-91				
13:45	+1000	1.1e-8	4.4e12	
13:50	+1000	1.1e-8	4.4e12	
7-1-91				
13:00	+1000	1.15e-8	4.2e12	
13:05	+1000	1.15e-8	4.2e12	

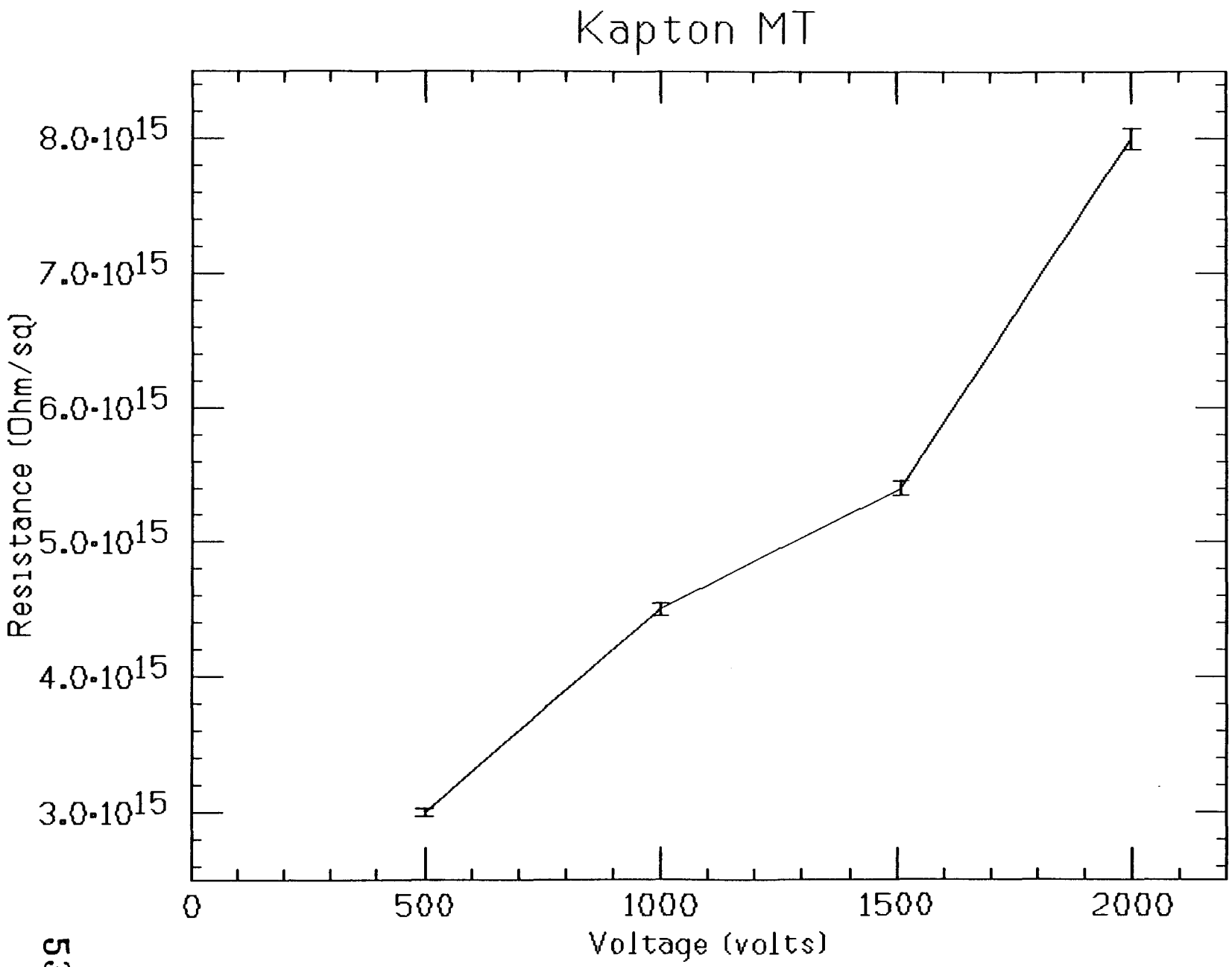
Hytrel (continued) 3inch electrode length X $\frac{1}{16}$inch gap X .02inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
7-2-91				
12:35	+1000	1.2e-8	4e12	Stable
12:40	+1000	1.2e-8	4e12	
7-3-91				
14:35	+1000	1.22e-8	3.9e12	
14:40	+1000	1.22e-8	3.9e12	
7-5-91				
12:20	+1000	1.2e-8	4e12	
12:30	+1000	1.2e-8	4e12	
7-8-91				
13:18	+1000	1.21e-8	4e12	
13:25	+1000	1.21e-8	4e12	


Hytrel
9.0·10^12
8.5·10^12
8.0·10^12
7.5·10^12
7.0·10^12
Resistance (Ohm/sq)
0
500
1000
1500
2000
2500
Voltage (volts)

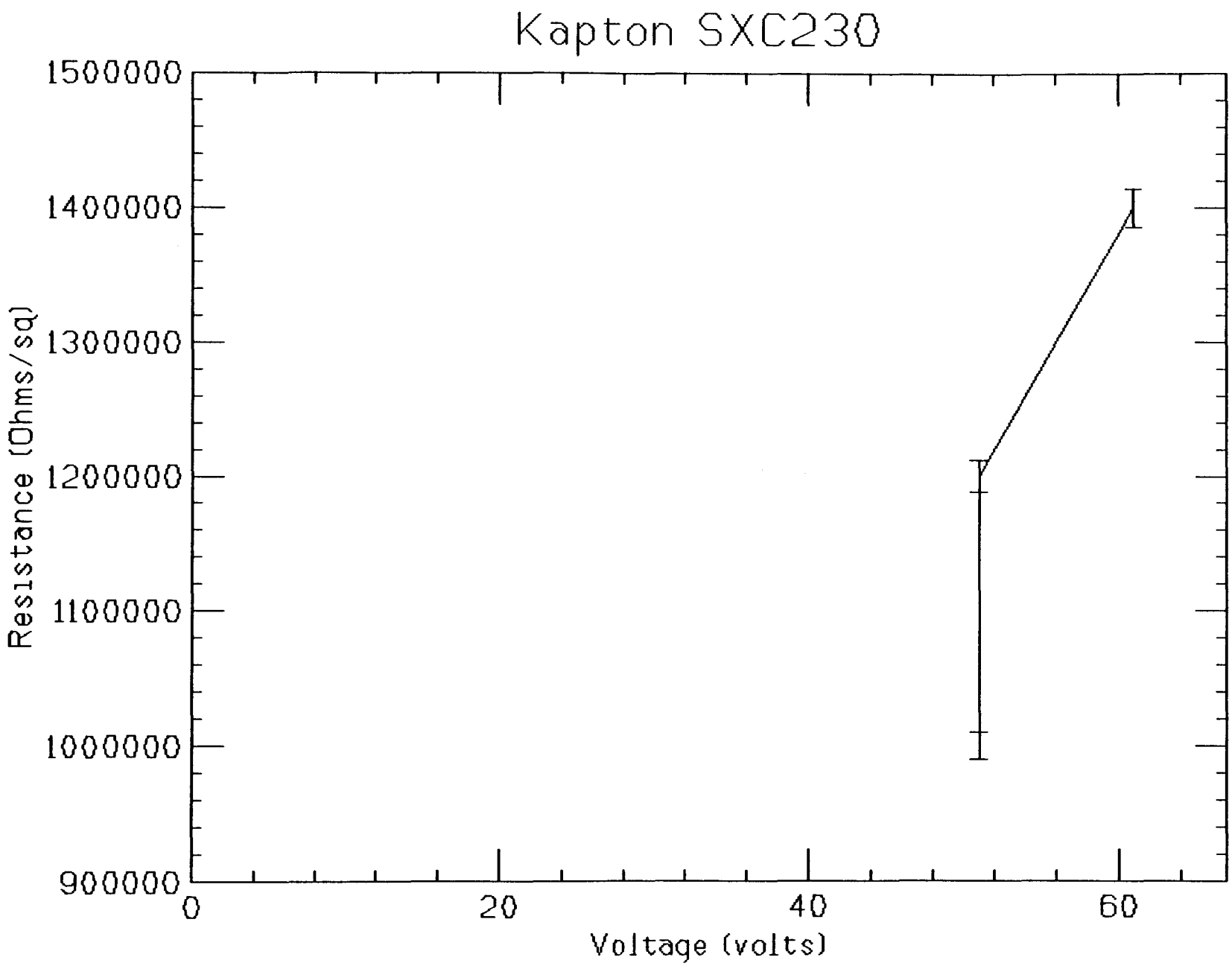
Kapton HY 3.5inch electrode length X $\frac{3}{16}$inch gap X .002inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
3-1-92				
21:00	-509	1.4e-11	6.5e14	
21:00	-1000	1.4e-11	1.3e15	
21:03	-2000	2.1e-11	1.7e15	
21:04	-3000	2.8e-11	1.9e15	


Kapton HY
2.0·10^15
1.8·10^15
1.5·10^15
1.3·10^15
1.0·10^15
7.5·10^14
Resistance (Ohms/sq)
0
1000
2000
3000
Voltage (volts)

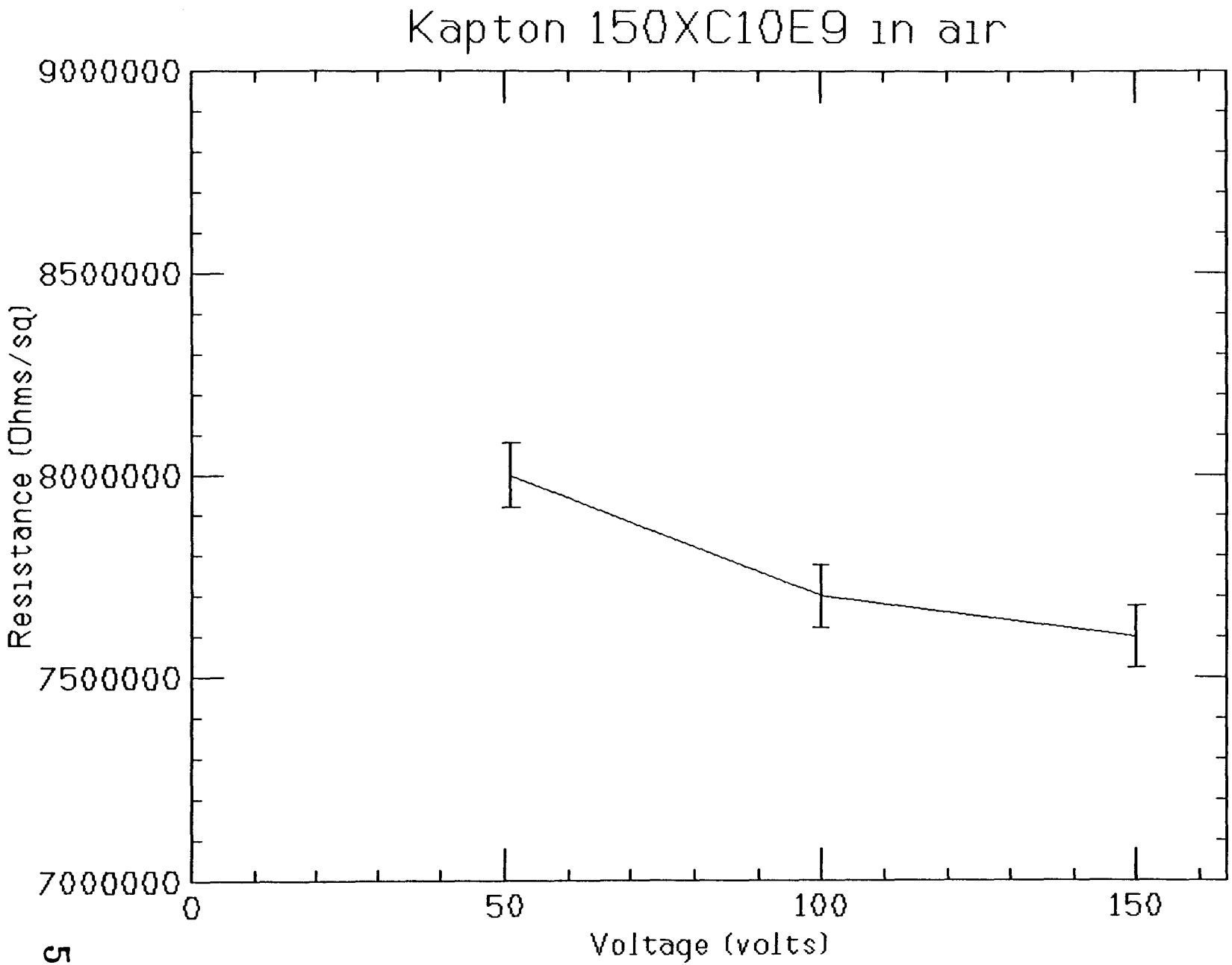
Kapton MT 3.5inch electrode length X $\frac{3}{16}$inch gap X .0015inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
3-1-92				
20:45	-500	3e-12	3e15	
20:46	-1000	4e-12	4.5e15	
20:48	-1509	5e-12	5.4e15	±1e-12Amps
20:50	-2000	4.5e-12	8e15	±.5e-12Amps


Kapton MT
Resistance (Ohm/sq)
8.0·10^15
7.0·10^15
6.0·10^15
5.0·10^15
4.0·10^15
3.0·10^15
0
500
1000
1500
2000
Voltage (volts)

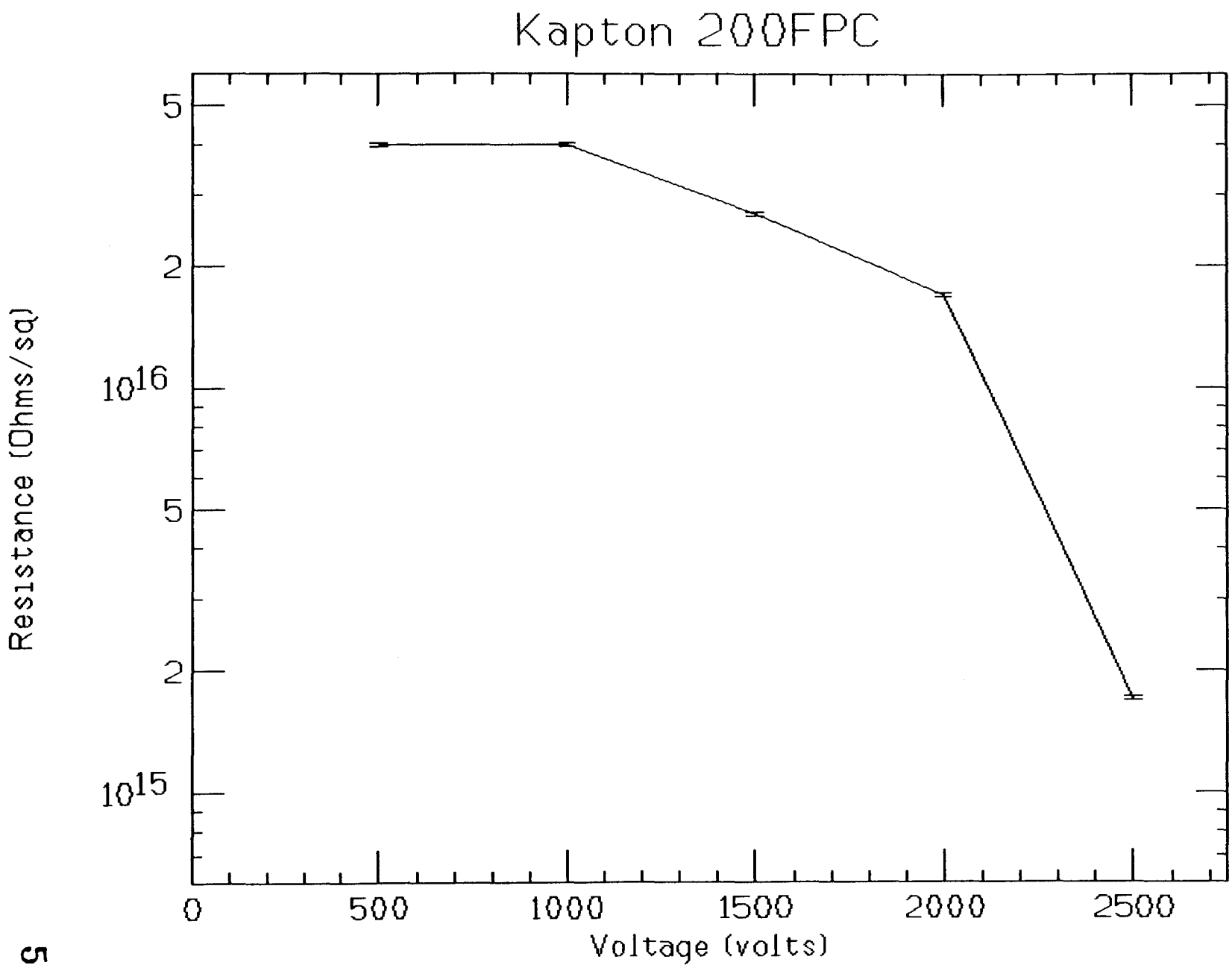
Kapton SXC230 3inch electrode length X $\frac{3}{16}$inch gap X inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
3-3-92				
12:05	-51	8e-4	1e6	±.2e-8Amps
12:05	-51	6.3e-4	1.2e6	
12:05	-61	7e-4	1.4e6	


Kapton SXC230
1500000
1400000
1300000
1200000
1100000
1000000
900000
Resistance (Ohms/sq)
0
20
40
60
Voltage (volts)

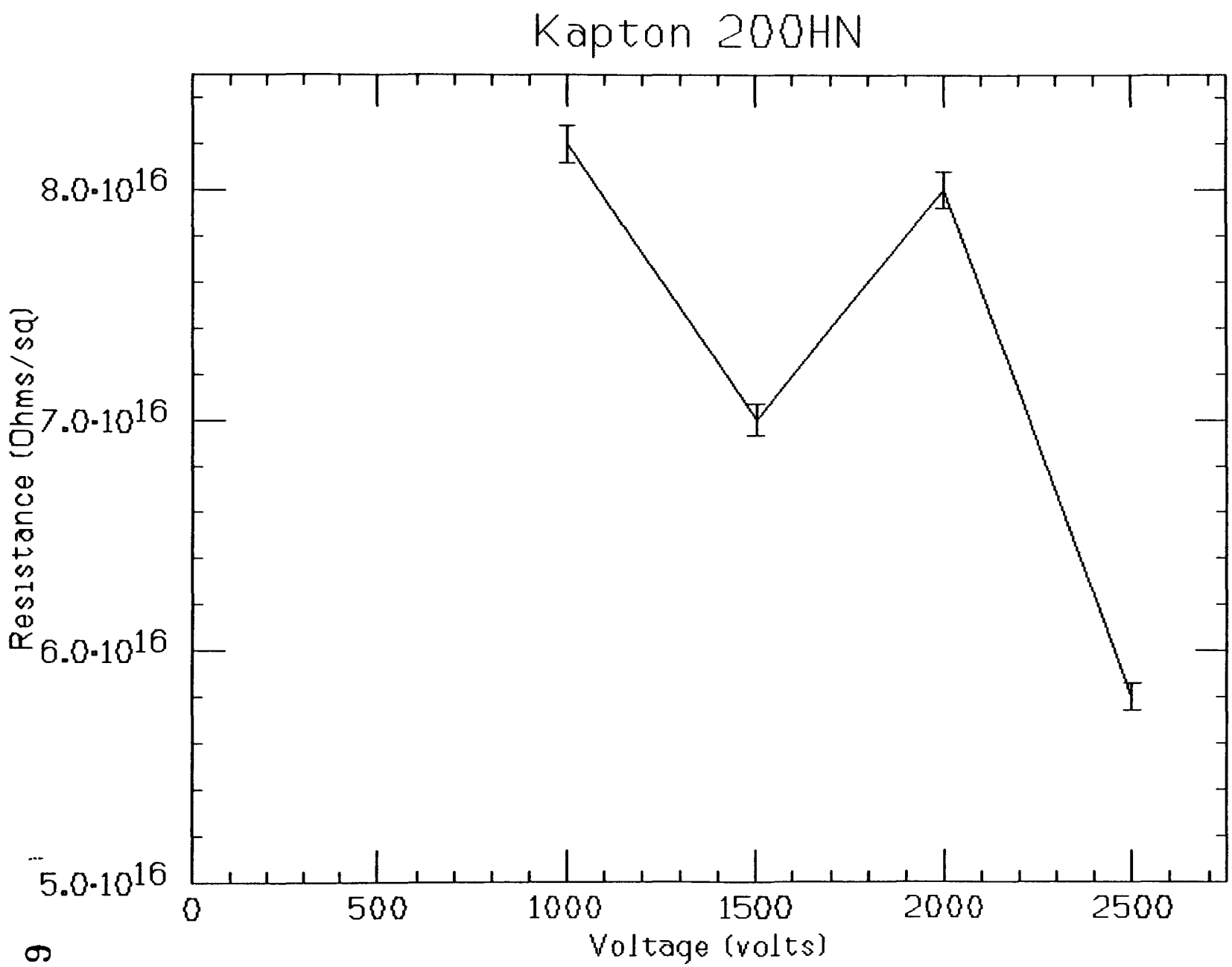
Kapton 150XC10E9 2inch electrode length X $\frac{1}{16}$inch gap X inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
3-12-92	Tested in air			
11:50	-51	2e-4	8e6	**100KΩ resistor in series.**
12:02	-100	4.1e-4	7.7e6	
12:15	-150	6.2e-4	7.6e6	**Max voltage without tripping.**
3-12-92	Tested in UHP nitrogen.			
12:32	-400	3.5e-4	3.6e7	
13:30	-400	3.4e-4	3.6e7	
14:30	-400	3.4e-4	3.6e7	
14:40	-400	3.4e-4	3.6e7	


Kapton 150XC10E9 in air
9000000
8500000
8000000
7500000
7000000
Resistance (Ohms/sq)
0
50
100
150
Voltage (volts)

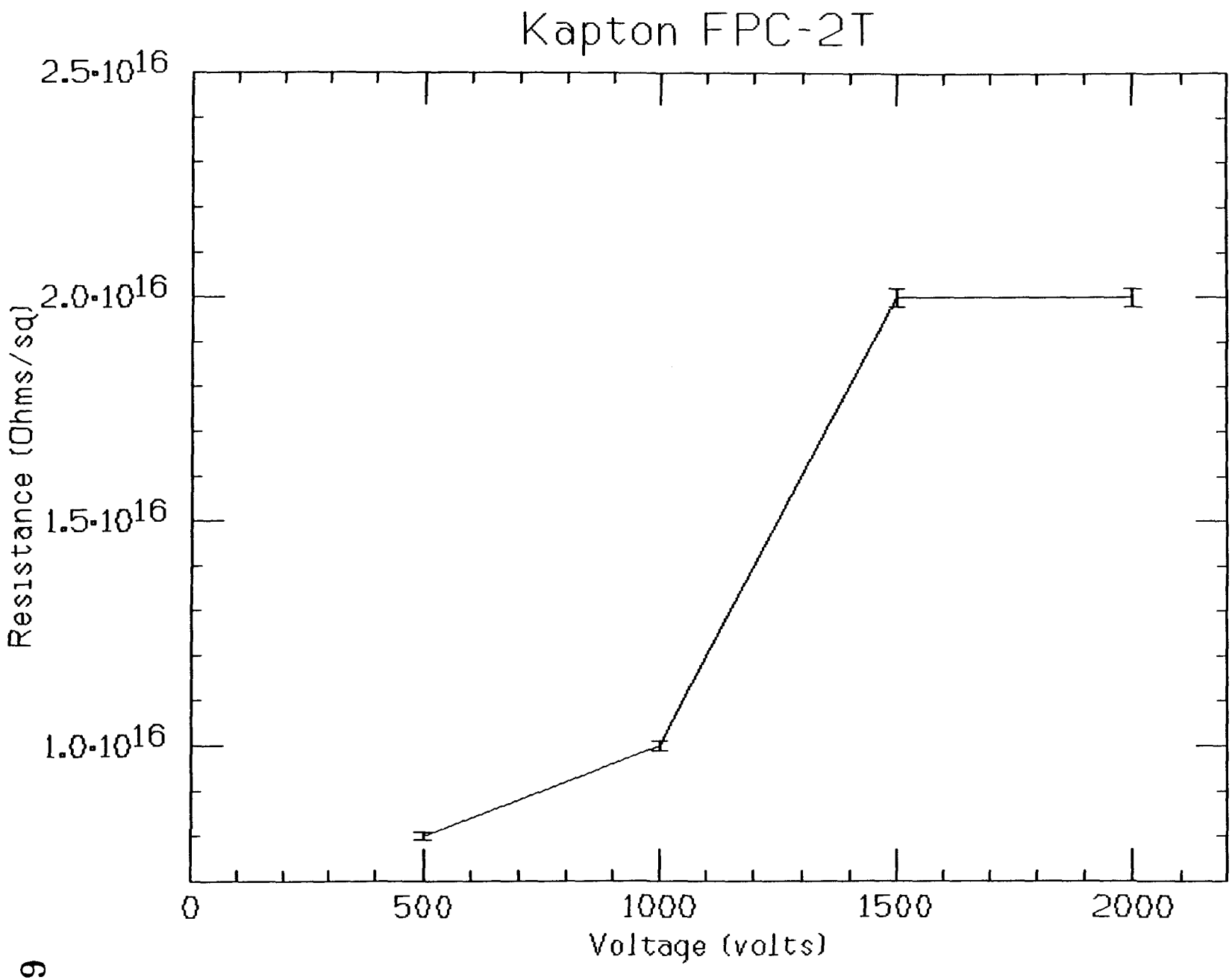
Kapton 200FPC 3inch electrode length X $\frac{3}{16}$inch gap X 2inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
3-6-92				
12:30	-501	3e-13	2.7e16	
12:40	-501	2e-13	4e16	**Stable**
12:41	-1000	4e-13	4e16	
12:45	-1501	9e-13	2.7e16	
12:47	-2000	1.9e-12	1.7e16	
12:50	-2500	7.5e-12	5e15	**Current increasing slowly.**
12:55	-2500	1.7e-11	1.7e15	**±.4e-11Amps.**


Kapton 200FPC
Resistance (Ohms/sq)
5
2
10^{16}
5
2
10^{15}
0
500
1000
1500
2000
2500
Voltage (volts)

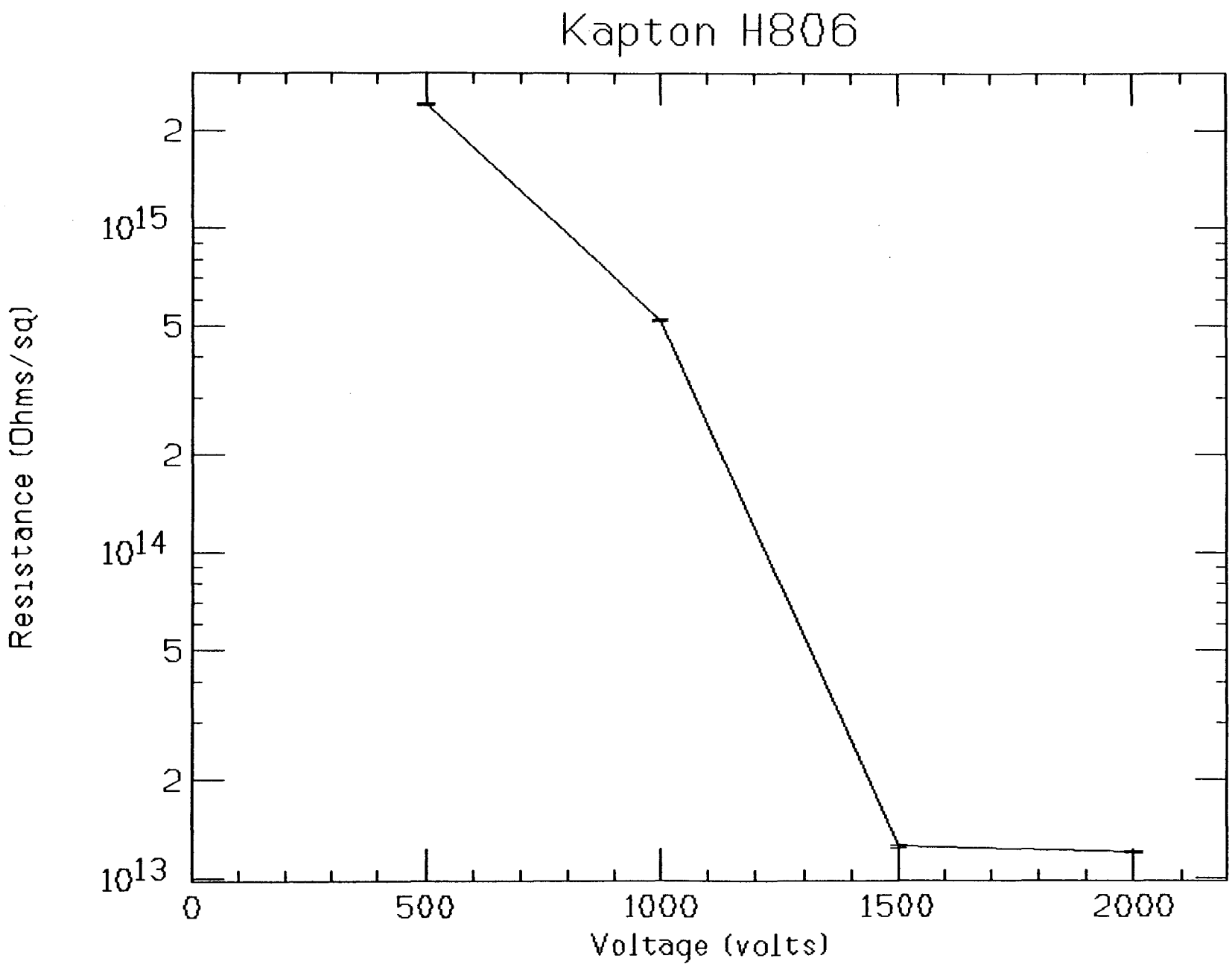
Kapton 200HN 2.5inch electrode length X $\frac{3}{16}$inch gap X .002inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
3-6-92				
13:00	-501	3.5e-13	2e16	
13:05	-1000	4.5e-13	3.1e16	
Re-zero scale and retest.				
13:10	-1000	1.7e-13	8.2e16	
13:13	-1501	3e-13	7e16	
13:15	-2000	3.5e-13	8e16	
13:19	-2500	6e-13	5.8e16	


Kapton 200HN
Resistance (Ohms/sq)
8.0·10^16
7.0·10^16
6.0·10^16
5.0·10^16
0
500
1000
1500
2000
2500
Voltage (volts)

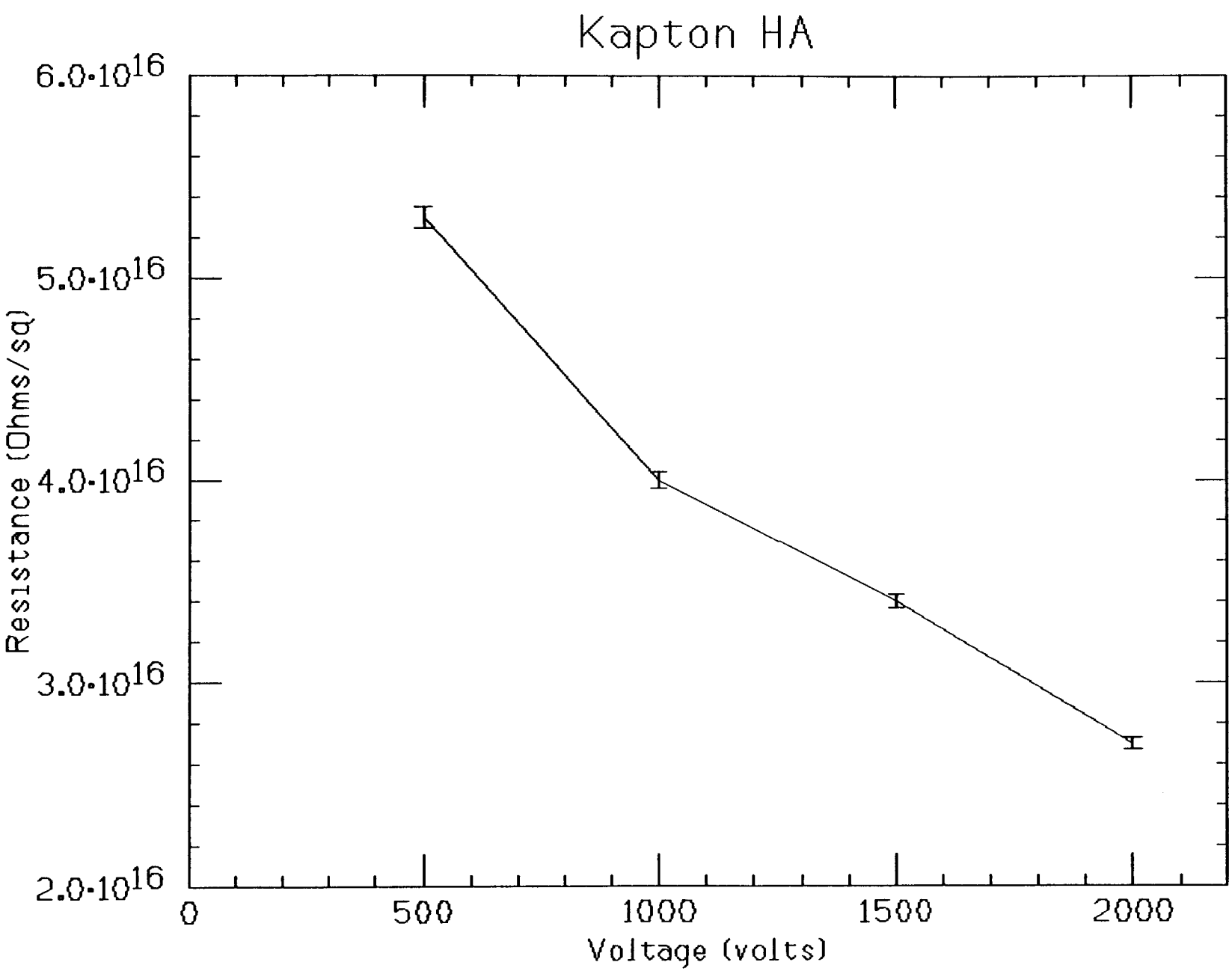
Kapton FPC-2T 3inch electrode length X $\frac{1}{16}$inch gap X .002inch thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
3-3-92				
15:51	-500	1.5e-12	5.3e15	**Slow fluctuations.**
15:55	-500	1e-12	8e15	
15:57	-1000	1e-12	1e16	
16:04	-1500	1.2e-12	2e16	
16:07	-2000	1.5e-12	2e16	


Kapton FPC-2T
2.5·10^16
2.0·10^16
1.5·10^16
1.0·10^16
Resistance (Ohms/sq)
0
500
1000
1500
2000
Voltage (volts)

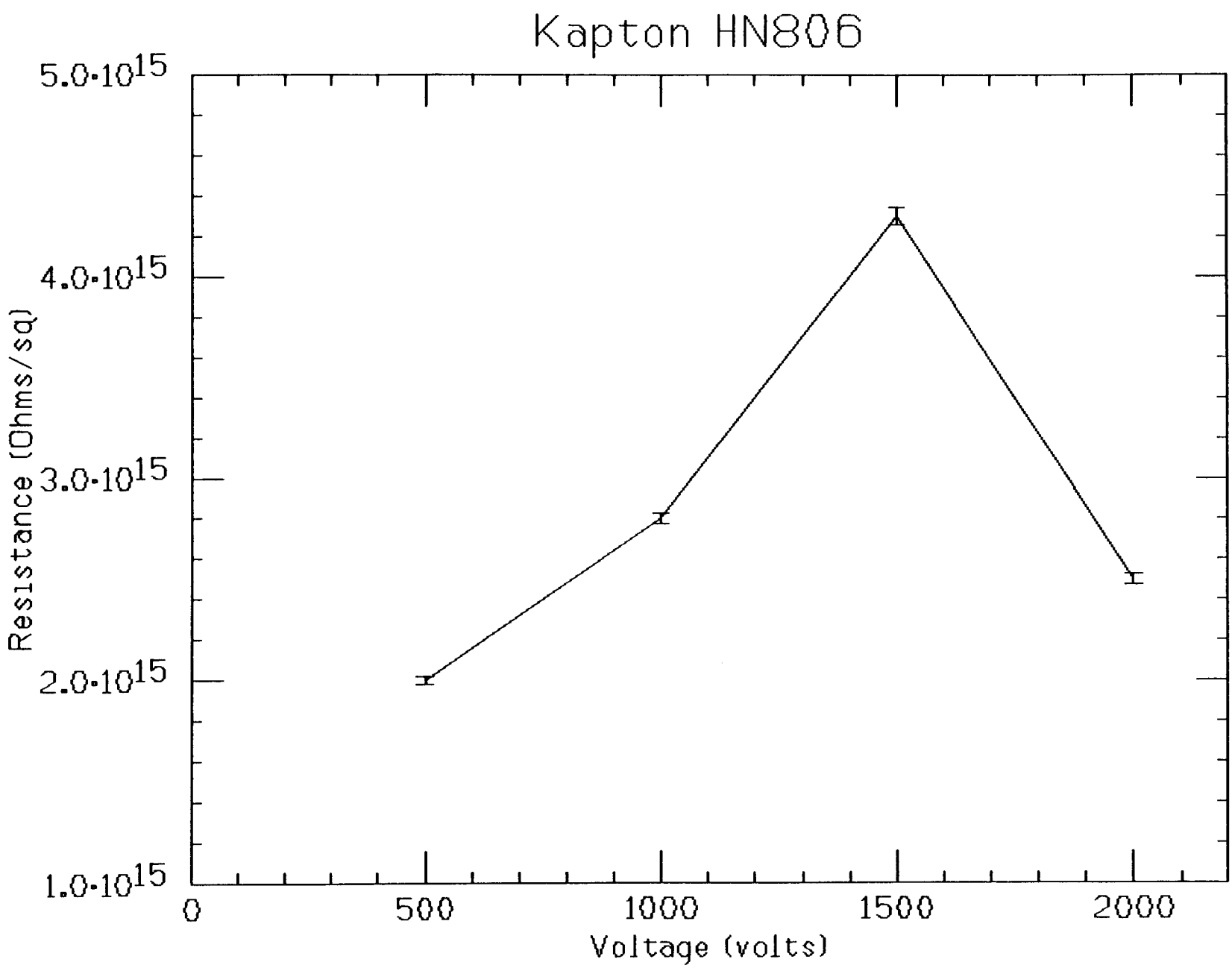
Kapton H806 3inch electrode length X $\frac{3}{16}$inch gap X inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
3-3-92				
15:30	-500	3.3e-12	2.4e15	
15:33	-1000	3.1e-11	5.2e14	
15:37	-1501	1.2e-10	1.25e13	
15:39	-2000	3e-9	1e13	
15:45	-2000	2e-9	1.2e13	±.2e-9Amps


Kapton H806
Resistance (Ohms/sq)
2
10^{15}
5
2
10^{14}
5
2
10^{13}
0
500
1000
1500
2000
Voltage (volts)

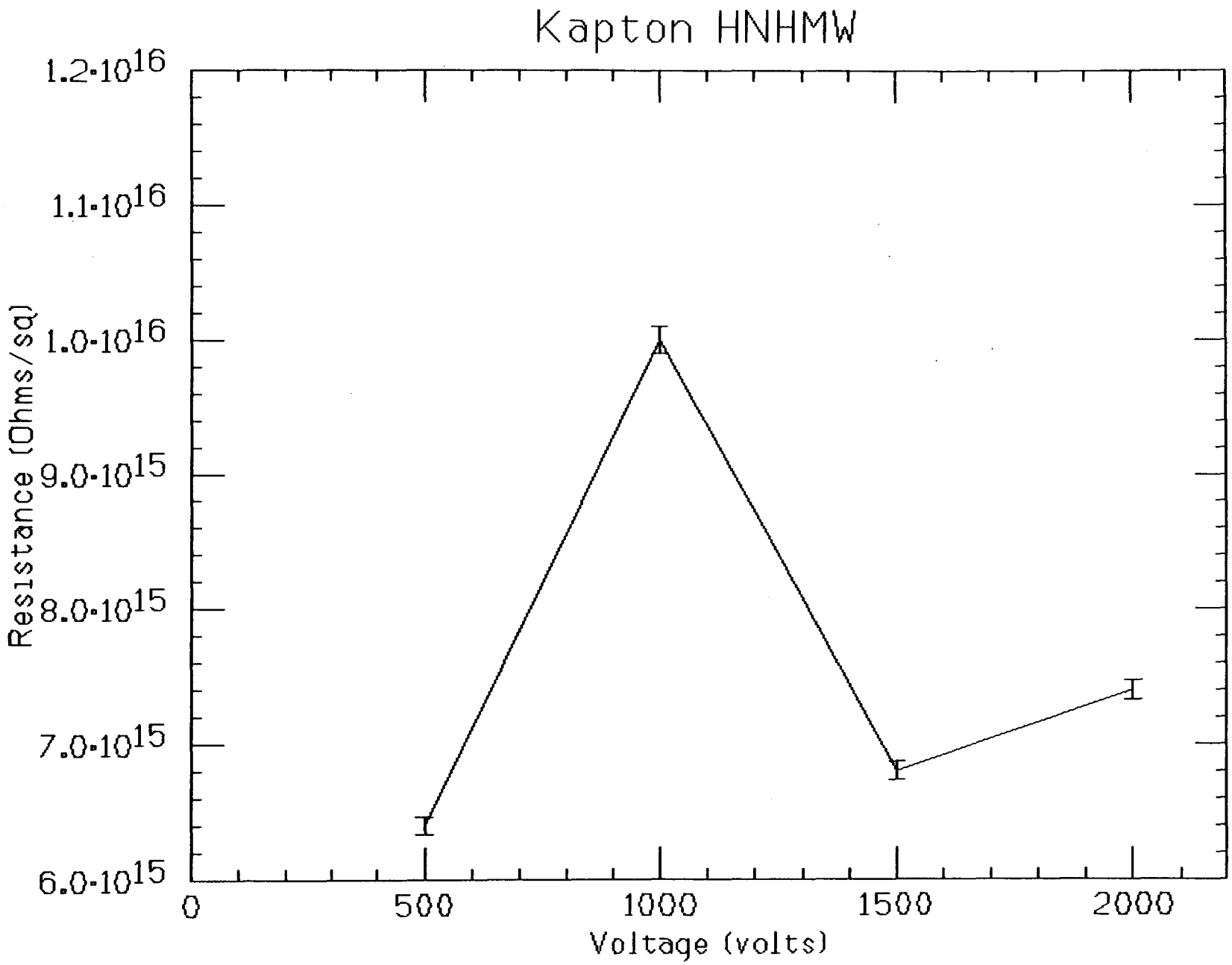
Kapton HA 3inch electrode length X $\frac{1}{16}$inch gap X .002inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
3-3-92				
16:10	-500	3e-13	2.7e16	**RC decay behavior.**
16:15	-500	1.5e-13	5.3e16	
16:20	-1000	4e-13	4e16	
16:27	-1501	7e-13	3.4e16	
16:30	-2000	1.2e-12	2.7e16	


Kapton HA
6.0·10^16
5.0·10^16
4.0·10^16
3.0·10^16
2.0·10^16
Resistance (Ohms/sq)
0
500
1000
1500
2000
Voltage (volts)

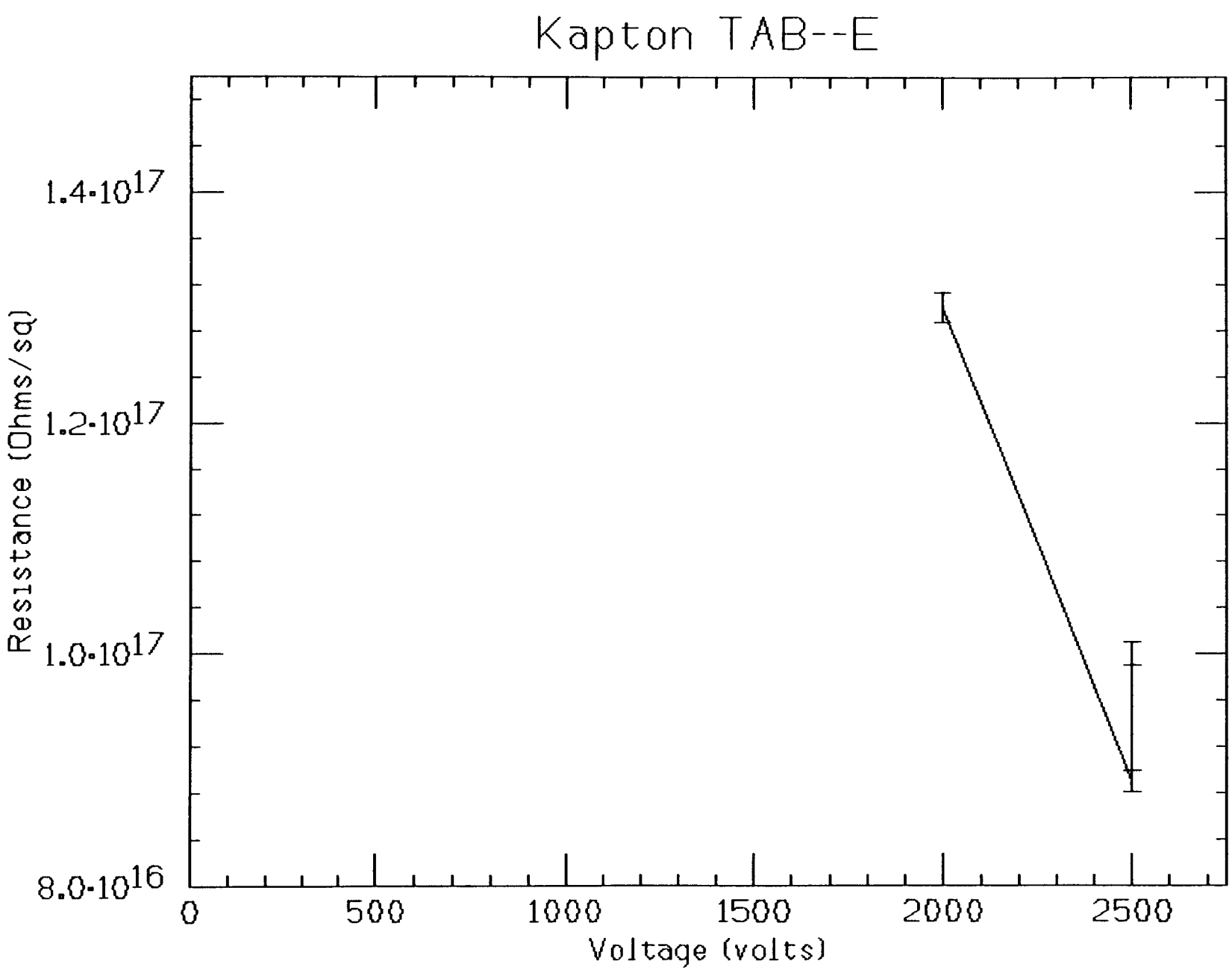
Kapton HN806 3inch elestrode length X $\frac{3}{16}$inch gap X .002inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
3-6-92				
12:05	-500	5.3e-12	1.5e15	
12:15	-500	4.7e-12	2e15	**Slow fluctuations**
12:20	-1000	5.6e-12	2.8e15	
12:30	-1501	6e-12	4e15	
12:35	-1501	5.5e-12	4.3e15	
12:40	-2000	1.3e-11	2.5e15	


Kapton HN806
5.0·10^15
4.0·10^15
3.0·10^15
2.0·10^15
1.0·10^15
Resistance (Ohms/sq)
0
500
1000
1500
2000
Voltage (volts)

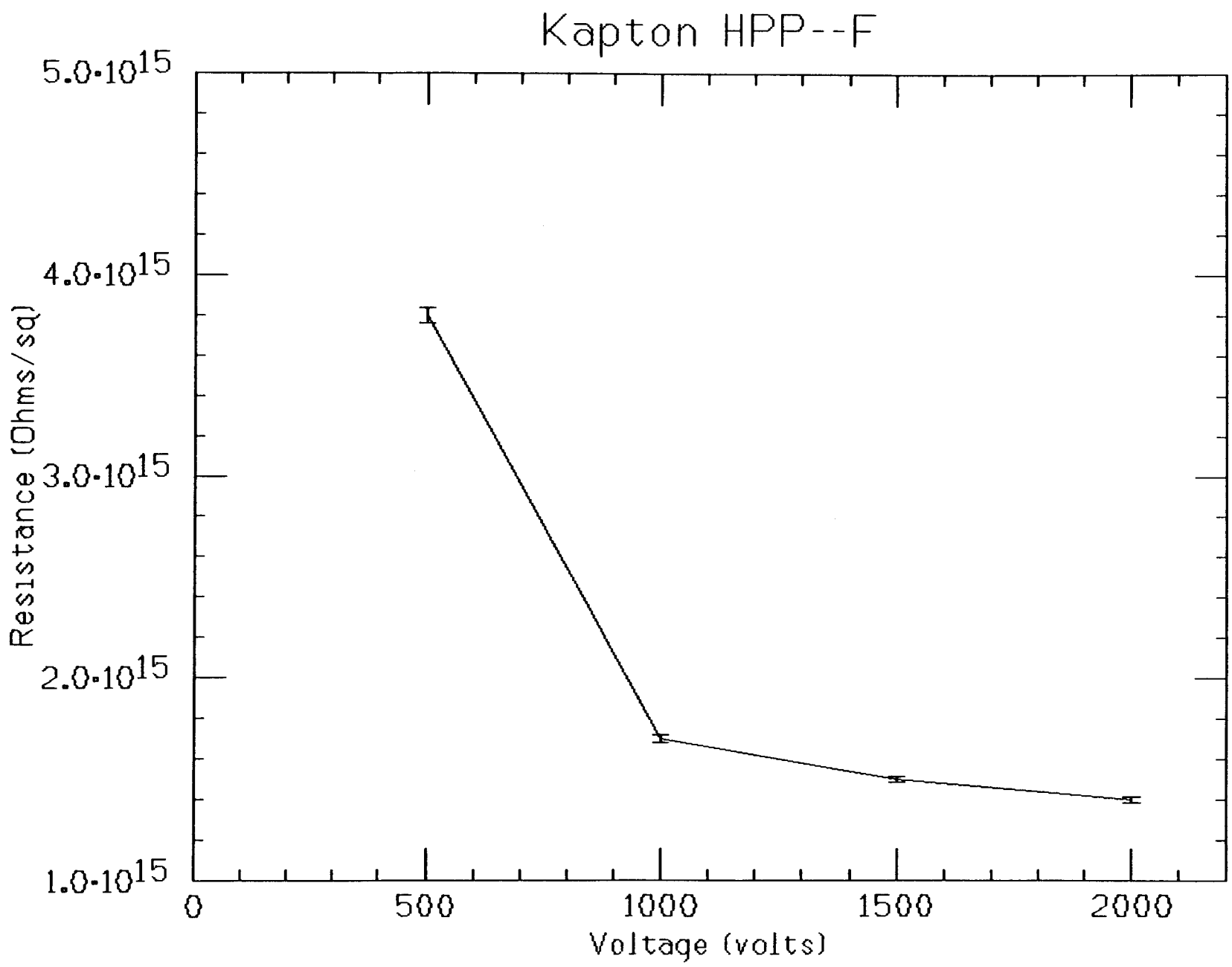
Kapton HNHMW 3inch electrode length X $\frac{3}{16}$inch gap X .005inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
3-3-92				
15:05	-500	1.25e-12	6.4e15	
15:10	-1000	1.6e-12	1e16	
15:13	-1501	3.7e-12	6.5e15	
15:15	-1501	3.5e-12	6.8e15	Sensitive
15:17	-2000	4.3e-12	7.4e15	Very slow flux ±.1e-12amps.


Kapton HNHMW
Resistance (Ohms/sq)
1.2·10^16
1.1·10^16
1.0·10^16
9.0·10^15
8.0·10^15
7.0·10^15
6.0·10^15
0
500
1000
1500
2000
Voltage (volts)

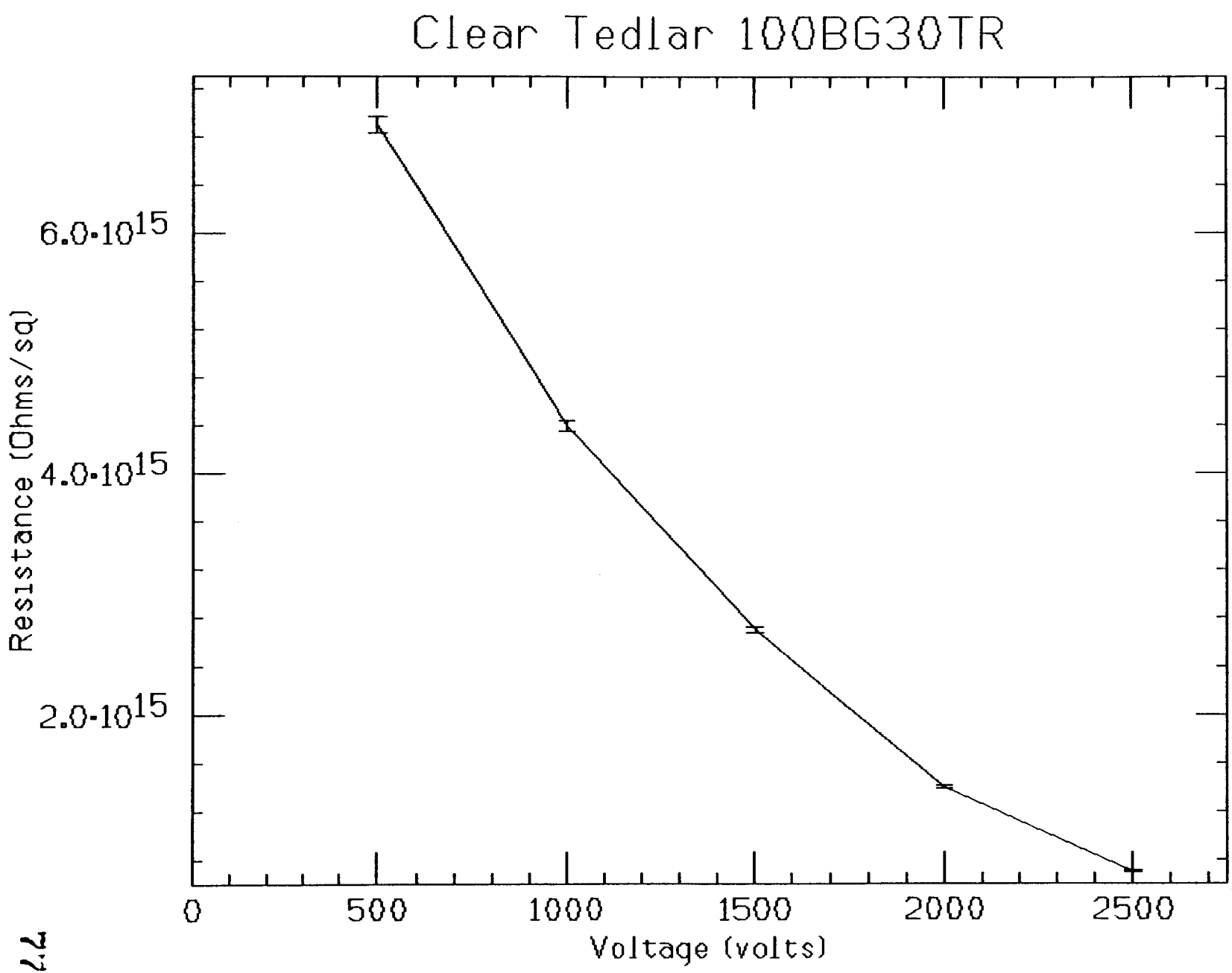
Kapton TAB-E 3inch electrode length X $\frac{3}{16}$inch gap X .002inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
3-3-92				
14:20	-250		—	**Current too small to measure.**
14:22	-501		—	
14:30	-2000	3e-13	1e17	
14:35	-2000	2.5e-13	1.3e17	
14:37	-2500	4.5e-13	8.9e16	
14:40	-2500	4e-13	1e17	


Kapton TAB--E
Resistance (Ohms/sq)
1.4·10^17
1.2·10^17
1.0·10^17
8.0·10^16
0
500
1000
1500
2000
2500
Voltage (volts)

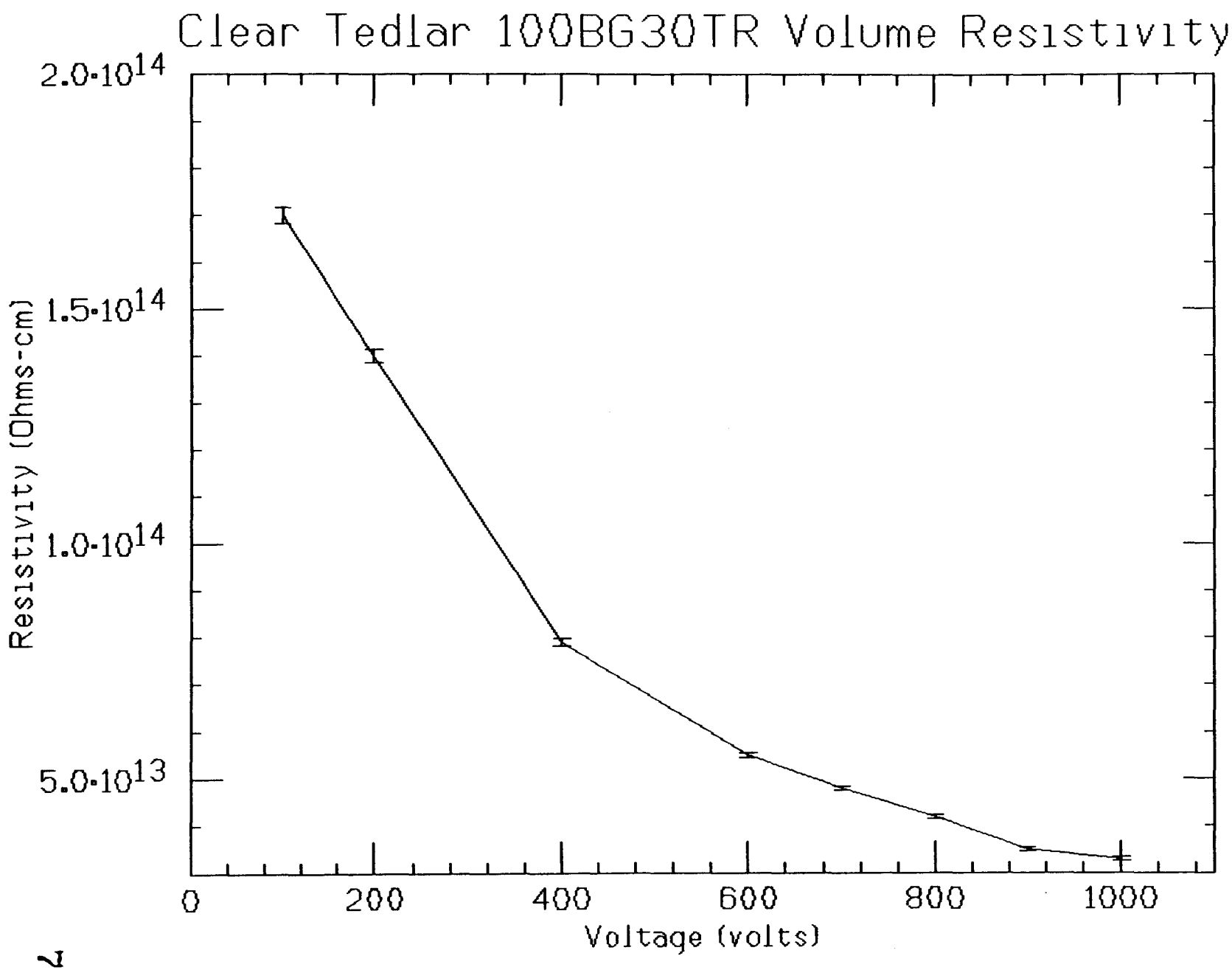
Kapton HPP-F 3inch electrode length X $\frac{3}{16}$inch gap X .002inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
3-3-92				
14:45	-501	1.8e-12	4.4e15	Current increasing
14:50	-501	2.1e-12	3.8e15	
14:51	-1000	9.4e-12	1.7e15	
14:55	-1501	1.6e-11	1.5e15	
14:58	-2000	2.3e-11	1.4e15	
15:00	-2000	2.2e-11	1.4e15	


Kapton HPP--F
5.0·10^15
4.0·10^15
3.0·10^15
2.0·10^15
1.0·10^15
Resistance (Ohms/sq)
0
500
1000
1500
2000
Voltage (volts)

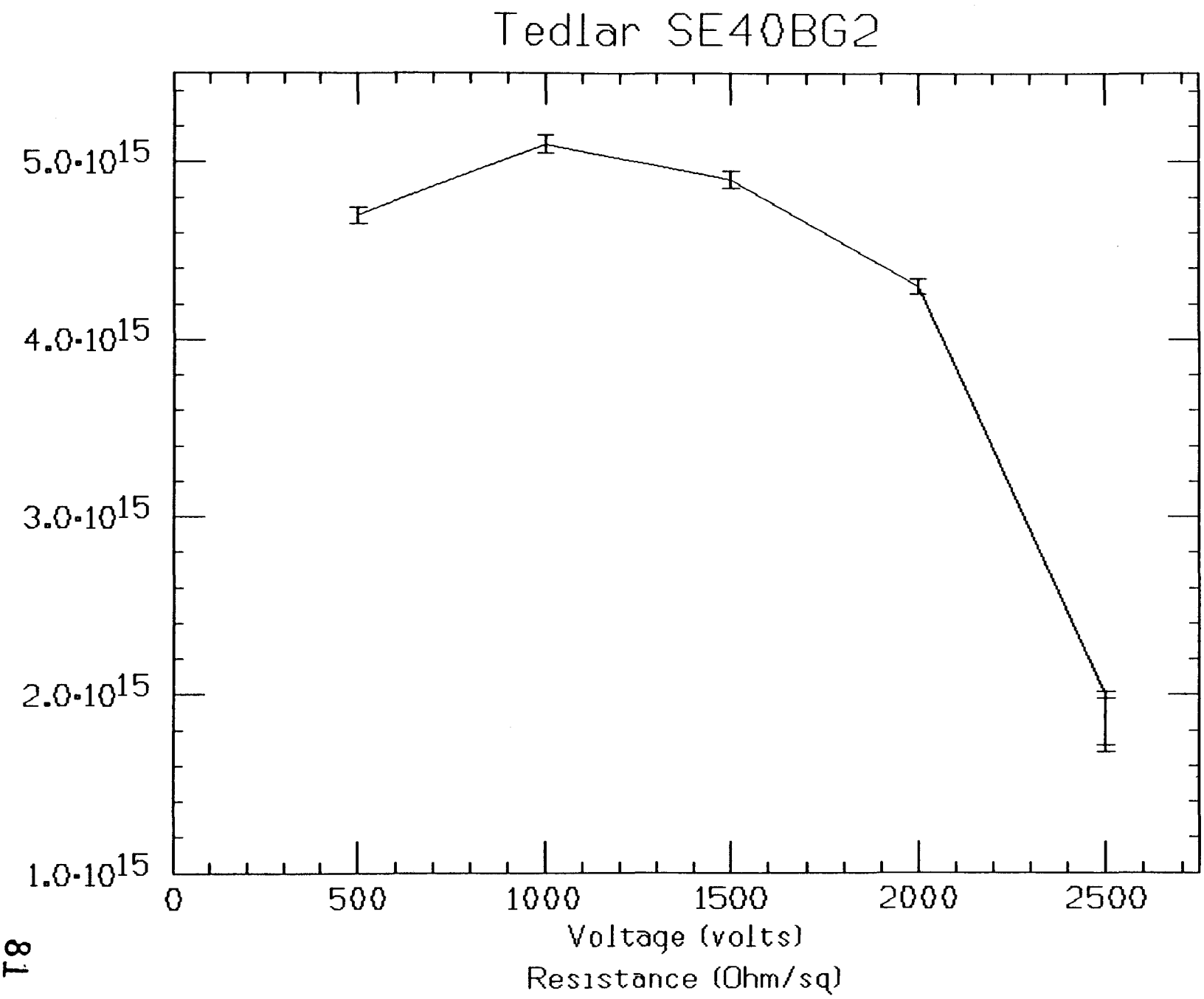
Clear Tedlar 100BG30TR 2inch electrode length X $\frac{1}{16}$inch gap X inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
11-10-01				
15:30	+500	2.5e-12	6.4e15	
15:33	+500	2.3e-12	6.9e15	
15:34	+1000	6.5e-12	5e15e15	
15:37	+1000	7.3e-12	4.4e15	
15:39	+1501	1.8e-11	2.7e15	±.1e-11Amps
15:45	+1501	1.8e-11	2.7e15	±.1e-11Amps
15:45	+2000	5e-11	1.3e15	Discharges
15:45	+2000	5e-11	1.3e15	±.2e-11Amps
15:50	+2000	4.6e-11	1.4e15	±.1e-11Amps
15:50	+2500	1.1e-10	7.3e14	±.1e-10Amps
16:00	+2500	1.15e-10	7e14	±.1e-10Amps
16:05	+2500	1.15e-10	7e14	±.1e-10Amps


Clear Tedlar 100BG30TR
Resistance (Ohms/sq)
6.0·10^15
4.0·10^15
2.0·10^15
0
500
1000
1500
2000
2500
Voltage (volts)

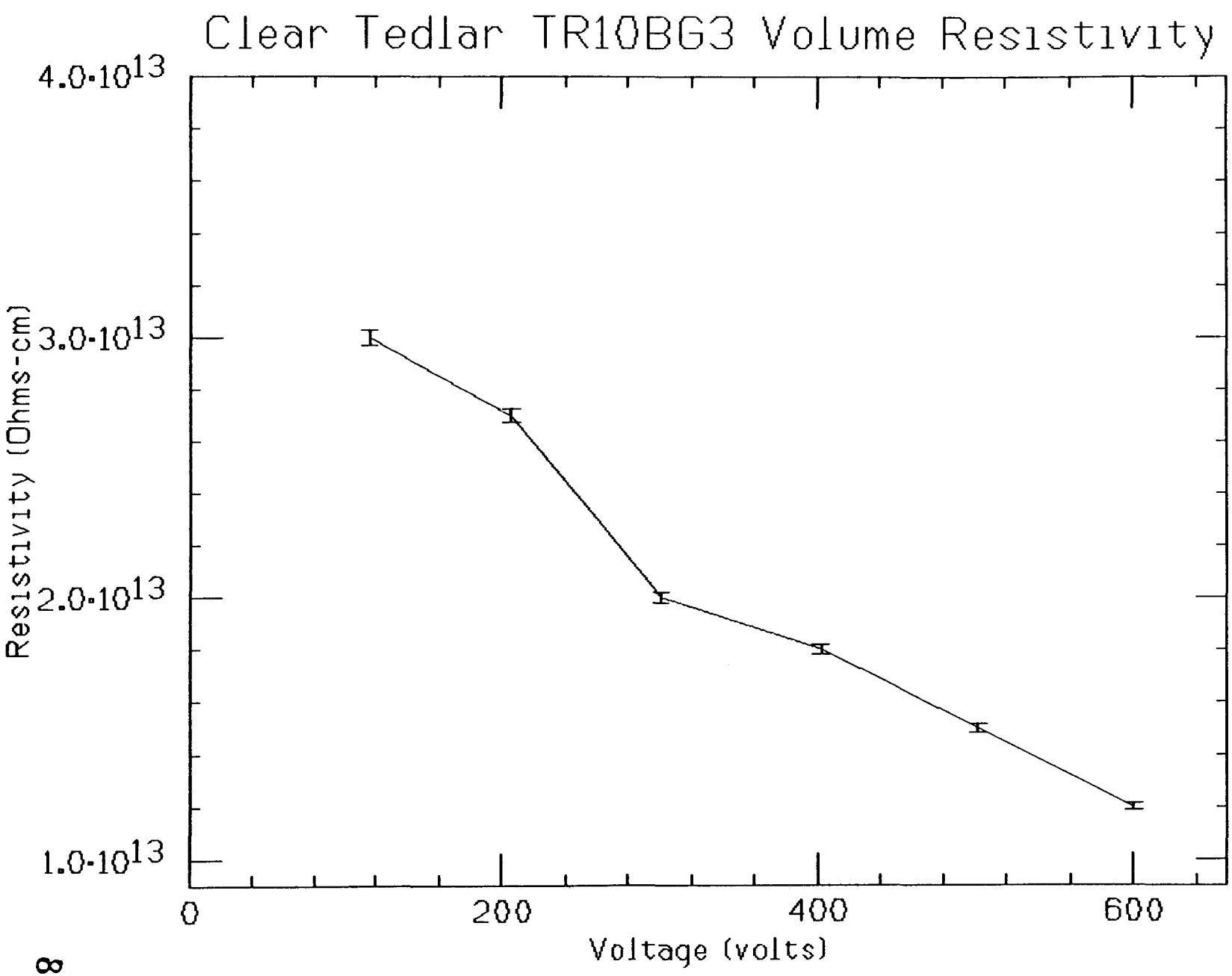
Clear Tedlar 100BG30TR Volume Resistivity Test .155inch^2 electrode area X inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistivity (Ohm-cm)**	**Notes & Comments**
11-20-91				
13:42	+100	2.3e-10	1.7e14	±.1e-10Amps
13:45	+200	5.6e-10	1.4e14	±.1e-10Amps
13:51	+401	2e-9	7.9e13	
13:54	+600	4.3e-9	5.5e13	
13:55	+701	5.8e-9	4.8e13	
13:58	+800	7.5e-9	4.2e13	
13:59	+900	1e-8	3.5e13	
14:00	+1000	1.2e-8	3.3e13	


Clear Tedlar 100BG30TR Volume Resistivity
2.0·10^14
1.5·10^14
1.0·10^14
5.0·10^13
Resistivity (Ohms-cm)
0
200
400
600
800
1000
Voltage (volts)

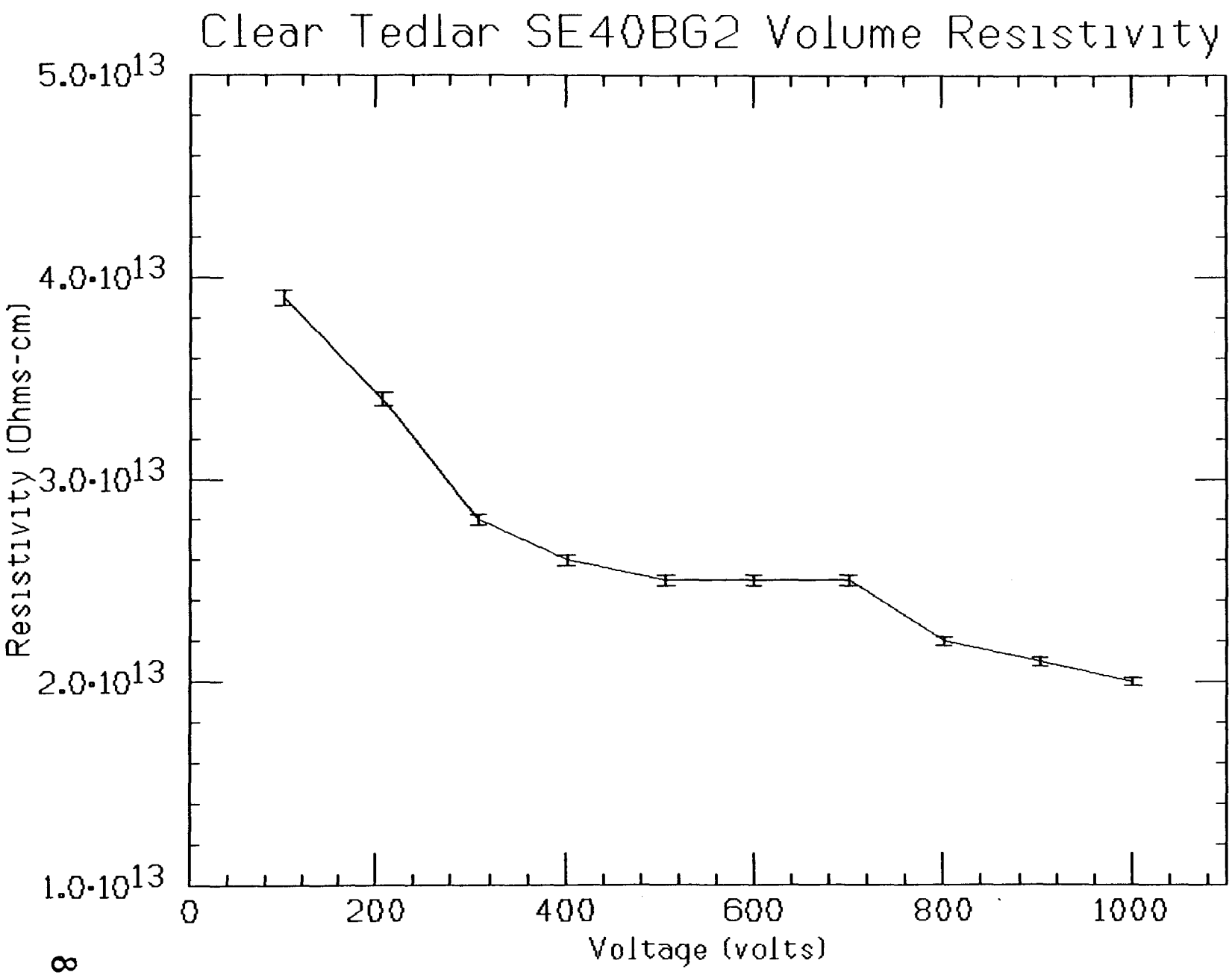
Tedlar SE40BG2 3.5electrode length X $\frac{1}{16}$inch gap X .004inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
7-25-91				
15:48	+500	6e-12	4.7e15	
15:49	+1000	1.2e-11	4.7e15	
15:52	+1000	1.1e-11	5.1e15	
15:53	+1500	1.8e-11	4.7e15	
15:55	+1500	1.7e-11	4.9e15	
15:55	+2000	3e-11	3.7e15	
15:57	+2000	2.7e-11	4e15	
15:59	+2000	2.6e-11	4.3e15	
16:00	+2500	7.1e-11	2e15	
16:03	+2500	7.6e-11	1.8e15	
16:05	+2500	7.7e-11	1.8e15	
16:10	+2500	7.9e-11	1.7e15	
16:11	+1000	9e-12	6.3e15	
16:15	+1000	1e-11	5.6e15	
16:20	+1000	1e-11	5.6e15	
16:25	+1000	1.1e-11	5.1e15	**Current fluctuations ±.1e-11Amps.**


Tedlar SE40BG2
5.0·10^15
4.0·10^15
3.0·10^15
2.0·10^15
1.0·10^15
0
500
1000
1500
2000
2500
Voltage (volts)
Resistance (Ohm/sq)

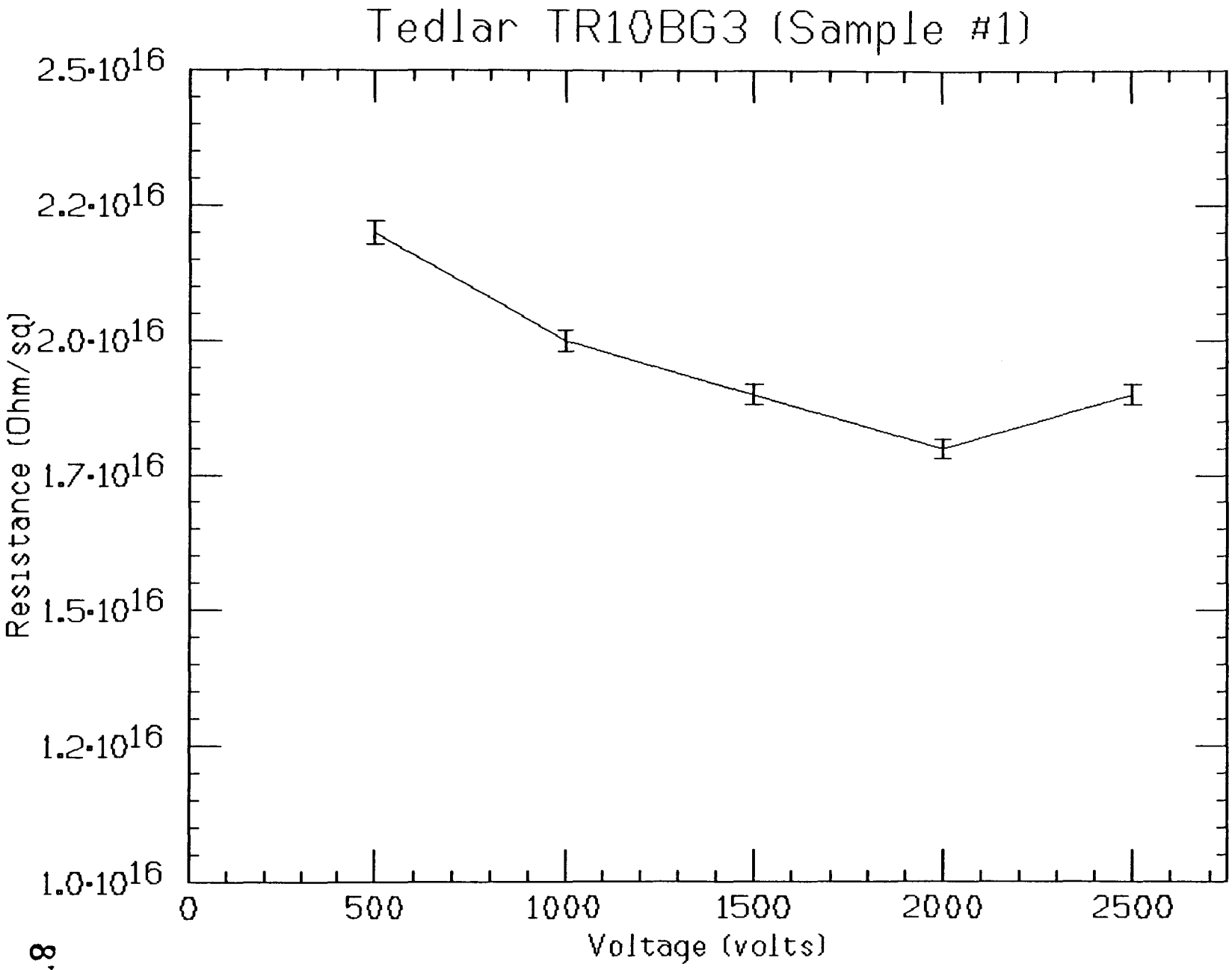
Clear Tedlar TR10BG3 Volume Resistivity Test .155inch^2 electrode area X .001inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistivity (Ohm-cm)**	**Notes & Comments**
7-25-91				
20:03	+116	1.5e-9	3e13	±.1e-9Amps
20:04	+206	3e-9	2.7e13	
20:05	+301	5.4e-9	2e13	
20:06	+402	8.8e-9	1.8e13	
20:07	+502	1.3e-8	1.5e13	
20:08	+600	1.9e-8	1.2e13	


Clear Tedlar TR10BG3 Volume Resistivity
4.0·10^13
3.0·10^13
2.0·10^13
1.0·10^13
Resistivity (Ohms-cm)
0
200
400
600
Voltage (volts)

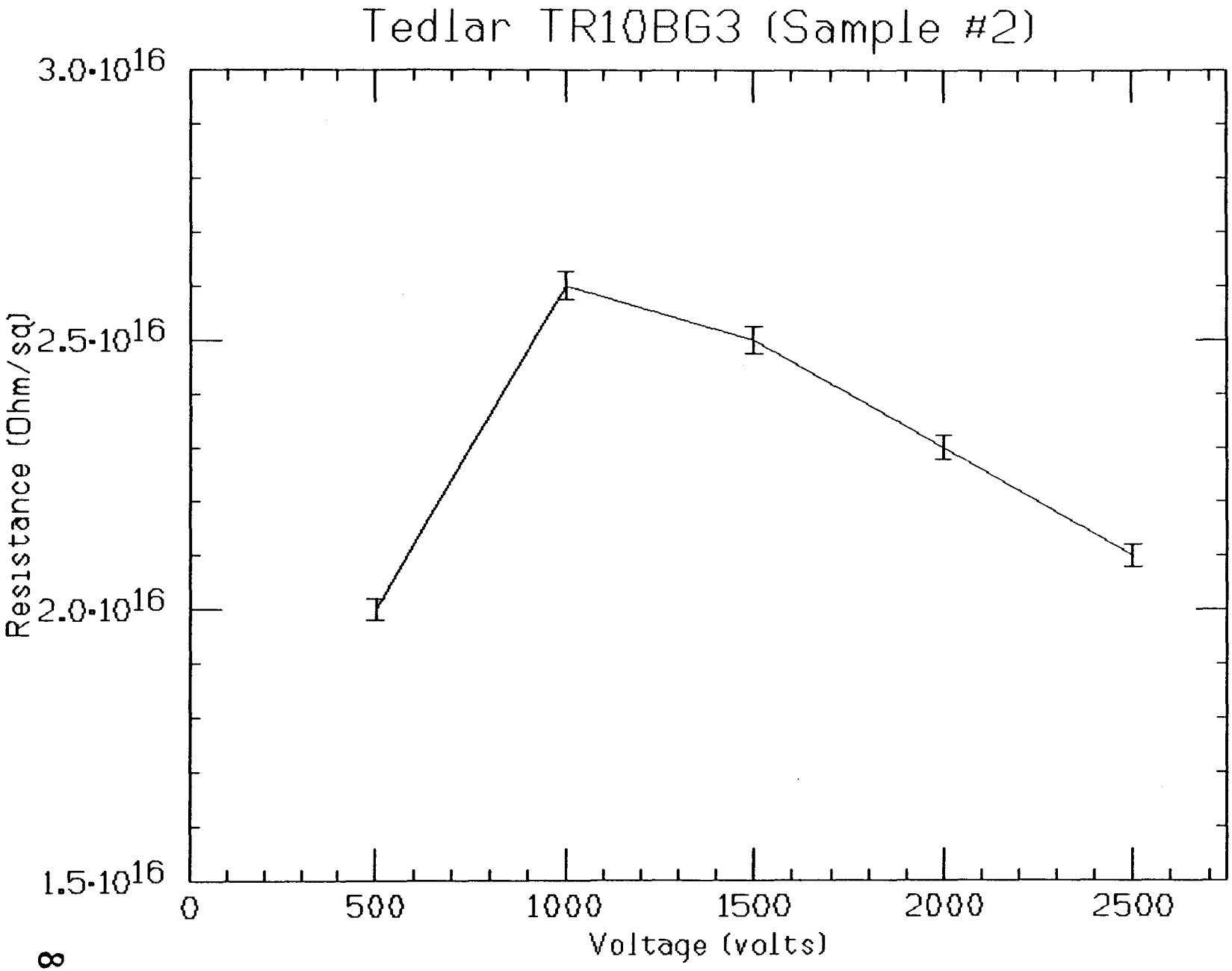
Clear Tedlar SE40BG2 Volume Resistivity Test .155inch^{2}electrode area X .004inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistivity (Ohm-cm)**	**Notes & Comments**
7-25-91				
19:03	+99	2.5e-10	3.9e13	
19:05	+208	6e-10	3.4e13	
19:06	+309	1.1e-9	2.8e13	
19:07	+402	1.5e-9	2.6e13	
19:08	+507	2e-9	2.5e13	
19:09	+600	2.3e-9	2.5e13	
19:10	+701	2.8e-9	2.5e13	
19:11	+801	3.5e-9	2.2e13	
19:12	+903	4.2e-9	2.1e13	±.1e-9Amps.
19:13	+1001	4.9e-9	2e13	±.1e-9Amps.


Clear Tedlar SE40BG2 Volume Resistivity
5.0·10^13
4.0·10^13
3.0·10^13
2.0·10^13
1.0·10^13
Resistivity (Ohms-cm)
0
200
400
600
800
1000
Voltage (volts)

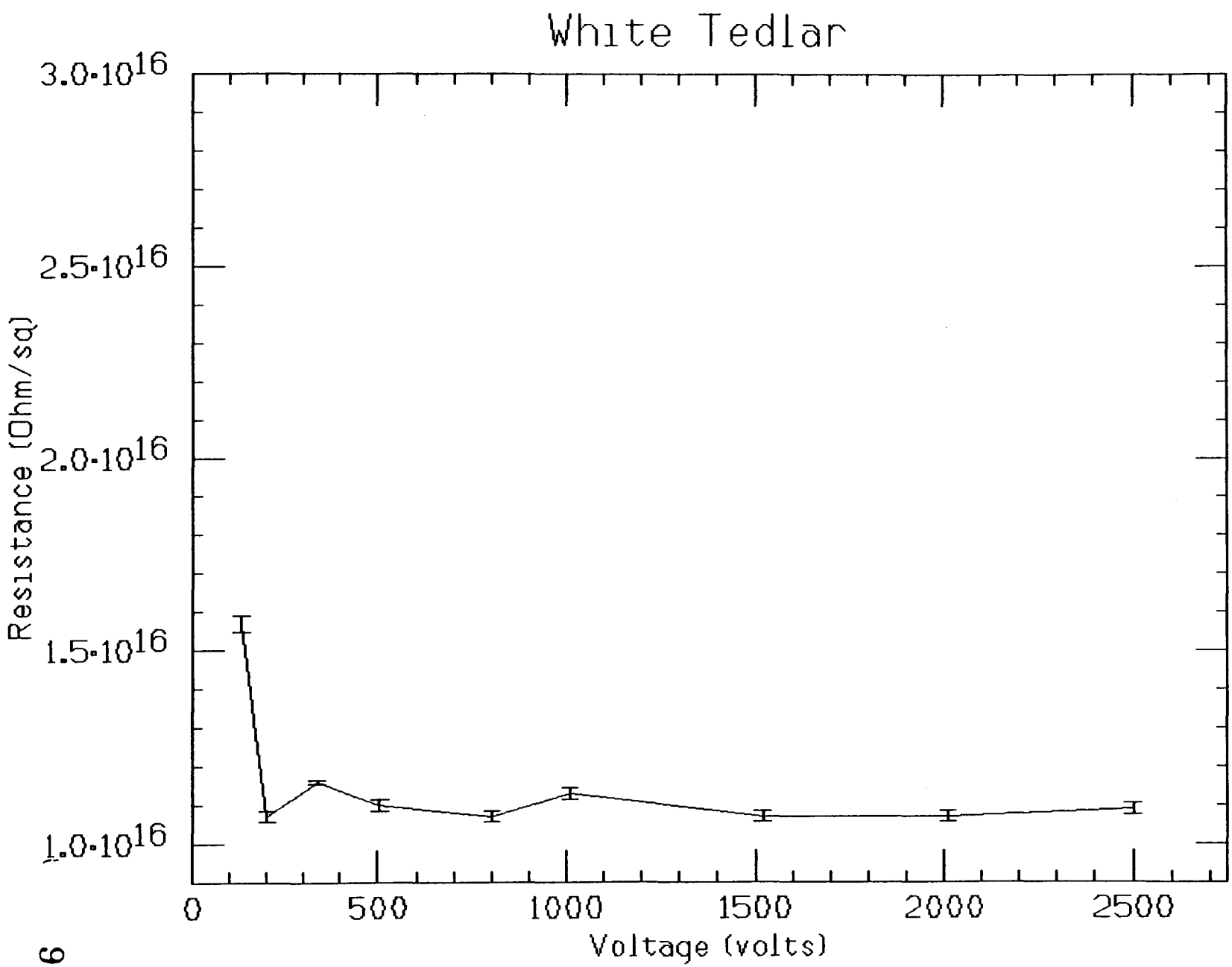
Tedlar TR10BG3 (Sample #1) 3inch electrode length X $\frac{1}{16}$inch gap X .001inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
7-25-91				
16:37	+500	1.4e-12	1.7e16	Current very jumpy ±.5e-12Amps.
16:40	+500	1.2e-12	2e16	±.1e-12Amps
16:45	+500	1.1e-12	2e16	±.1e-12Amps
16:46	+1000	2.7e-12	1.7e16	±.1e-12Amps
16:50	+1000	2.4e-12	2e16	Current settling
16:55	+1000	2.4e-12	2e16	
16:56	+1500	4.3e-12	1.7e16	
16:57	+1500	4e-12	1.8e16	
16:59	+1500	3.7e-12	1.9e16	Minor fluctuations
17:00	+2000	5.5e-12	1.7e16	±.1e-12Amps
17:05	+2000	5.2e-12	1.8e16	Steady
17:06	+2500	7.1e-12	1.7e16	
17:10	+2500	6.4e-12	1.9e16	
17:12	+1000	1.3e-12	3.7e16	Current very jumpy ±.3e-12Amps
17:16	+1000	2.1e-12	2.3e16	Current increasing slowly
17:20	+1000	2.4e-12	2e16	
17:25	+1000	2.5e-12	1.9e16	Small fluctuations


Tedlar TR10BG3 (Sample #1)
Resistance (Ohm/sq)
2.5·10^16
2.2·10^16
2.0·10^16
1.7·10^16
1.5·10^16
1.2·10^16
1.0·10^16
0
500
1000
1500
2000
2500
Voltage (volts)

Tedlar TR10BG3 (Sample #2) 3inch electrode length X $\frac{1}{16}$inch gap X .001inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
7-25-91				
17:40	+501	1.1e-12	2e16	Current jumpy ±.1e-12Amps
17:41	+1001	2.1e-12	2.3e16	±.1e-12Amps
17:45	+1001	1.9e-12	2.5e16	
17:48	+1001	1.8e-12	2.6e16	Steady
17:49	+1500	3.4e-12	2.1e16	
17:52	+1500	2.9e-12	2.5e16	Steady
17:53	+2000	4.5e-12	2.1e16	Current decreasing
17:55	+2000	4e-12	2.4e16	
18:00	+2000	4.1e-12	2.3e16	Steady
18:01	+2500	6.1e-12	1.9e16	
18:03	+2500	5.6e-12	2.1e16	Stable
18:08	+2500	5.6e-12	2.1e16	
18:09	+1000	1e-12	4.8e16	Current increasing
18:10	+1000	1.5e-12	3.2e16	
18:15	+1000	1.7e-12	2.8e16	
18:18	+1000	1.8e-12	2.6e16	

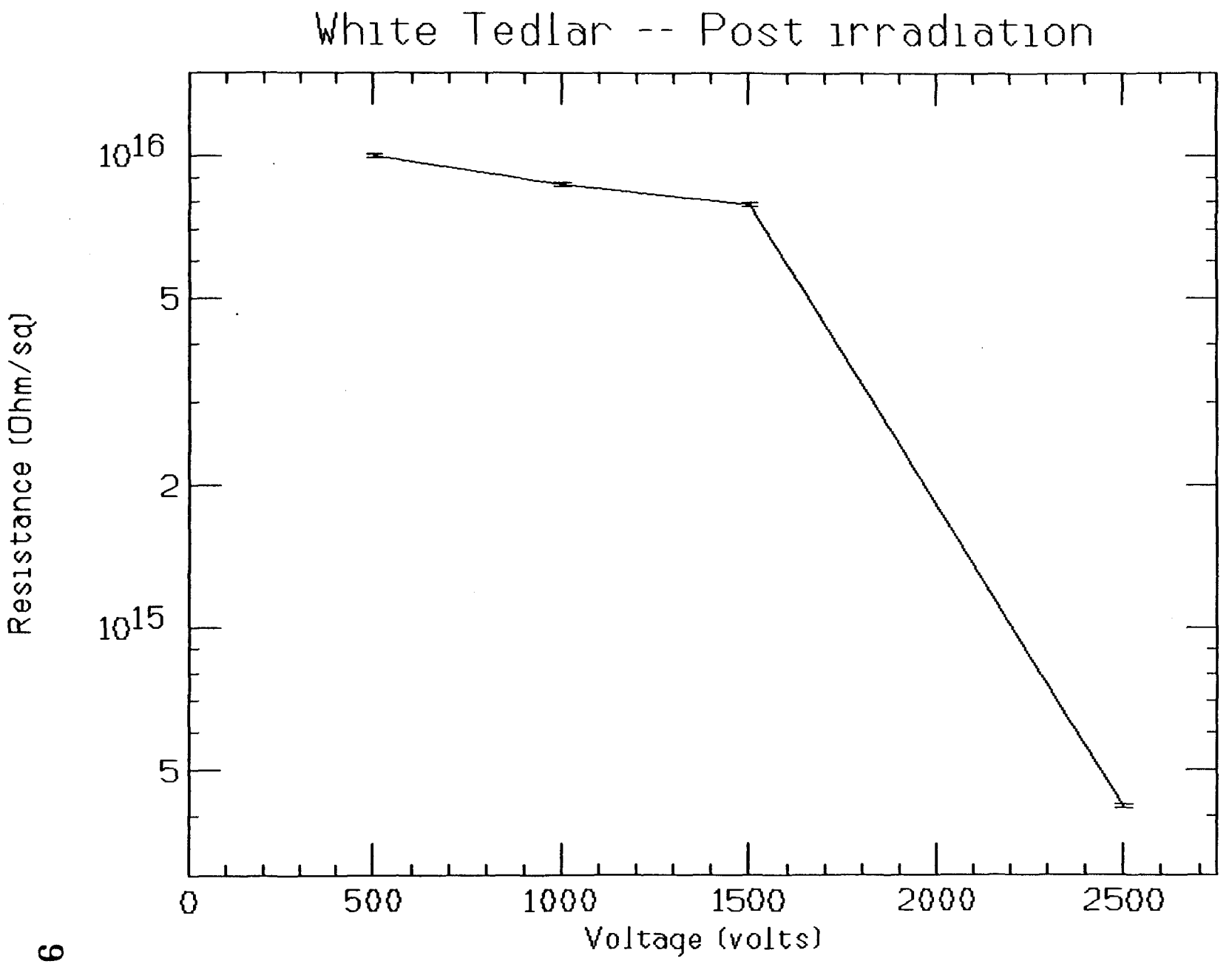

Tedlar TR10BG3 (Sample #2)
3.0·10^16
2.5·10^16
2.0·10^16
1.5·10^16
Resistance (Ohm/sq)
0
500
1000
1500
2000
2500
Voltage (volts)

White Tedlar 2inch electrode length X $\frac{1}{16}$inch gap X .001inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
5-1-91				
17:40	+131	4e-13	1.57e16	
17:42	+201	9e13	1.07e16	
17:43	+337	1.4e-12	1.16e16	
17:44	+505	2.2e-12	1.1e16	
17:45	+801	3.6e-12	1.07e16	
17:46	+1009	4.3e-12	1.13e16	
17:47	+1520	6.8e-12	1.07e16	
17:49	+2010	9e-12	1.07e16	
17:51	+2500	1.1e-11	1.09e16	
17:55	+2500	9e-12	1.3e16	

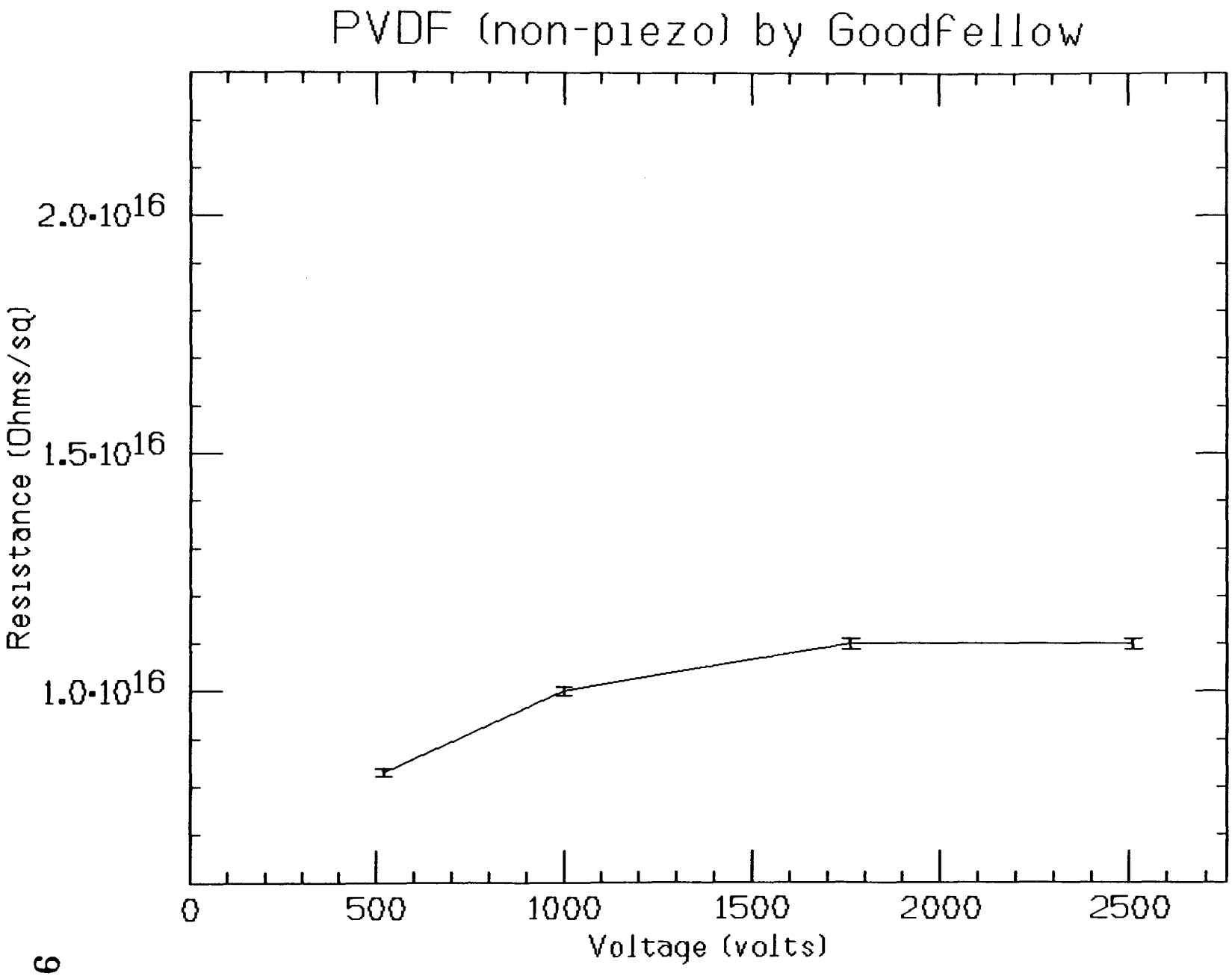

White Tedlar
3.0·10^16
2.5·10^16
2.0·10^16
1.5·10^16
1.0·10^16
Resistance (Ohm/sq)
0
500
1000
1500
2000
2500
Voltage (volts)

Retest after $10^{11} \frac{n}{cm^2}$ irradiation.
White Tedlar
2inch electrode length **X** $\frac{1}{16}$inch gap **X** .001inch thickness

Date & Time	Voltage (volts)	Current (Amps)	Resistance (Ohms/sq)	Notes & Comments
9-22-91				
17:34	+502	1.75e-12	9.2e15	±.1e-12Amps
17:40	+502	1.6e-12	1e16	
17:40	+1002	4.5e-12	7.1e15	
17:45	+1002	3.7e-12	8.7e15	
17:45	+1503	7.5e-12	6.4e15	
17:49	+1503	6.1e-12	7.9e15	
17:50	+2500	2.2e-10	3.6e14	±.1e-10Amps
17:59	+2500	1.9e-10	4.2e14	

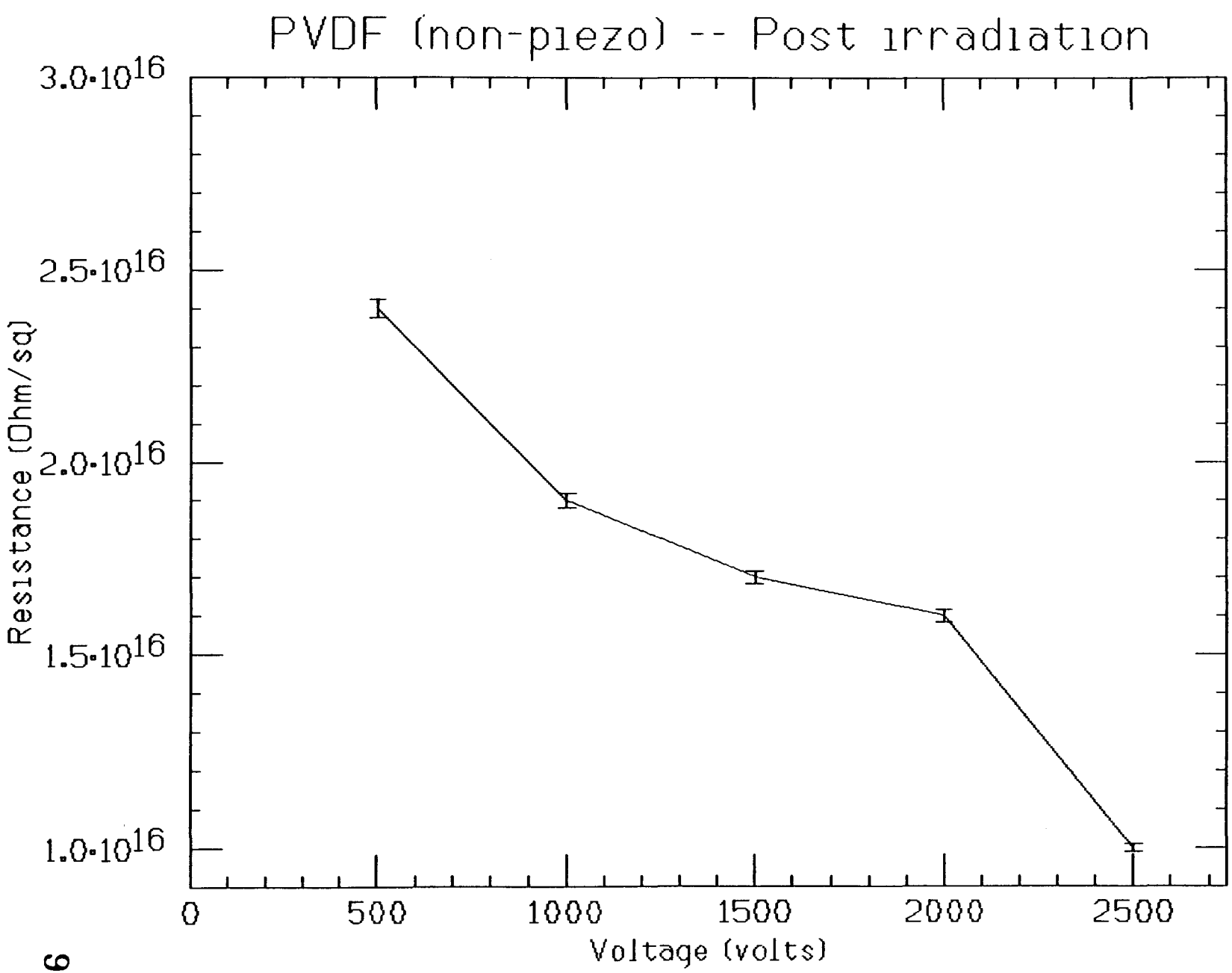

White Tedlar -- Post irradiation
Resistance (Ohm/sq)
10^{16}
5
2
10^{15}
5
0
500
1000
1500
2000
2500
Voltage (volts)

PVDF (non-piezo) by Goodfellow 1.5electrode length X $\frac{1}{16}$inch gap X .02inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
5-7-91				
19:15	+520	1.85e-12	6.7e15	
19:18	+520	1.5e-12	8.3e15	
19:20	+1000	3.2e-12	7.5e15	The current settles with time
19:21	+1000	2.8e-12	8.6e15	
19:23	+1000	2.4e-12	1e16	
19:24	+1760	——	——	Current settling
19:27	+1760	4.5e-12	9.4e15	
19:31	+1760	3.7e-12	1.1e16	
19:33	+2510	6.85e-12	8.8e15	
19:36	+2510	5.7e-12	1e16	
19:37	+2510	5.4e-12	1.1e16	
Re-zero ammeter				
20:08	+1000	1.5e-12	1.6e16	
20:20	+1000	1.45e-12	1.7e16	

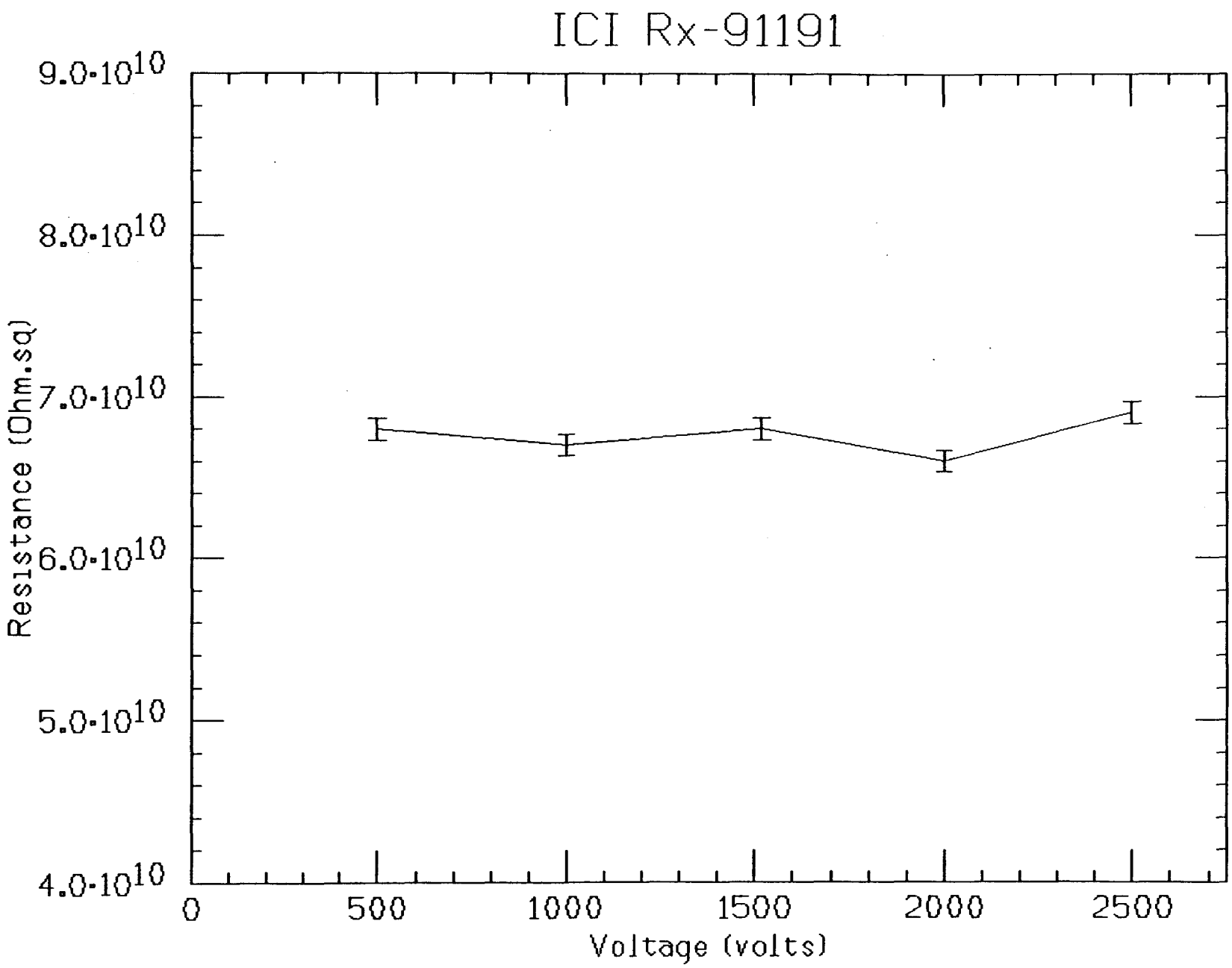

PVDF (non-piezo) by Goodfellow
Resistance (Ohms/sq)
2.0·10^16
1.5·10^16
1.0·10^16
0
500
1000
1500
2000
2500
Voltage (volts)

Retest after $10^{11} \frac{n}{cm^2}$ irradiation.
PVDF non-piezo
1.5inch electrode length X $\frac{1}{16}$inch gap X .2inch thickness

Date & Time	Voltage (volts)	Current (Amps)	Resistance (Ohms/sq)	Notes & Comments
9-18-91				
12:50	+503	1.1e-12	1.1e16	±.1e-12Amps
12:56	+503	5e-11	2.4e16	
12:57	+1002	2e-12	1.2e16	
13:05	+1002	1.25e-12	1.9e16	
13:06	+1501	3e-12	1.2e16	Slow fluctuations.
13:10	+1501	2.1e-12	1.7e16	
13:12	+2000	3.9e-12	1.2e16	
13:20	+2000	3e-12	1.6e16	
13:21	+2500	6e-12	1e16	
13:45	+2500	5.9e-12	1e16	


PVDF (non-piezo) -- Post irradiation
3.0·10^16
2.5·10^16
2.0·10^16
1.5·10^16
1.0·10^16
Resistance (Ohm/sq)
0
500
1000
1500
2000
2500
Voltage (volts)

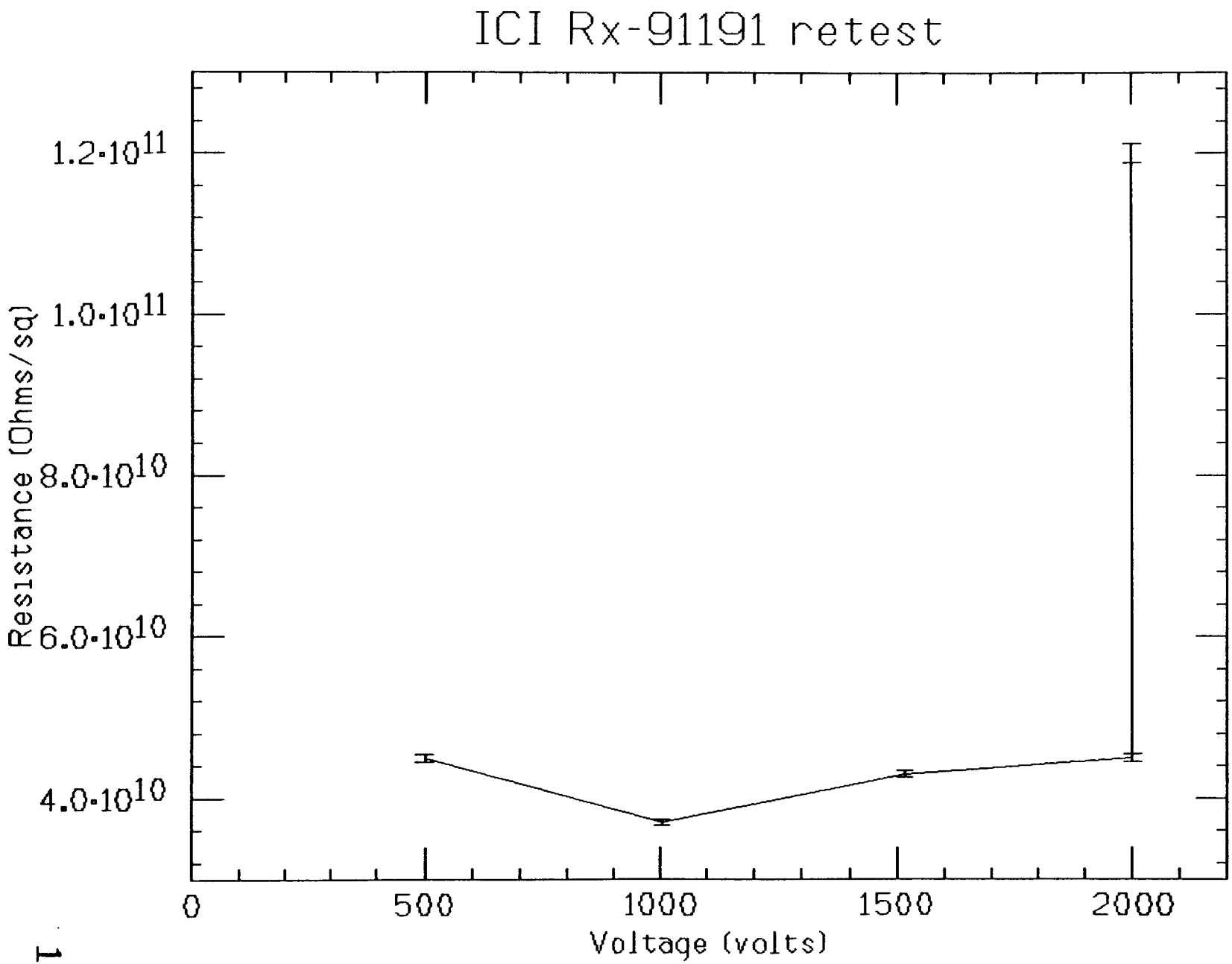
ICI Rx-91191 3inch electrode length X $\frac{1}{16}$inch gap X .063inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
8-23-91				
14:35	+500	3.5e-7	6.8e10	
14:36	+1000	7.2e-7	6.7e10	
14:37	+1520	1.08e-6	6.8e10	
14:38	+2000	1.46e-6	6.6e10	
14:39	+2500	1.74e-6	6.9e10	**Small fluctuations initially but settled.**


ICI Rx-91191
9.0·10^10
8.0·10^10
7.0·10^10
6.0·10^10
5.0·10^10
4.0·10^10
Resistance (Ohm.sq)
0
500
1000
1500
2000
2500
Voltage (volts)

ICI Rx-91191 retest

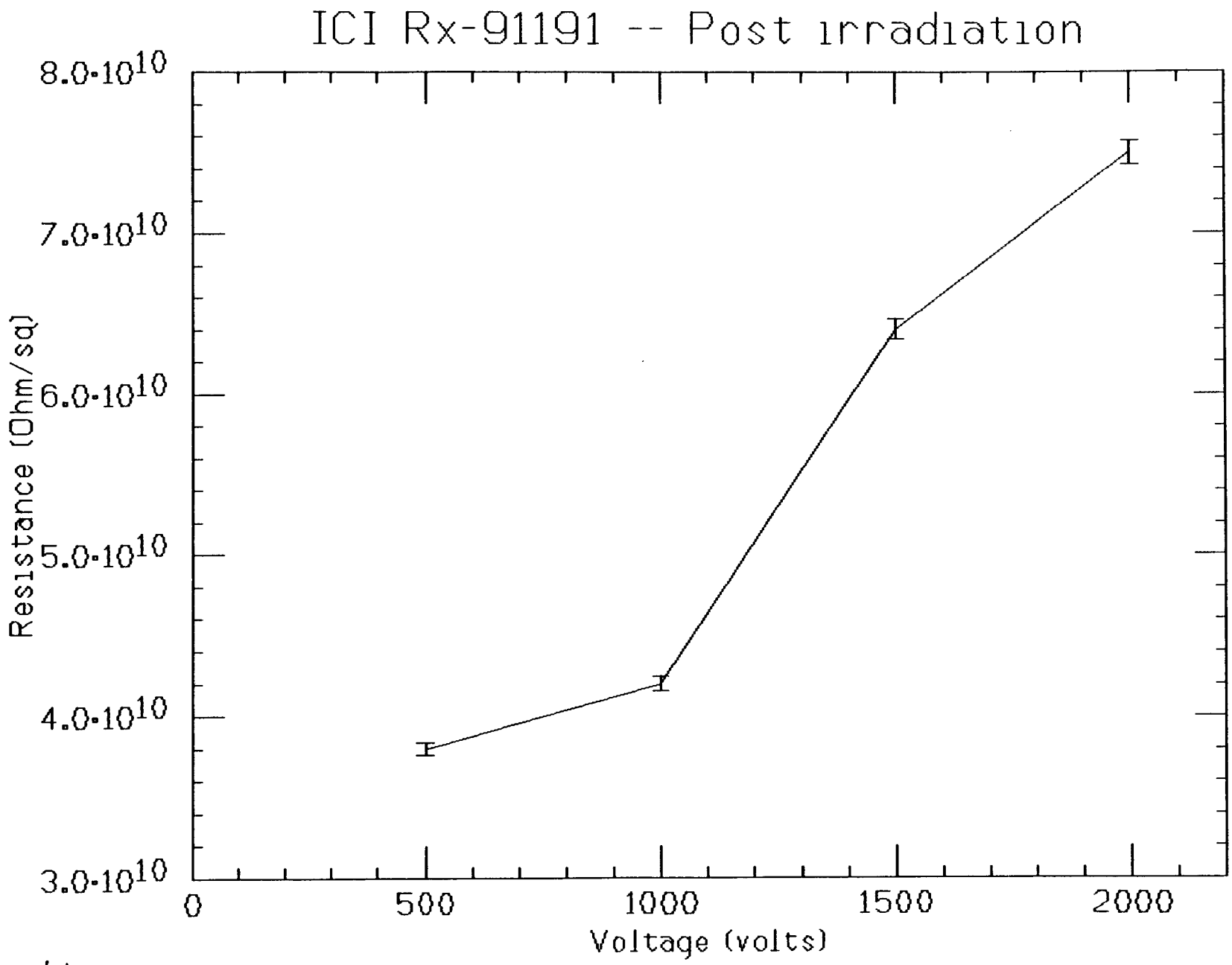
3inch electrode length X $\frac{1}{16}$inch gap X .063inch substrate thickness

Date & Time	Voltage (volts)	Current (Amps)	Resistance (Ohms/sq)	Notes & Comments
9-9-91				
14:45	+500	5.6e-7	4.3e10	
14:50	+500	5.4e-7	4.4e10	
14:52	+500	5.3e-7	4.5e10	
14:53	+1004	1.3e-6	3.7e10	
14:54	+1518	1.7e-6	4.3e10	
14:55	+2000	2.15e-6	4.5e10	
14:57	+2000	1.85e-6	5.2e10	
15:00	+2000	1.6e-6	6e10	
15:01	+2000	1.5e-6	6.4e10	
15:05	+2000	1.25e-6	7.7e10	
15:10	+2000	1.1e-6	8.7e10	
15:15	+2000	1e-6	9.6e10	
15:23	+2000	9e-5	1.1e11	
15:30	+2000	8.5e-5	1.1e11	
15:36	+2000	8e-5	1.2e11	Stable

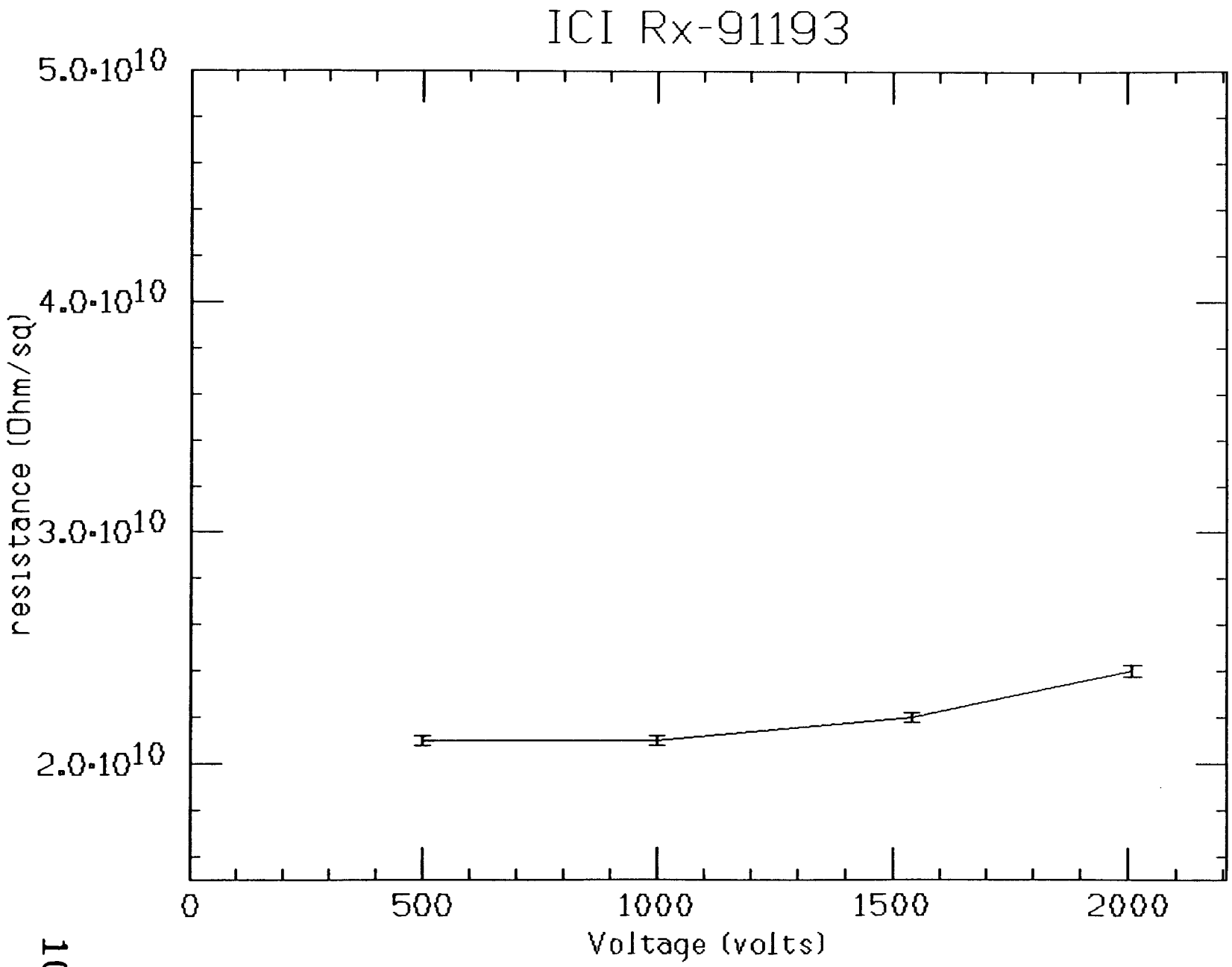

ICI Rx-91191 retest
Resistance (Ohms/sq)
1.2·10^11
1.0·10^11
8.0·10^10
6.0·10^10
4.0·10^10
0
500
1000
1500
2000
Voltage (volts)

Retest after $10^{11} \frac{n}{cm^2}$ irradiation.
ICI Rx-91191
3inch electrode length X $\frac{1}{16}$inch gap X $\frac{1}{16}$inch thickness

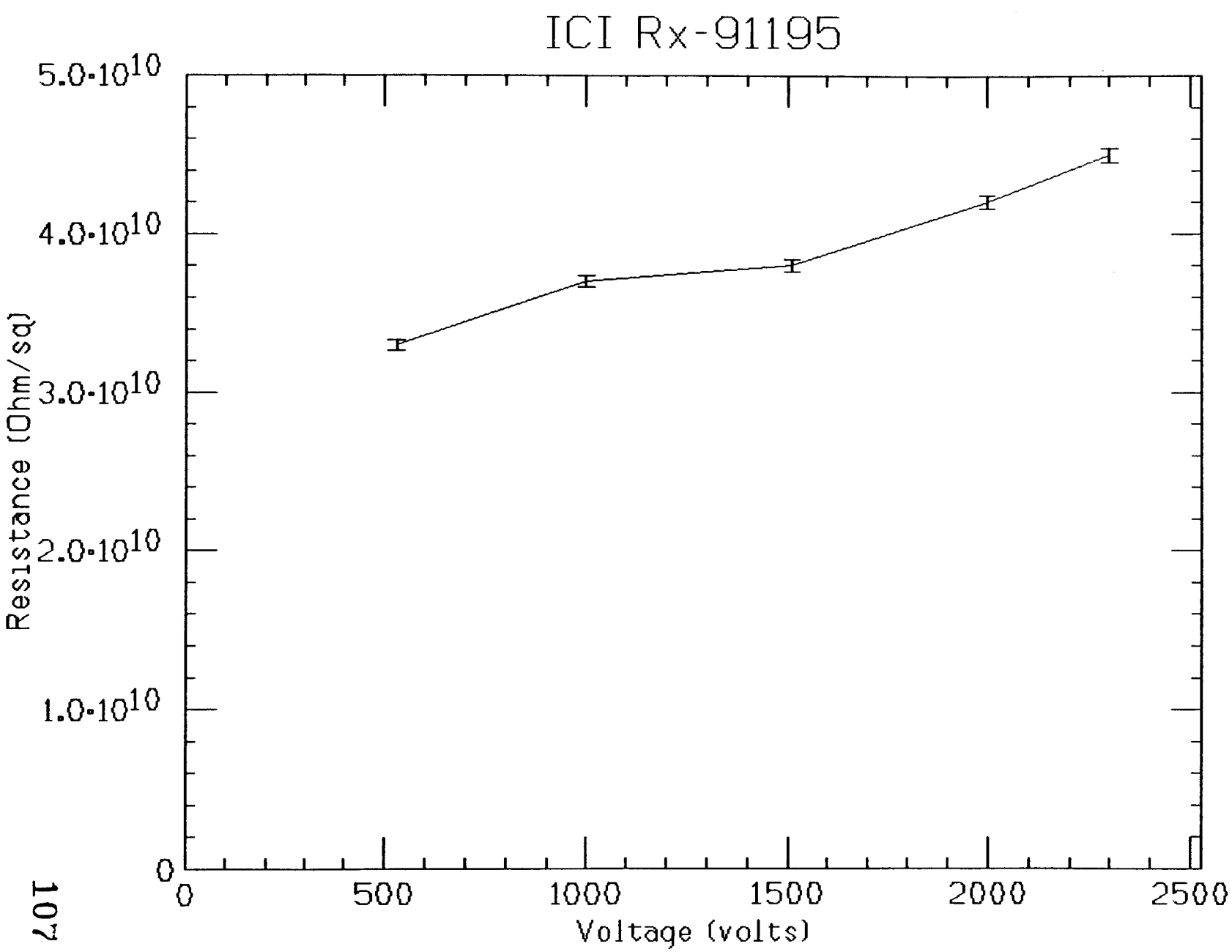
Date & Time	Voltage (volts)	Current (Amps)	Resistance (Ohms/sq)	Notes & Comments
9-17-91				
10:14	+500	7.1e-7	3.7e11	
10:19	+500	6.7e-7	3.8e11	
10:20	+1000	1.2e-6	4.1e11	
10:25	+1000	1e-6	4.2e11	
10:26	+1501	1.35e-6	5.6e11	
10:31	+1501	1.2e-6	6.4e11	
10:33	+2000	1.6e-6	6.4e11	±.1e-6Amps, signs of breakdown
10:40	+2000	1.35e-6	7.5e11	Tripped at 2.8KV.


ICI Rx-91191 -- Post irradiation
8.0·10^10
7.0·10^10
6.0·10^10
5.0·10^10
4.0·10^10
3.0·10^10
Resistance (Ohm/sq)
0
500
1000
1500
2000
Voltage (volts)

ICI Rx-91193 3inch electrode length X $\frac{1}{16}$inch gap X .063inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
8-23-91				
12:25	+500	1.15e-6	2.1e10	
12:30	+1000	2.25e-6	2.1e10	
12:31	+1540	3.35e-6	2.2e10	
12:32	+2010	4e-6	2.4e10	**@2.3KV started breaking down, sparking**

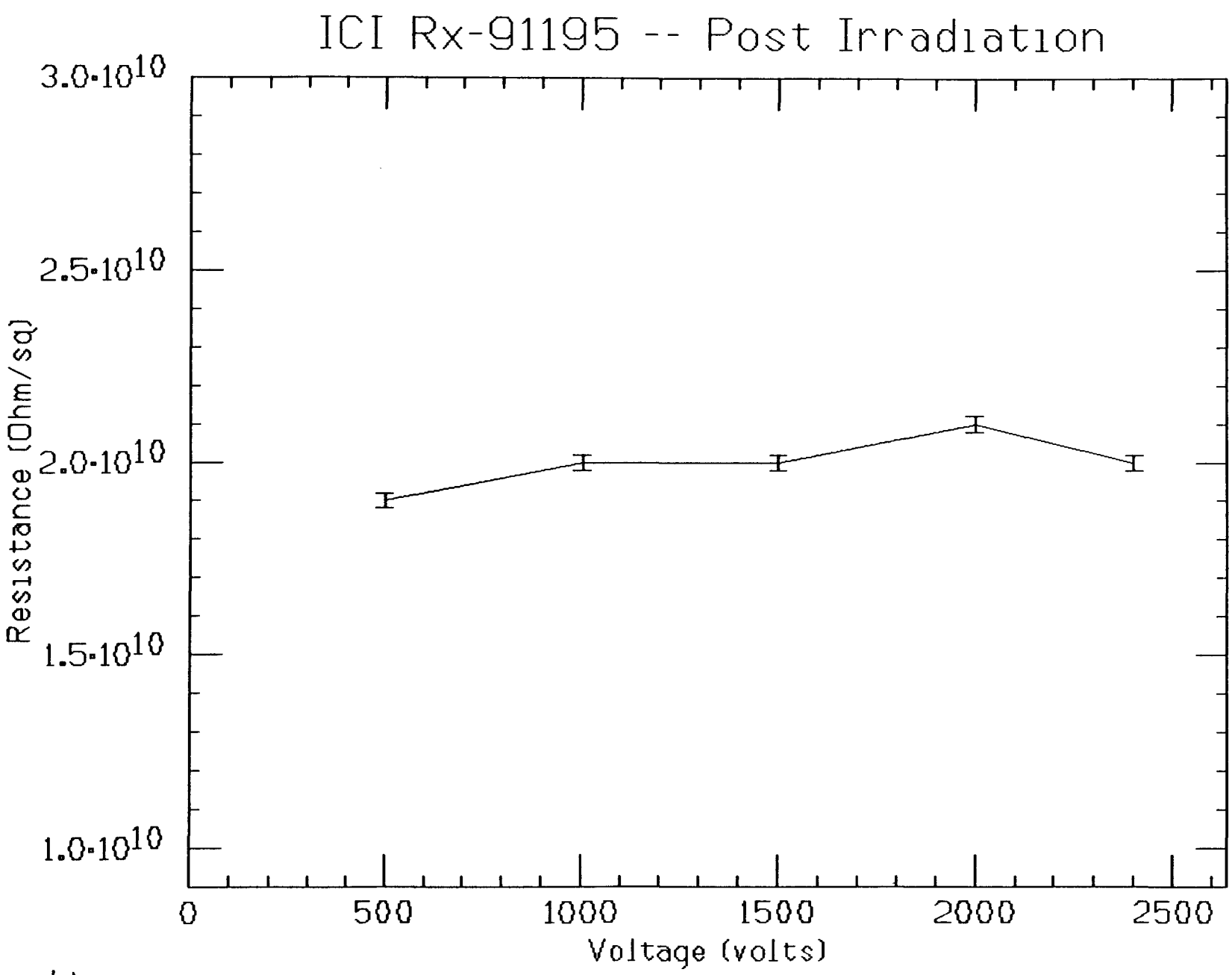

ICI Rx-91193
5.0·10^10
4.0·10^10
3.0·10^10
2.0·10^10
resistance (Ohm/sq)
0
500
1000
1500
2000
Voltage (volts)

ICI Rx-91195 3inch electrode length X $\frac{1}{16}$inch gap X .063inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
8-23-91				
11:50	+530	8.1e-7	3.1e10	
11:55	+530	7.6e-7	3.3e10	
11:56	+1000	1.3e-6	3.7e10	
11:58	+1510	1.9e-6	3.8e10	
12:00	+2000	2.3e-6	4.2e10	
12:03	+2300	2.45e-6	4.5e10	**Starts breaking down, sparking.**
There are scores in the surface that bridge gap, appears that they were there before test.				

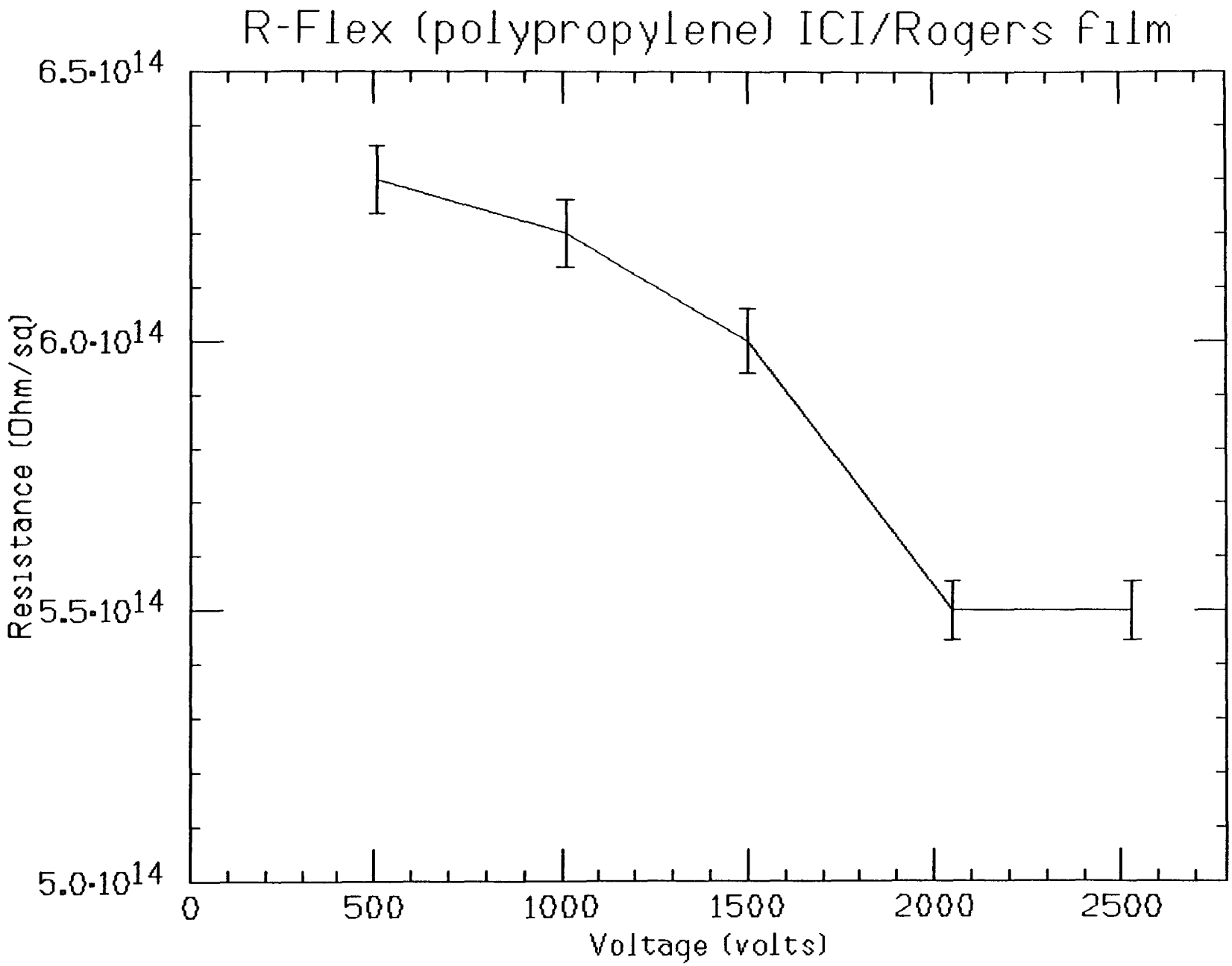

ICI Rx-91195
5.0·10^10
4.0·10^10
3.0·10^10
2.0·10^10
1.0·10^10
0
Resistance (Ohm/sq)
0
500
1000
1500
2000
2500
Voltage (volts)

Retest after $10^{11} \frac{n}{cm^2}$ irradiation.
ICI Rx-91195
3inch electrode length X $\frac{1}{16}$inch gap X $\frac{1}{16}$inch thickness

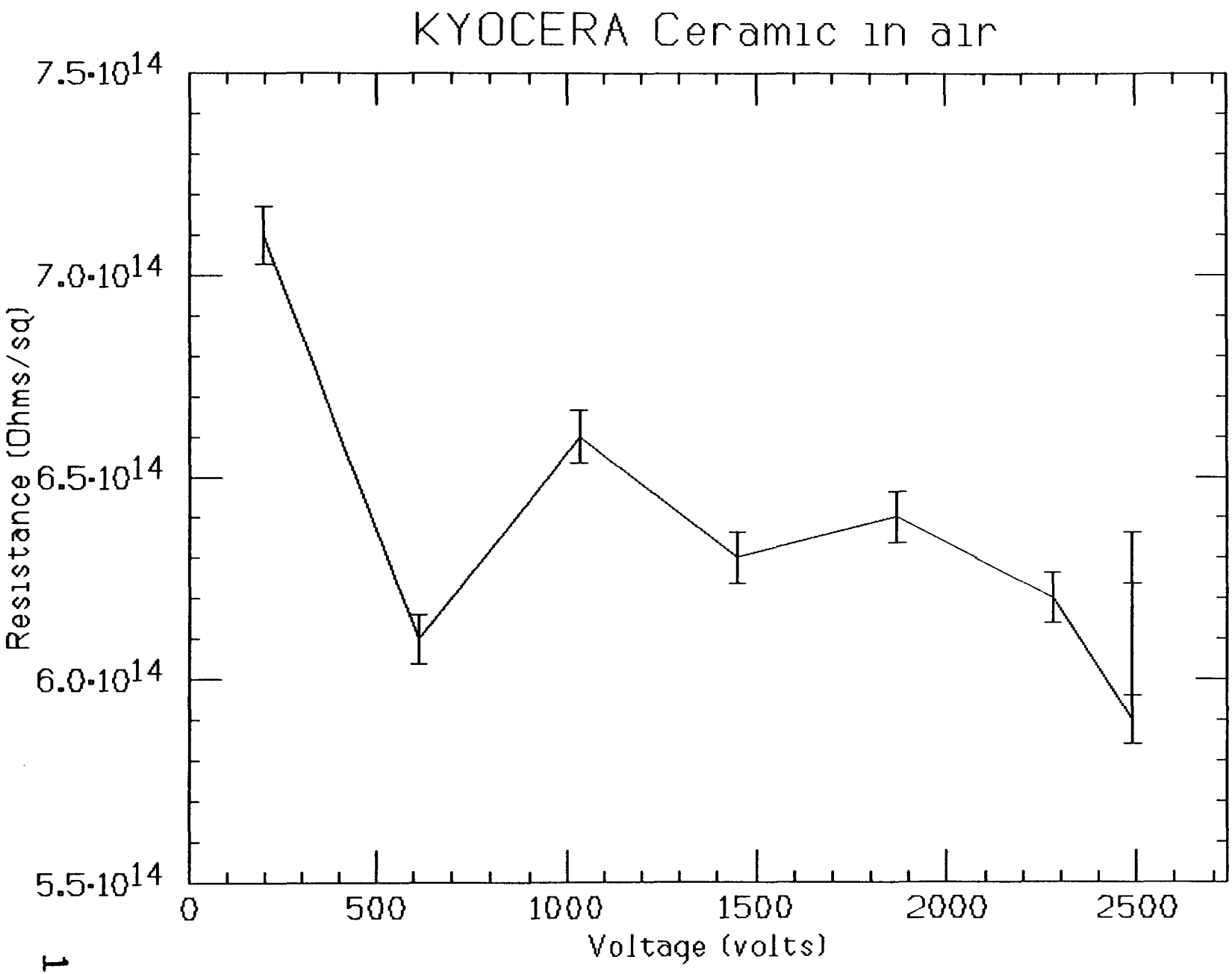
Date & Time	Voltage (volts)	Current (Amps)	Resistance (Ohms/sq)	Notes & Comments
9-17-91				
9:35	+500	1.3e-6	1.8e10	Stable
9:40	+500	1.25e-6	1.9e10	
9:41	+1002	2.5e-6	1.9e10	
9:45	+1002	2.4e-6	2e10	
9:45	+1500	3.6e-6	2e10	
9:55	+1500	3.5e-6	2e10	
9:56	+2000	4.7e-6	2.1e10	
10:06	+2000	4.7e-6	2.1e10	
10:08	+2400	5.8e-6	2e10	Tripped at 2.4KV, showing signs of breakdown.

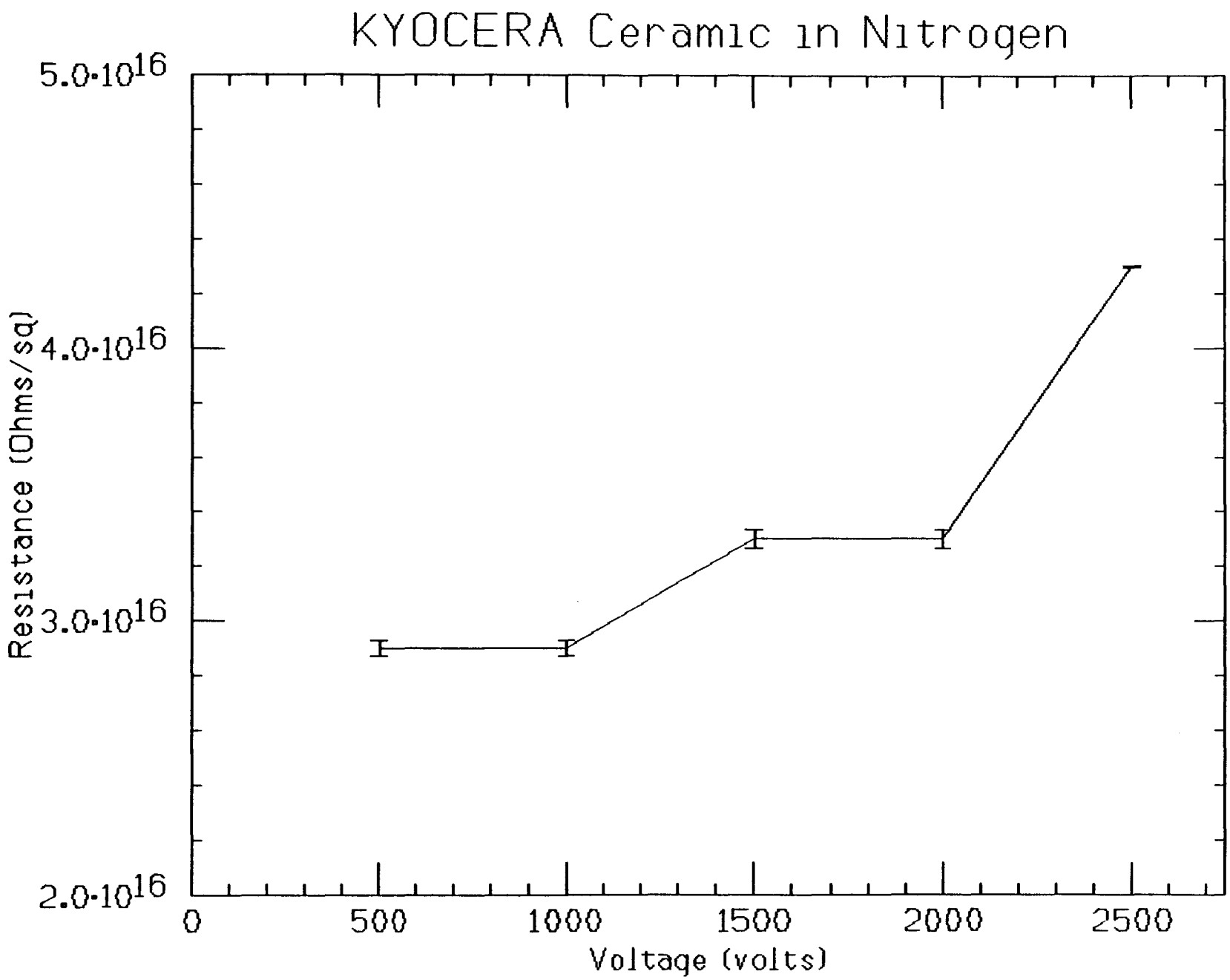

ICI Rx-91195 -- Post Irradiation
3.0·10^10
2.5·10^10
2.0·10^10
1.5·10^10
1.0·10^10
Resistance (Ohm/sq)
0
500
1000
1500
2000
2500
Voltage (volts)

R-Flex (polypropylene) ICI/Rogers film 3inch electrode length X $\frac{1}{16}$inch gap X .002inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
8-2-91				
19:08	+510	3.9e-11	6.3e14	
19:09	+1010	7.8e-11	6.2e14	Very steady
19:10	+1500	1.2e-10	6e14	
19:11	+2050	1.8e-10	5.5e14	
19:13	+2530	2.2e-10	5.5e14	

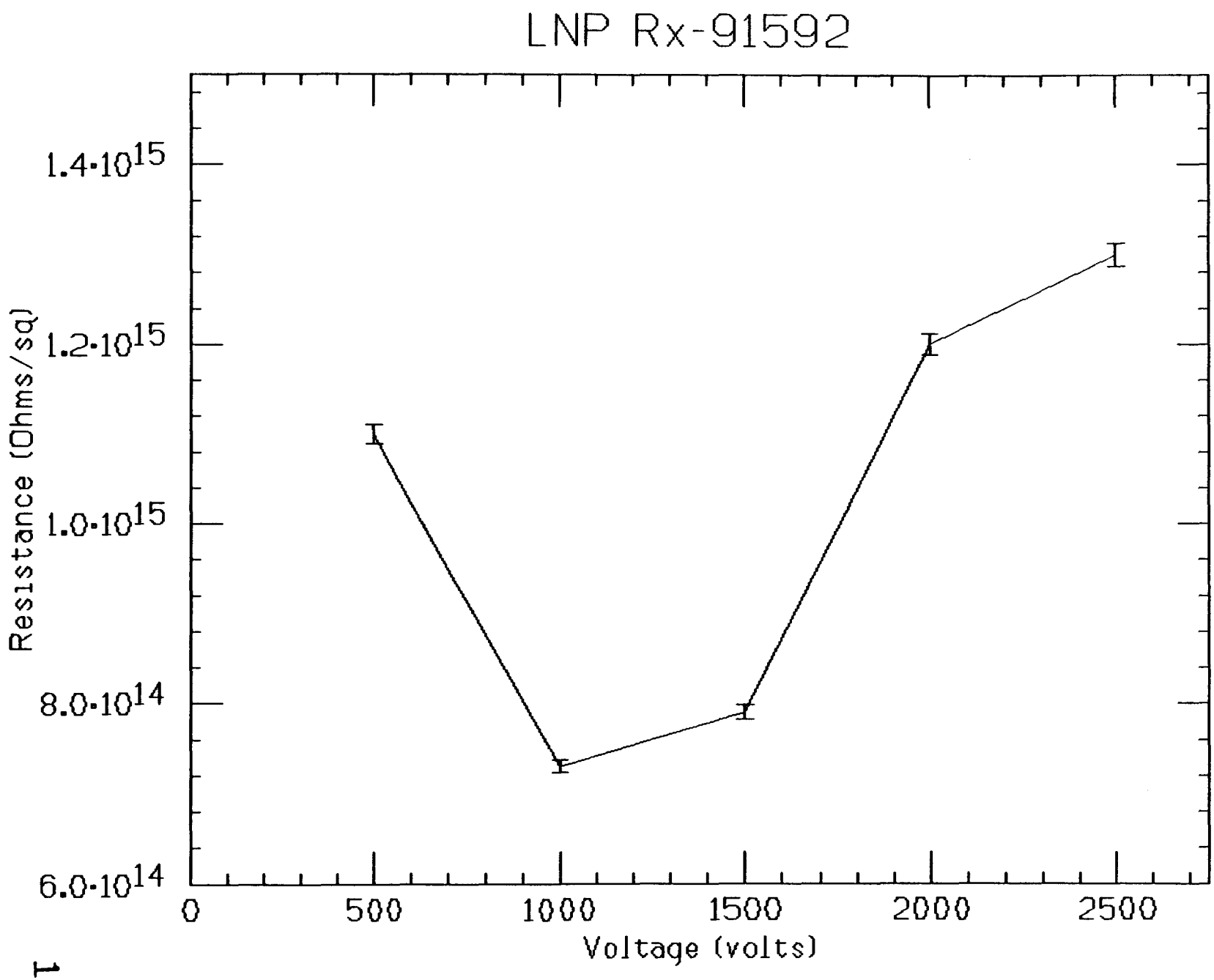

R-Flex (polypropylene) ICI/Rogers film
6.5·10^14
6.0·10^14
5.5·10^14
5.0·10^14
Resistance (Ohm/sq)
0
500
1000
1500
2000
2500
Voltage (volts)

KYOCERA ceramic 1.63inch electrode length X $\frac{1}{16}$inch gap X .01inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
6-25-92	Tested in air			
16:00	+195	7.1e-12	7.1e14	
16:03	+614	2.6e-11	6.1e14	
16:04	+1034	4.1e-11	6.6e14	
16:05	+1452	6e-11	6.3e14	
16:07	+1871	7.6e-11	6.4e14	
16:08	+2280	9.5e-11	6.2e14	
16:09	+2490	1.1e-10	5.9e14	
16:15	+2490	1.03e-10	6.3e14	Very stable.
7-17-92	Tested in UHP nitrogen			
15:45	+201	—	—	
15:50	+501	4.5e-13	2.9e16	Stable
15:52	+1001	9e-13	2.9e16	
15:54	+1501	1.2e-12	3.3e16	
15:55	+2000	1.6e-12	3.3e16	
15:56	+2500	2.1e-12	3.1e16	
16:00	+2500	1.5e-12	4.3e16	

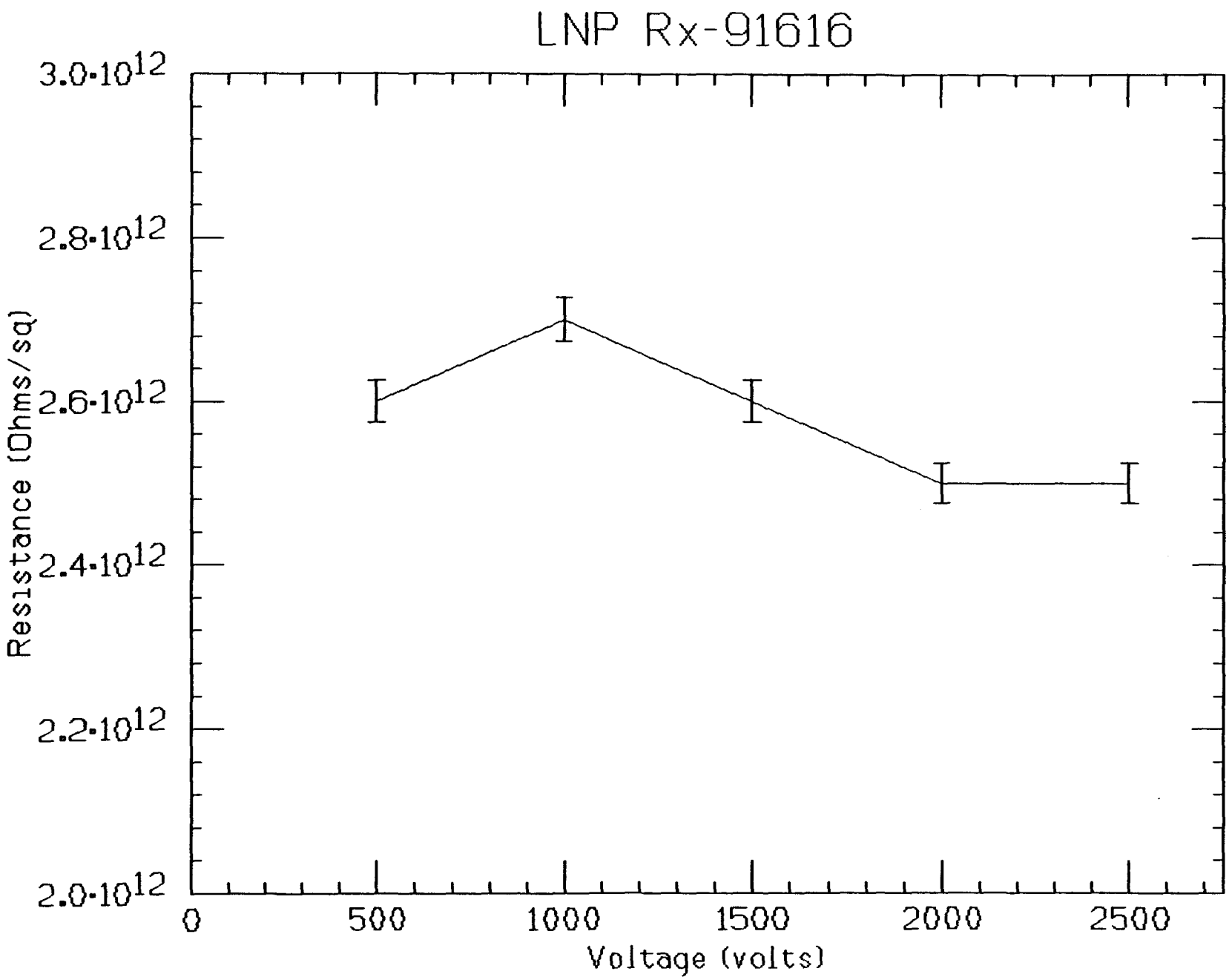

KYOCERA Ceramic in air
7.5·10^14
7.0·10^14
6.5·10^14
6.0·10^14
5.5·10^14
Resistance (Ohms/sq)
0
500
1000
1500
2000
2500
Voltage (volts)


KYOCERA Ceramic in Nitrogen
5.0·10^16
4.0·10^16
3.0·10^16
2.0·10^16
Resistance (Ohms/sq)
0
500
1000
1500
2000
2500
Voltage (volts)

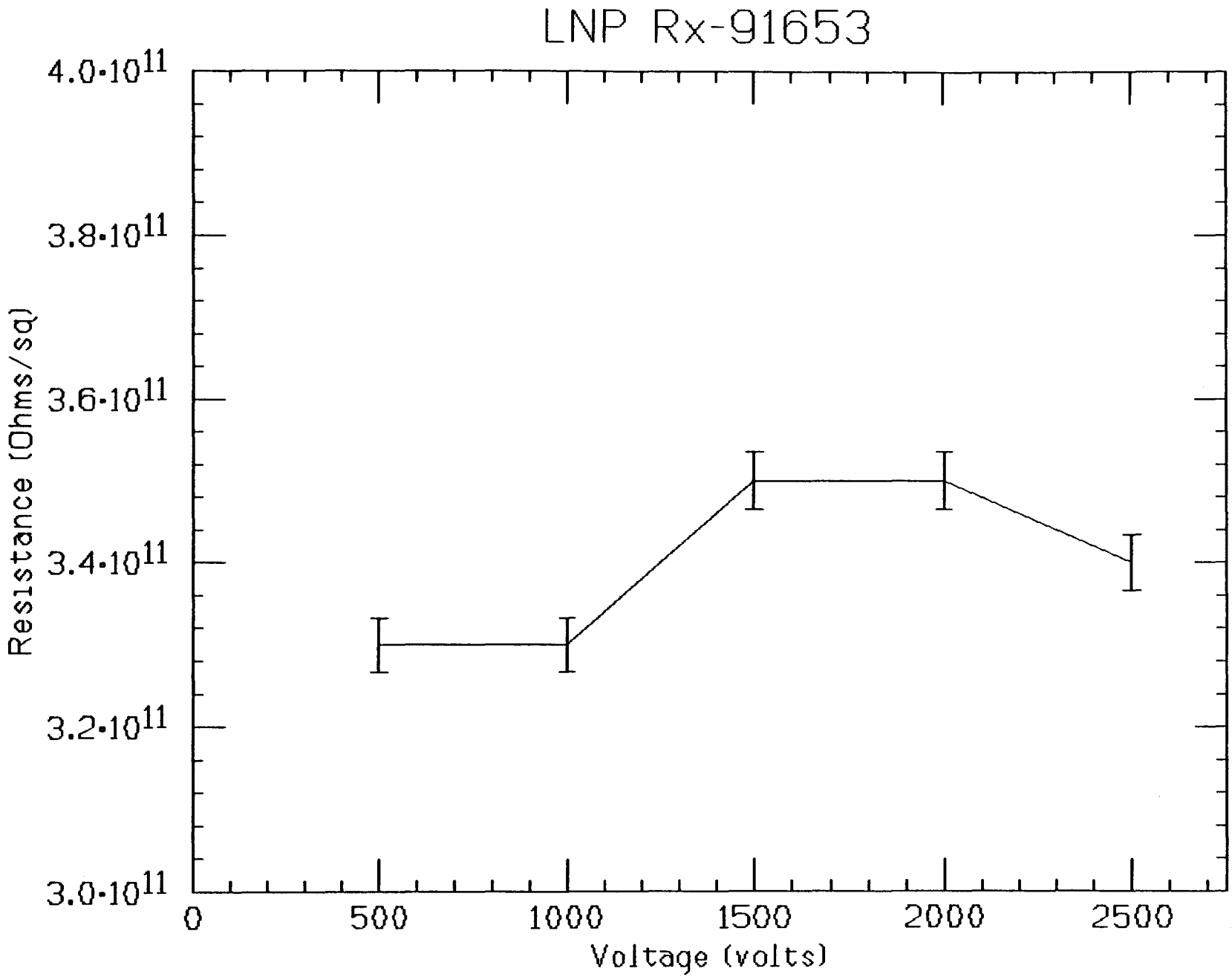
LNP Rx-91592 2.5inch electrode length X $\frac{1}{16}$inch gap X $\frac{1}{16}$inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
12-24-91				
5:55	+500	2.8e-11	7.1e14	
5:55	+500	2.8e-11	1e15	
5:56	+500	1.8e-11	1.1e15	
5:58	+1000	5.5e-11	7.2e14	
5:59	+1500	7.6e-11	7.9e14	**Some RC decay.**
6:10	+1500	4.5e-11	1.3e15	**±.1e-11Amps**
6:13	+2000	7e-11	1.1e15	
6:14	+2000	6.7e-11	1.2e15	
6:15	+2500	9.8e-11	1e15	
6:23	+2500	7.7e-11	1.3e15	**±.05e-11Amps**


LNP Rx-91592
Resistance (Ohms/sq)
1.4·10^15
1.2·10^15
1.0·10^15
8.0·10^14
6.0·10^14
0
500
1000
1500
2000
2500
Voltage (volts)

LNP Rx-91616 2.5inch electrode length X $\frac{1}{16}$inch gap X $\frac{1}{16}$inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
12-24-91				
5:37	+500	7.8e-9	2.6e12	
5:40	+500	7.6e-9	2.6e12	
5:41	+1000	1.5e-8	2.7e12	
5:42	+1500	2.35e-8	2.6e12	
5:43	+2000	3.15e-8	2.5e12	
5:45	+2500	4e-8	2.5e12	


LNP Rx-91616
3.0·10^12
2.8·10^12
2.6·10^12
2.4·10^12
2.2·10^12
2.0·10^12
Resistance (Ohms/sq)
0
500
1000
1500
2000
2500
Voltage (volts)

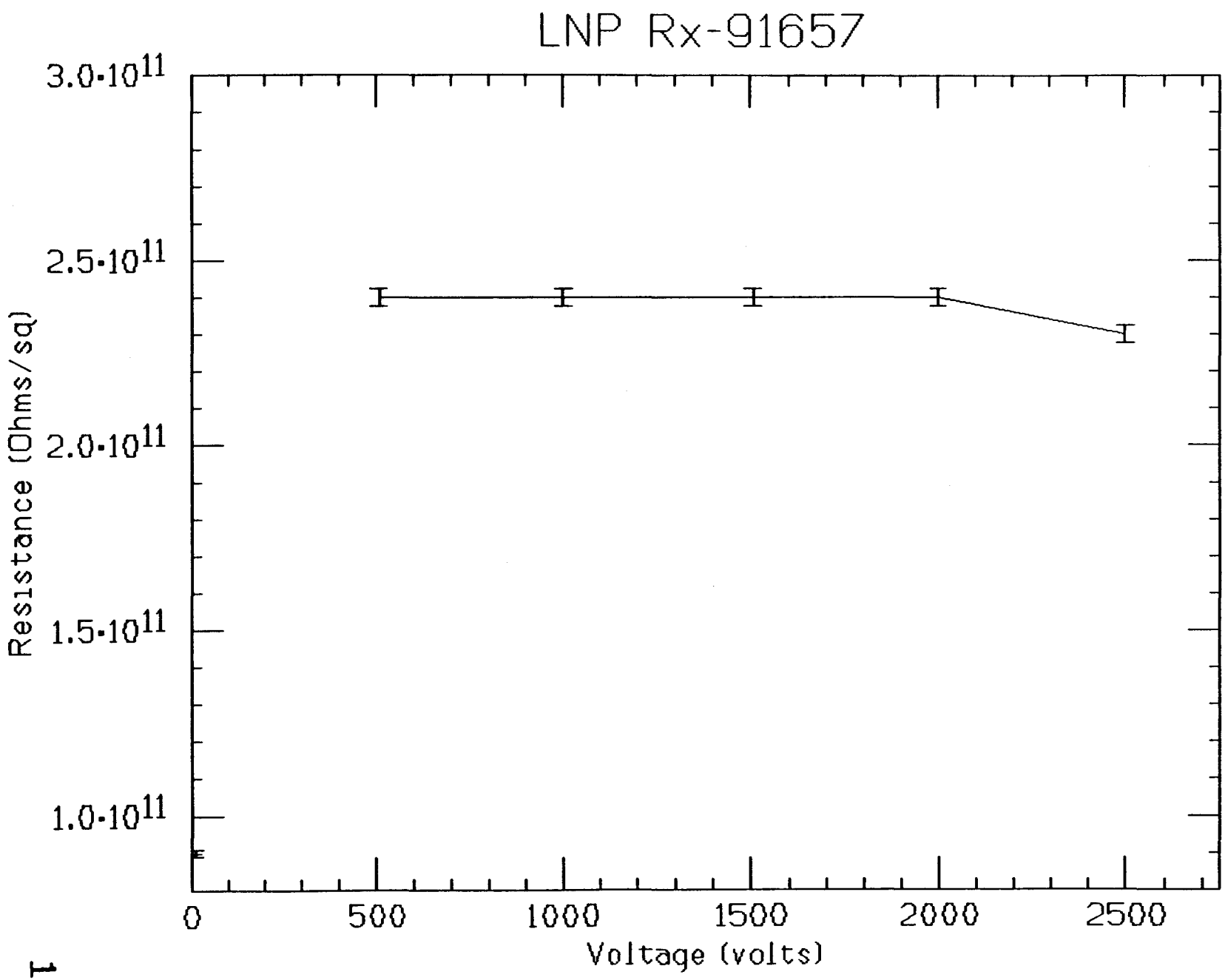
LNP Rx-91653 2.5inch electrode length X $\frac{1}{16}$inch gap X $\frac{1}{16}$inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
12-24-91				
6:33	+500	6.2e-8	3.2e11	Very steady.
6:35	+500	6e-8	3.3e11	
6:37	+1000	1.2e-7	3.3e11	
6:38	+1520	1.7e-7	3.6e11	
6:39	+2000	2.3e-7	3.5e11	
6:40	+2000	2.95e-7	3.4e11	±.05e-7Amps

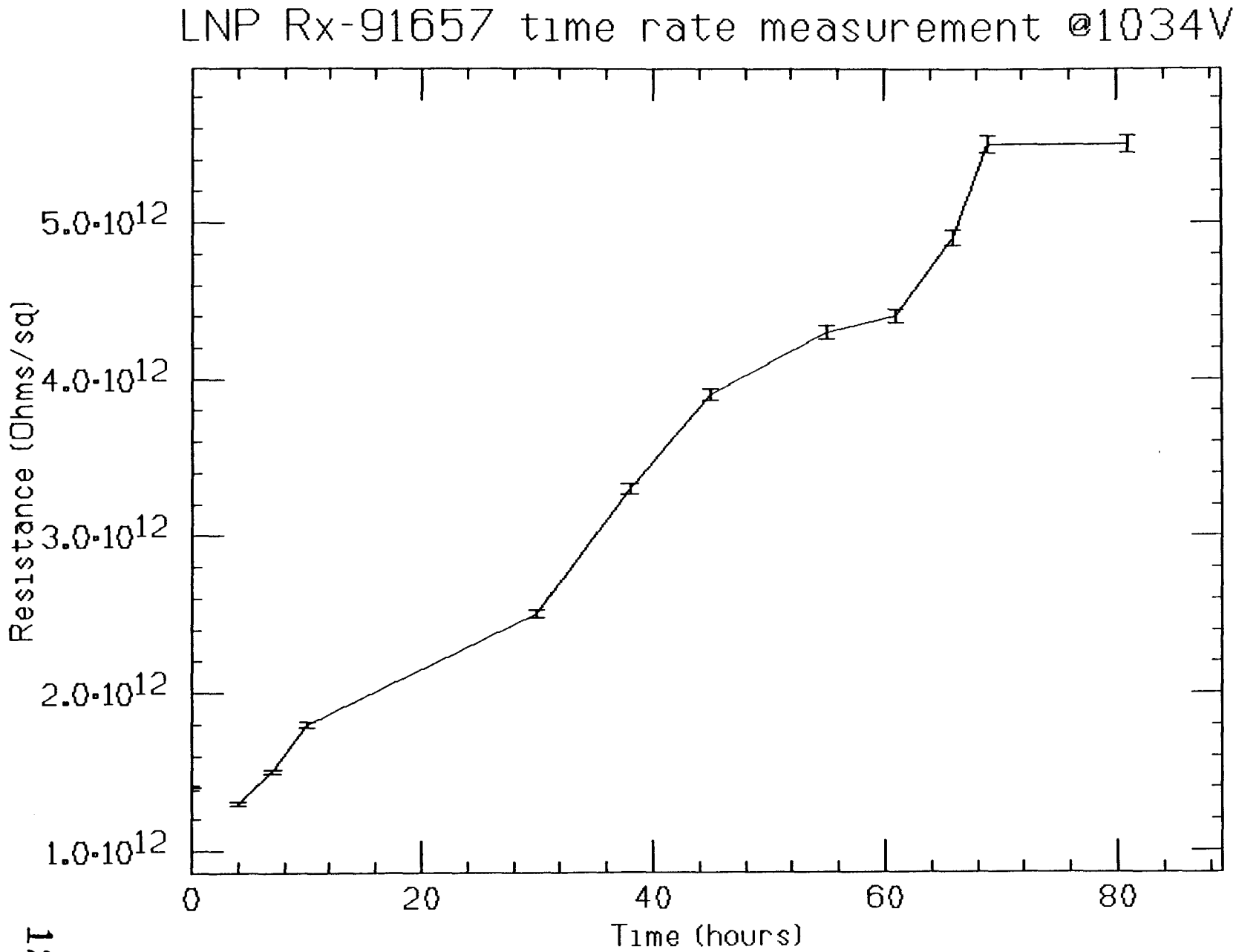

LNP Rx-91653
4.0·10^11
3.8·10^11
3.6·10^11
3.4·10^11
3.2·10^11
3.0·10^11
Resistance (Ohms/sq)
0
500
1000
1500
2000
2500
Voltage (volts)

LNP Rx-91657

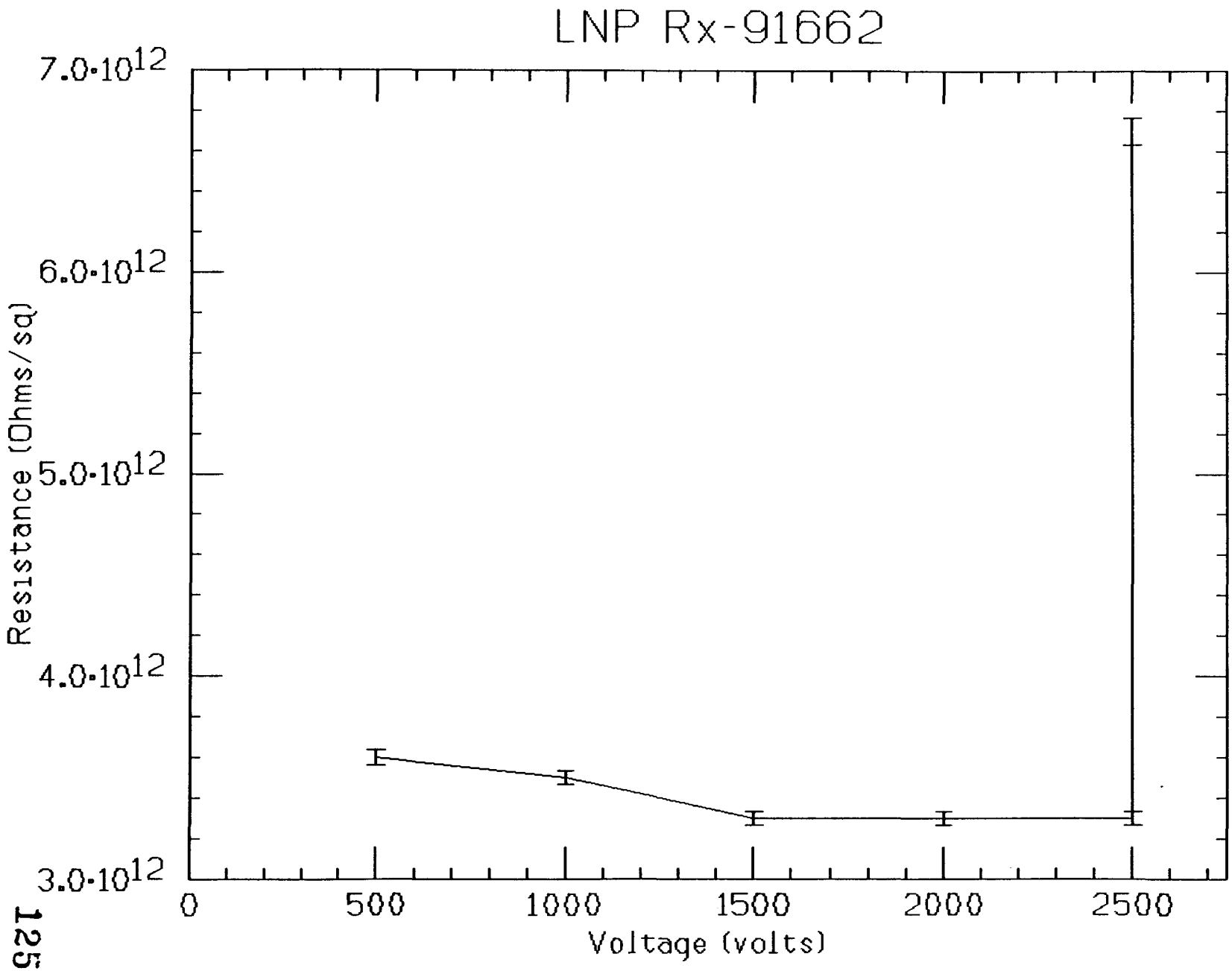
2.5inch electrode length X $\frac{1}{16}$inch gap X $\frac{1}{16}$inch substrate thickness

Date & Time	Voltage (volts)	Current (Amps)	Resistance (Ohms/sq)	Notes & Comments
2-24-92				**Metalizable ABS/Copolyether**
12:06	-11	4.9e-9	9e10	
12:11	-506	8.48e-8	2.4e11	
12:15	-506	8.4e-8	2.4e11	
12:16	-1002	1.7e-7	2.4e11	
12:19	-1506	2.53e-7	2.4e11	
13:00	-2000	3.43e-7	2.4e11	
13:21	-2500	4.35e-7	2.3e11	
2-25-92	Grounded backplane painted on.			
9:01	-1000	1.35e-7	3e11	
6-7-92	Tested in UHP nitrogen.			
10:10	+1034	4.2e-8	9.8e11	**Backplane not grounded.**
14:10	+1034	3.3e-8	1.3e12	
14:37	+1034	3.3e-8	1.3e12	
17:05	+1034	2.75e-8	1.5e12	
20:25	+1034	2.3e-8	1.8e12	
6-8-92				
6:00	+1034	1.65e-8	2.5e12	
14:30	+1034	1.26e-8	3.3e12	
21:30	+1034	1.06e-8	3.9e12	
6-9-92				
5:50	+1034	.96e-8	4.3e12	
11:10	+1034	.95e-8	4.4e12	
16:00	+1034	.85e-8	4.8e12	
19:25	+1034	.74e-8	5.5e12	
6-10-92				
7:10	+1034	.75e-8	5.5e12	

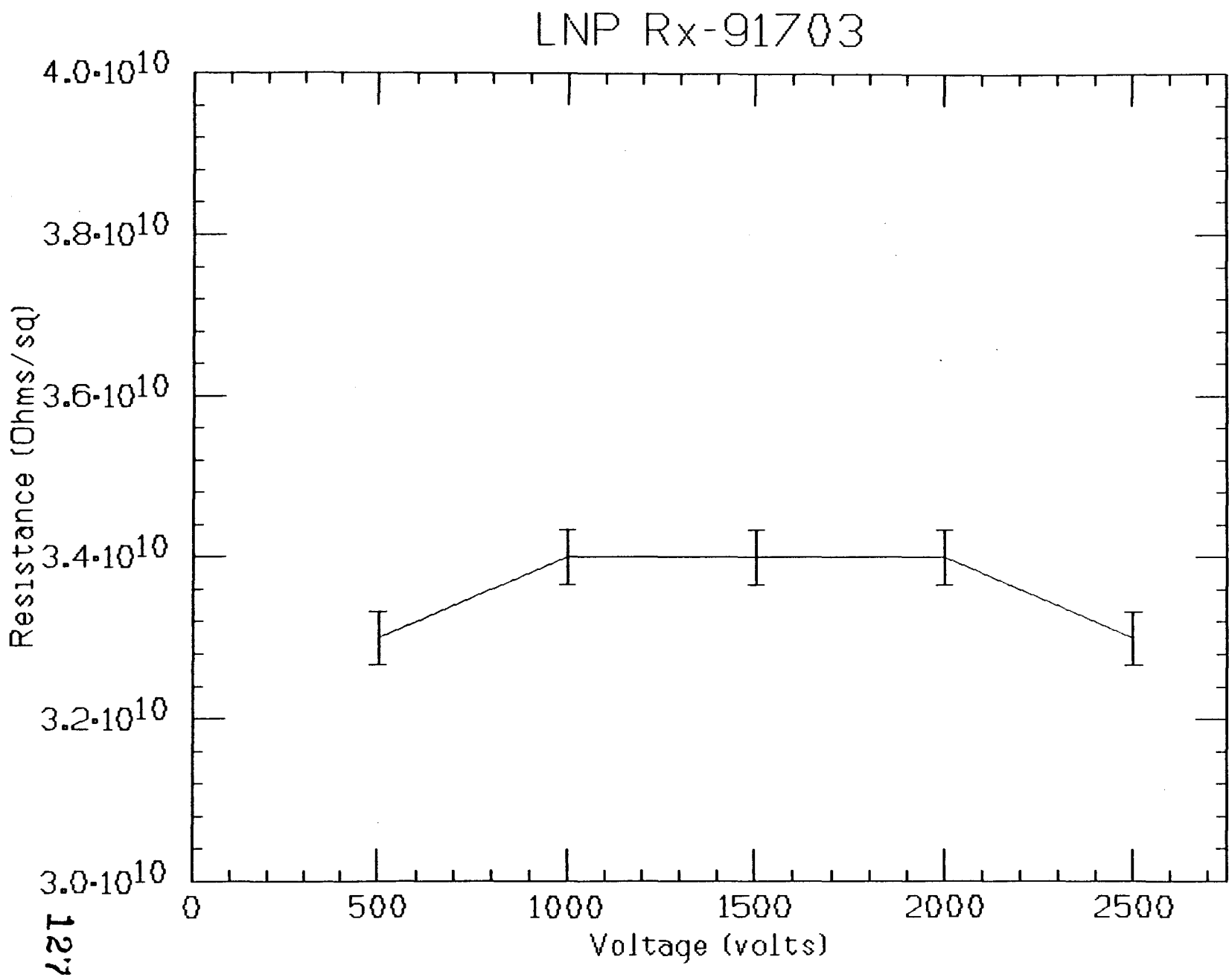

LNP Rx-91657
3.0·10^11
2.5·10^11
2.0·10^11
1.5·10^11
1.0·10^11
Resistance (Ohms/sq)
0
500
1000
1500
2000
2500
Voltage (volts)


LNP Rx-91657 time rate measurement @1034V
Resistance (Ohms/sq)
5.0·10^12
4.0·10^12
3.0·10^12
2.0·10^12
1.0·10^12
0
20
40
60
80
Time (hours)

LNP Rx-91662 2.5inch electrode length X $\frac{1}{16}$inch gap X $\frac{1}{16}$inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
12-24-91				
1:44	+500	5.9e-9	3.4e12	
2:45	+500	5.5e-9	3.6e12	
2:45	+1000	1.15e-8	3.5e12	
2:46	+1500	1.8e-8	3.3e12	
2:46	+2000	2.4e-8	3.3e12	
2:47	+2500	3e-8	3.3e12	
2:48	+2500	2.9e-8	3.4e12	
17:05	+2500	1.5e-8	6.7e12	**Sample broke down at 3KV.**

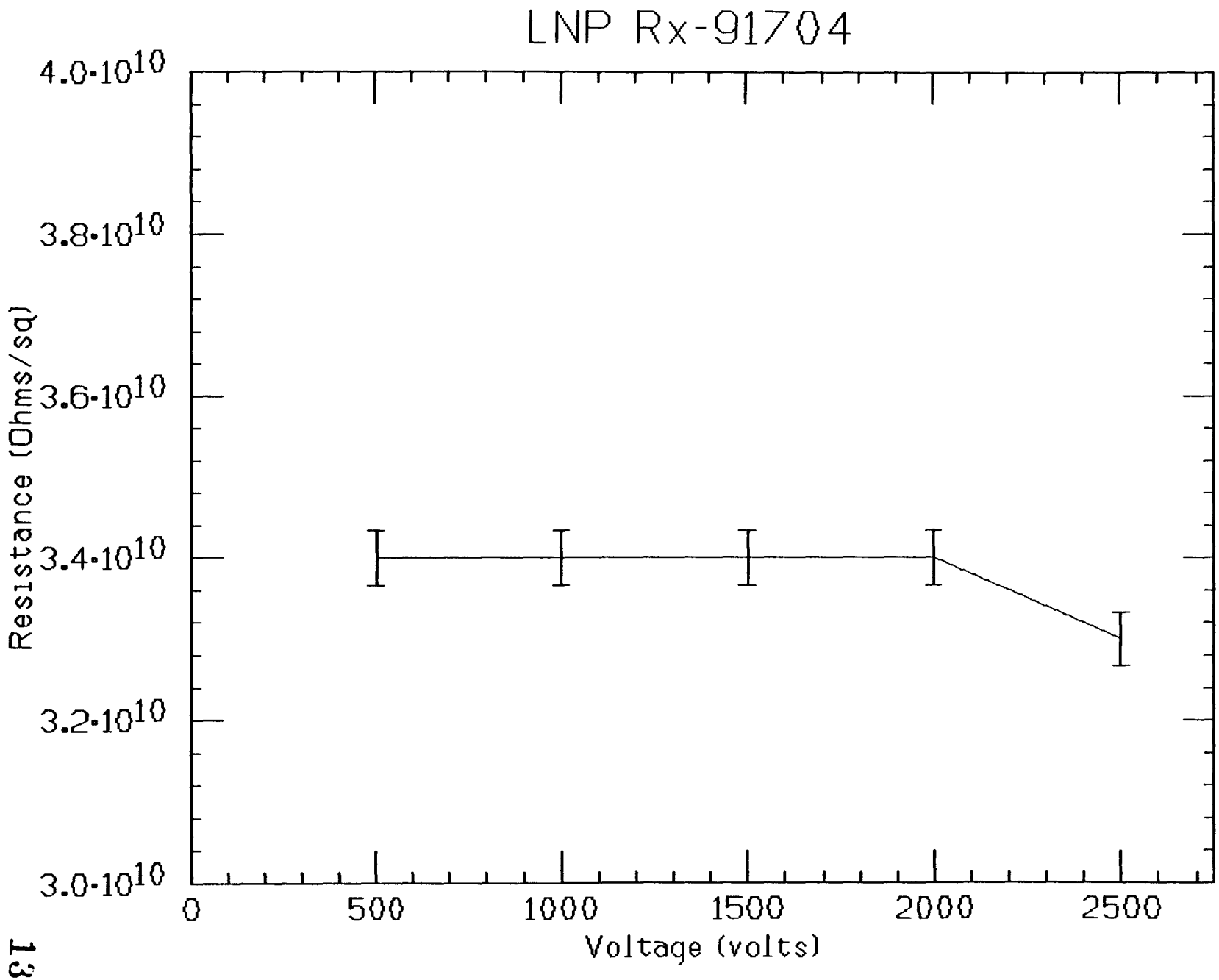

LNP Rx-91662
7.0·10^12
6.0·10^12
5.0·10^12
4.0·10^12
3.0·10^12
Resistance (Ohms/sq)
0
500
1000
1500
2000
2500
Voltage (volts)

LNP Rx-91703 2inch electrode length X $\frac{1}{16}$inch gap X $\frac{1}{16}$inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
12-5-91				
14:14	+501	4.8e-7	3.3e10	**Stable throughout**
14:20	+501	4.7e-7	3.3e10	
14:21	+1001	9.5e-7	3.4e10	
14:23	+1001	9.5e-7	3.4e10	
14:24	+1502	1.4e-6	3.4e10	
14:27	+1502	1.4e-6	3.4e10	
14:28	+2000	1.9e-6	3.4e10	
14:31	+2000	1.9e-6	3.4e10	
14:31	+2500	2.4e-6	3.3e10	
14:35	+2500	2.4e-6	3.3e10	


LNP Rx-91703
4.0·10^10
3.8·10^10
3.6·10^10
3.4·10^10
3.2·10^10
3.0·10^10
Resistance (Ohms/sq)
0
500
1000
1500
2000
2500
Voltage (volts)

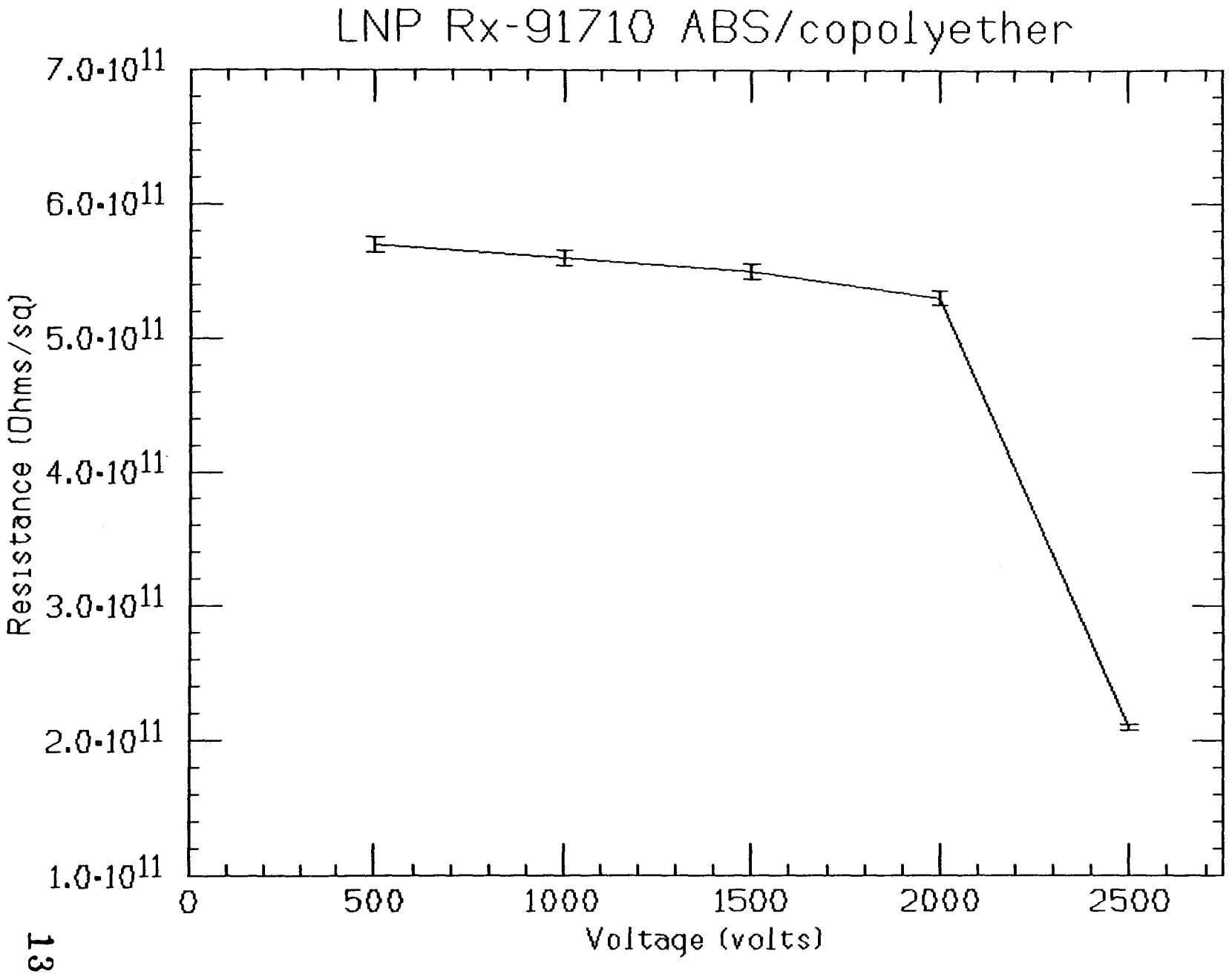
LNP Rx-91703 (2nd batch) 2.25inch electrode length X $\frac{1}{16}$inch gap X $\frac{1}{16}$inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
12-24-91				
6:55	+1010	2.4e-6	1.5e10	
6:58	+2500	6.4e-6	1.4e10	±.05-e6Amps

LNP Rx-91704 2inch electrode length X $\frac{1}{16}$inch gap X $\frac{1}{16}$inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
12-5-91				
14:39	+501	4.7e-7	3.4e10	**Stable throughout**
14:40	+1000	9.5e-7	3.4e10	
14:42	+1501	1.5e-6	3.2e10	
14:45	+1501	1.4e-6	3.4e10	
14:46	+2000	1.95e-6	3.4e10	
14:50	+2000	1.9e-6	3.4e10	
14:51	+2500	——	——	**Sparked three times, so voltage was decreased**
14:52	+2400	2.3e-6	3.3e10	


LNP Rx-91704
4.0·10^10
3.8·10^10
3.6·10^10
3.4·10^10
3.2·10^10
3.0·10^10
Resistance (Ohms/sq)
0
500
1000
1500
2000
2500
Voltage (volts)

LNP Rx-91704 (2nd batch) 1.75inch electrode length X $\frac{1}{16}$inch gap X $\frac{1}{16}$inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amsp)**	**Resistance (Ohms/sq)**	**Notes & Comments**
12-24-91				
6:45	+500	8.7e-7	1.6e10	
6:49	+2020	3.5e-6	1.6e10	
6:50	+2520	4.4e-6	1.6e10	Steady

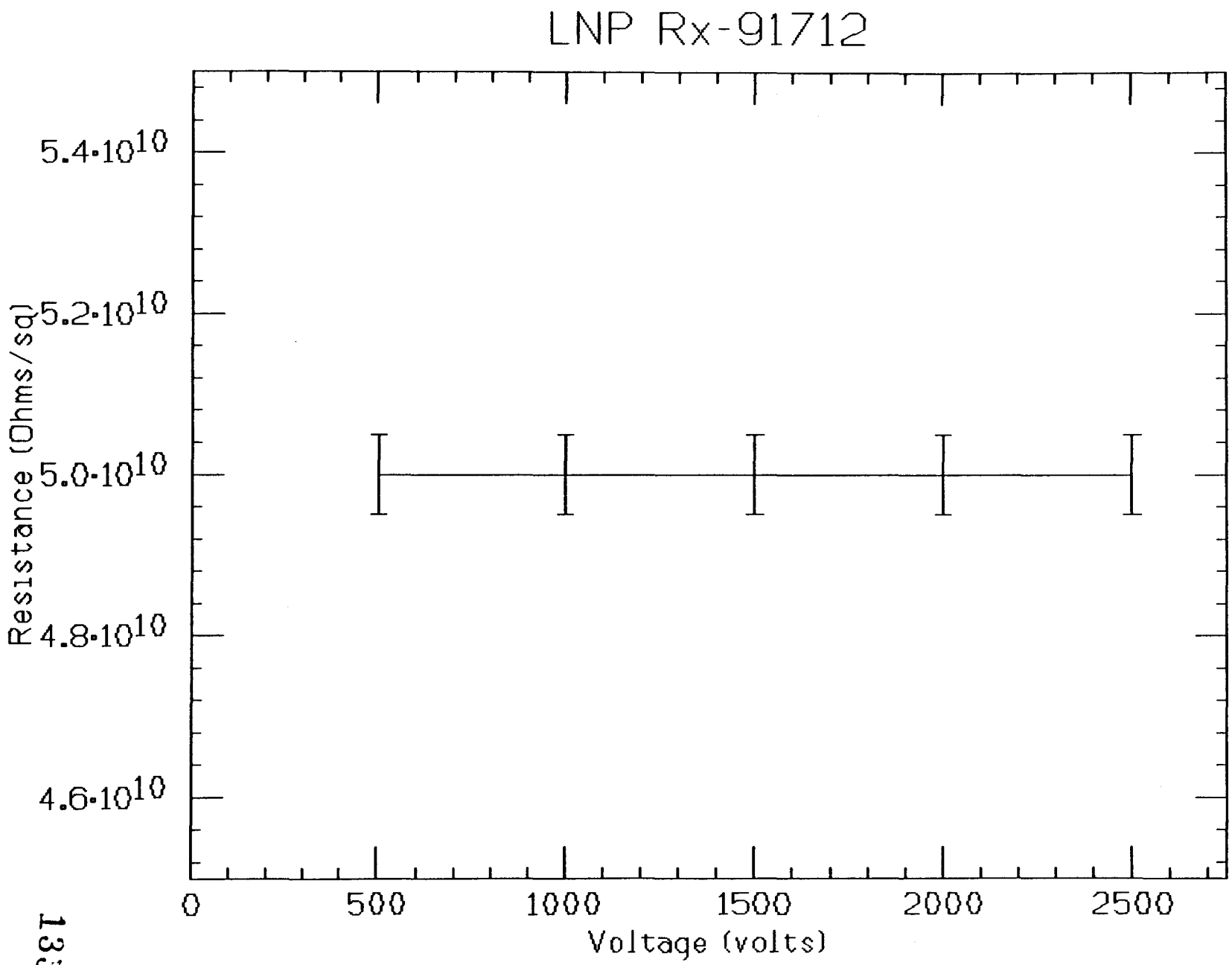
LNP Rx-91710 ABS/Copolyether 3inch electrode length X $\frac{1}{16}$inch gap X $\frac{1}{16}$inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
12-19-91				
00:15	+500	2.8e-8	5.7e11	
00:16	+1000	5.7e-8	5.6e11	
00:20	+1500	8.7e-8	5.5e11	
00:21	+2000	1.2e-7	5.3e11	
00:22	+2500	1.5e-7	5.3e11	
00:26	+2500	1.2e-7	2.1e11	


LNP Rx-91710 ABS/copolyether
7.0·10^11
6.0·10^11
5.0·10^11
4.0·10^11
3.0·10^11
2.0·10^11
1.0·10^11
Resistance (Ohms/sq)
0
500
1000
1500
2000
2500
Voltage (volts)

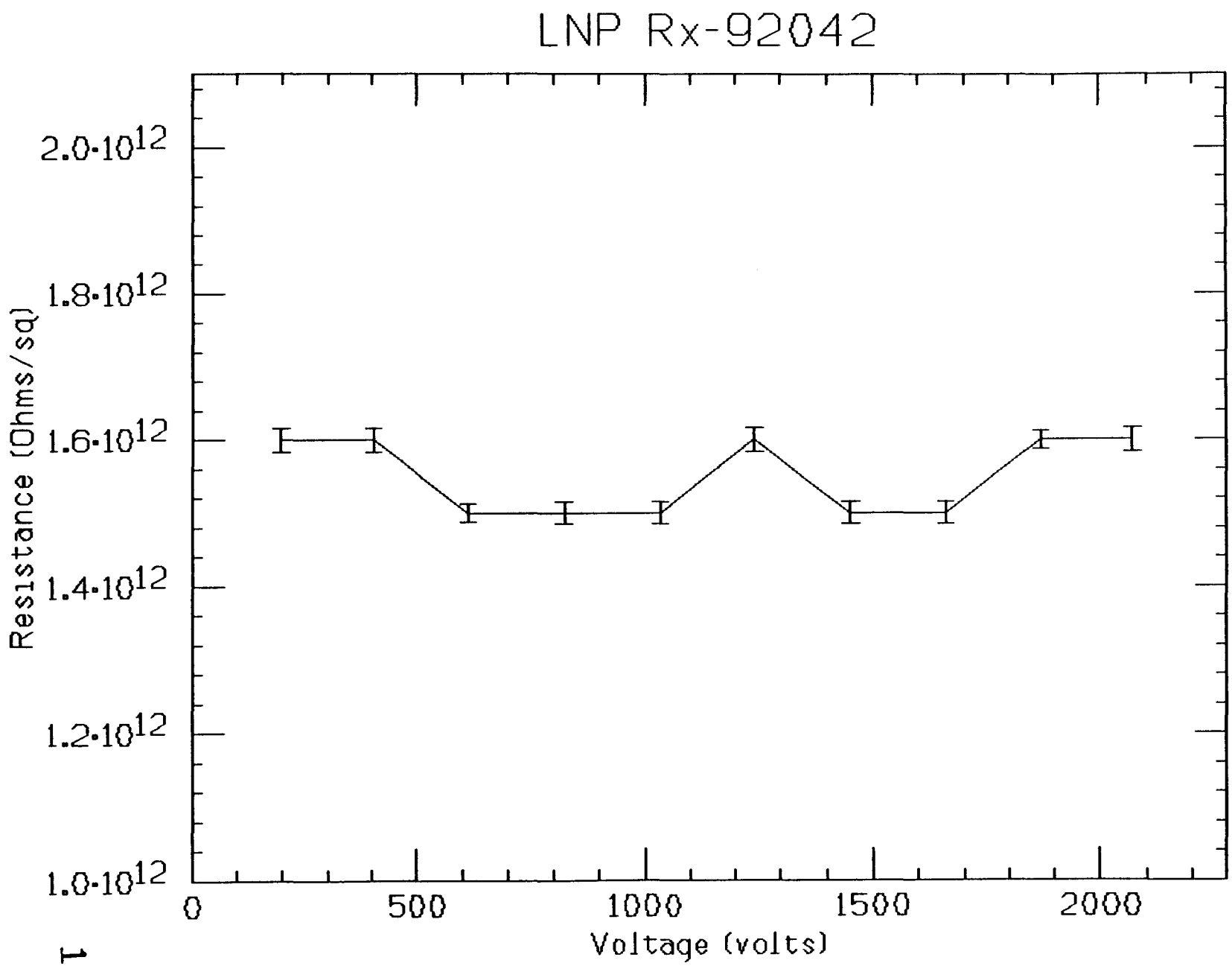
LNP Rx-91712

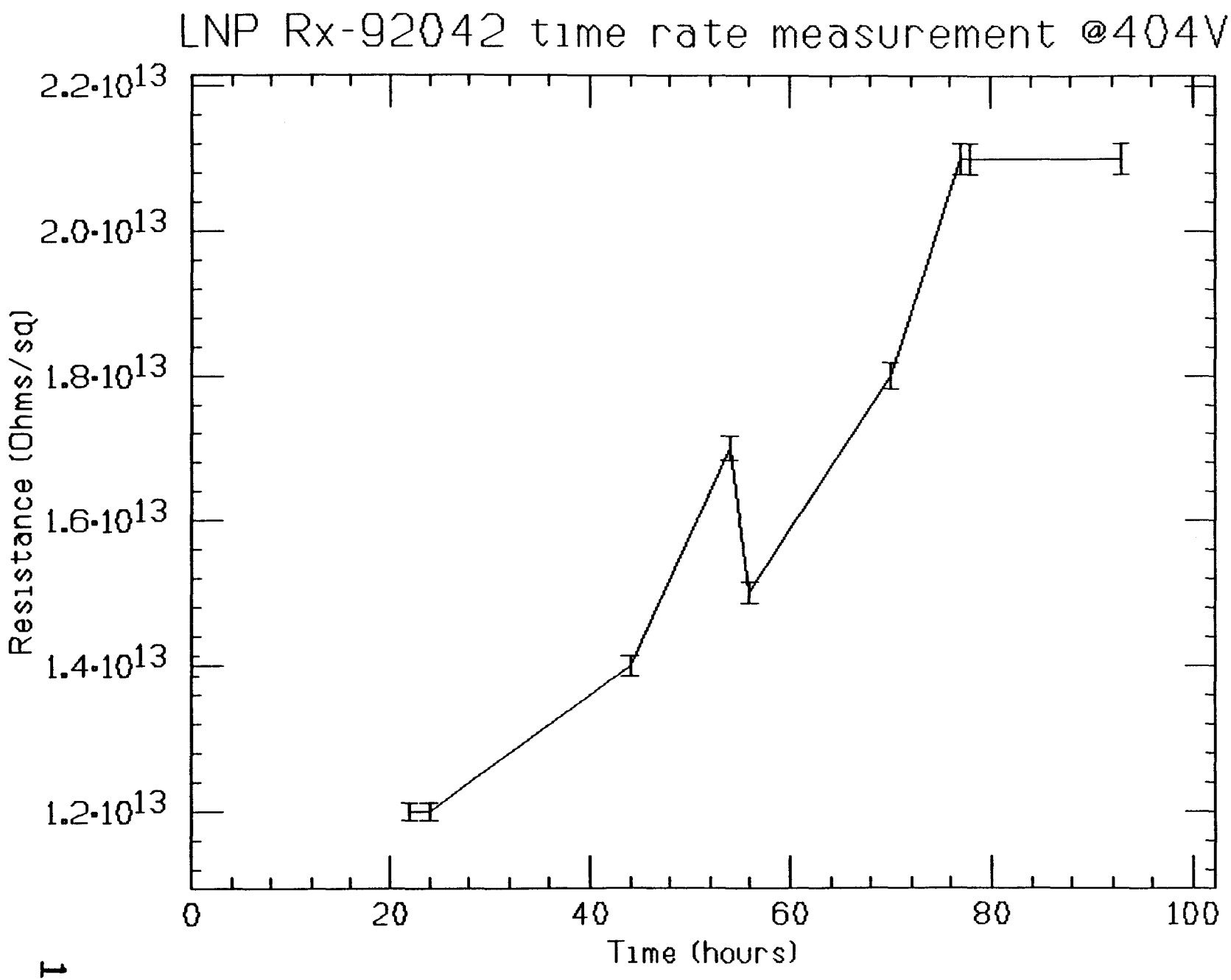
2inch electrode length X $\frac{1}{16}$inch gap X $\frac{1}{16}$inch substrate thickness

Date & Time	Voltage (volts)	Current (Amps)	Resistance (Ohms/sq)	Notes & Comments
12-5-91				
15:00	+504	3.2e-7	5e10	The current is very stable
15:02	+1000	6.5e-7	5e10	
15:06	+1504	9.5e-7	5e10	
15:08	+2000	1.3e-6	5e10	Stable
15:15	+2500	1.7e-6	5e10	


LNP Rx-91712
5.4·10^10
5.2·10^10
5.0·10^10
4.8·10^10
4.6·10^10
Resistance (Ohms/sq)
0
500
1000
1500
2000
2500
Voltage (volts)

LNP Rx-92042 2.1inch electrode length X $\frac{1}{16}$inch gap X $\frac{1}{16}$inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
5-22-92				
14:07	+195	4.3e-9	1.5e12	**Stable, sample made w/ tape.**
14:10	+195	4.2e-9	1.6e12	
14:12	+404	8.7e-9	1.6e12	
14:13	+614	1.4e-8	1.5e12	
14:14	+823	1.9e-8	1.5e12	
14:15	+1034	2.3e-8	1.5e12	
14:16	+1242	2.7e-8	1.6e12	
14:16	+1452	3.2e-8	1.5e12	
14:17	+1661	3.7e-8	1.5e12	
14:17	+1871	4.1e-8	1.6e12	
14:18	+2070	4.5e-8	1.6e12	


LNP Rx-92042
Resistance (Ohms/sq)
2.0·10^12
1.8·10^12
1.6·10^12
1.4·10^12
1.2·10^12
1.0·10^12
0
500
1000
1500
2000
Voltage (volts)

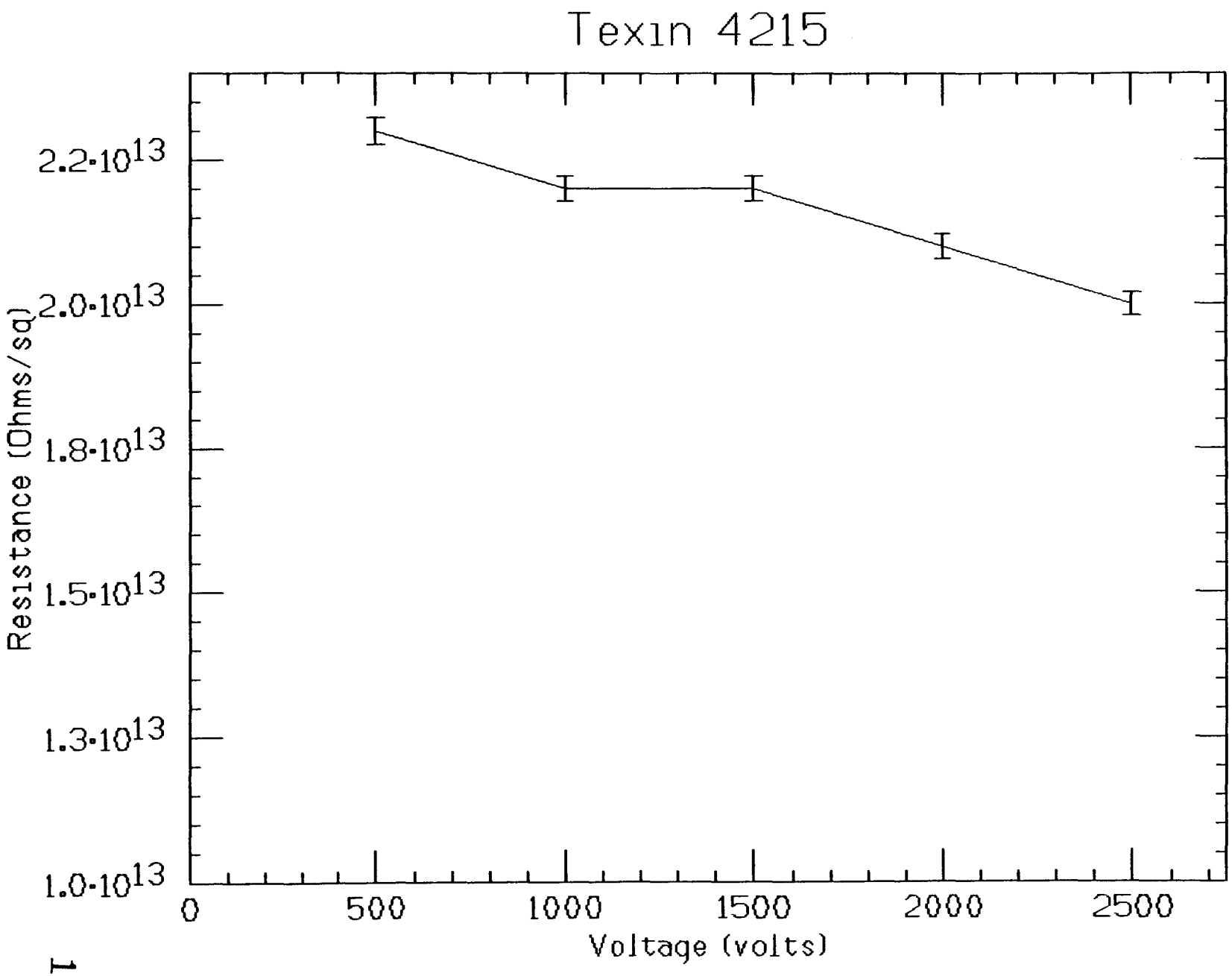

LNP Rx-92042 time rate measurement @404V
Resistance (Ohms/sq)
2.2·10^13
2.0·10^13
1.8·10^13
1.6·10^13
1.4·10^13
1.2·10^13
0
20
40
60
80
100
Time (hours)

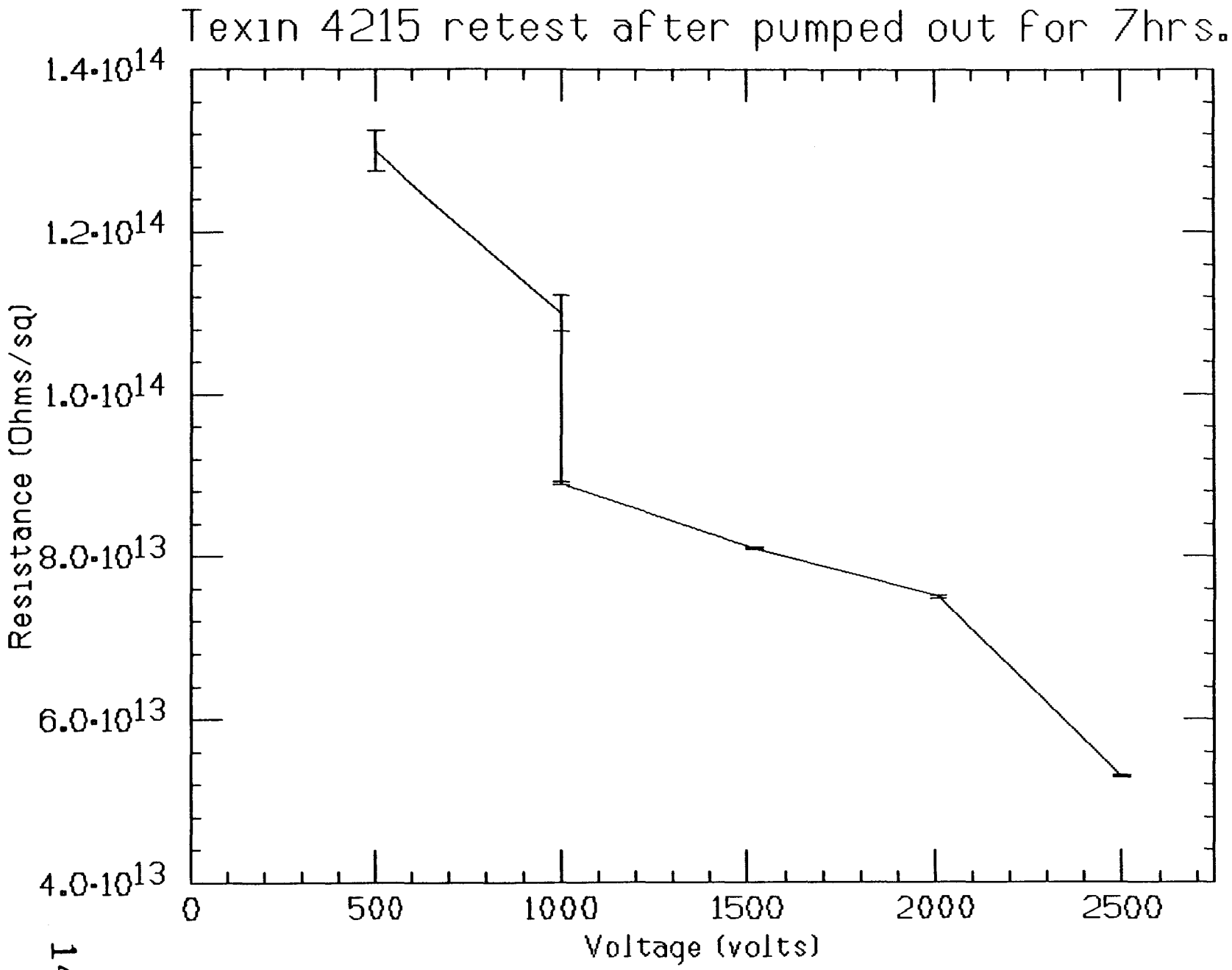
Texin 4215

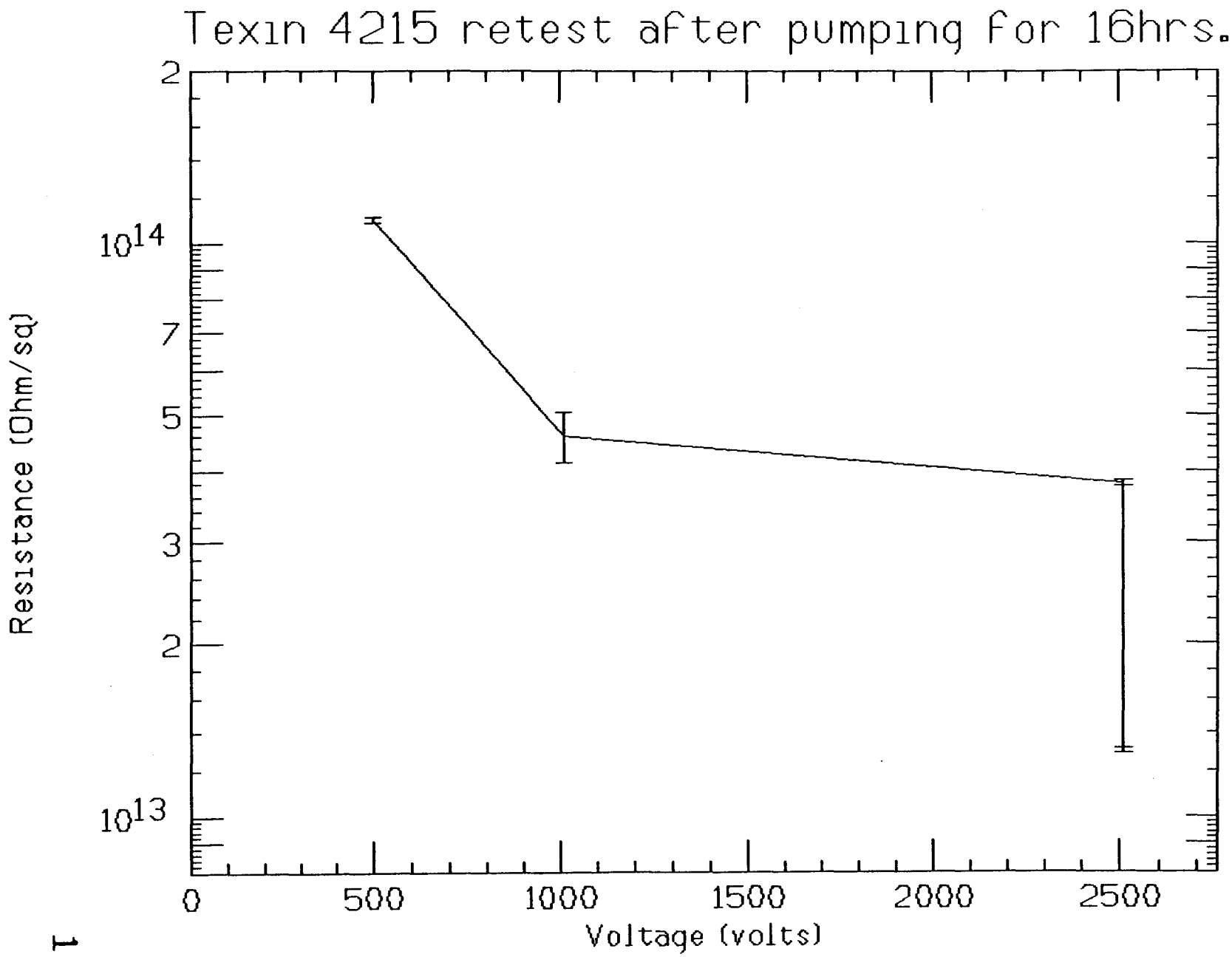
2inch electrode length X $\frac{1}{16}$inch gap X .01inch substrate thickness

Date & Time	Voltage (volts)	Current (Amps)	Resistance (Ohms/sq)	Notes & Comments
5-14-91				
16:26	+500	7e-10	2.3e13	
16:30	+500	7.1e-10	2.3e13	
16:31	+1000	1.47e-9	2.2e13	
16:34	+1000	1.44e-9	2.2e13	
16:35	+1500	2.16e-9	2.2e13	
16:36	+1500	2.16e-9	2.2e13	
16:37	+2000	3e-9	2.1e13	**Signs of breakdown ±1e-10Amp jumps.**
17:18	+2000	3e-9	2.1e13	
17:20	+2500	3.9e-9	2e13	
17:22	+2500		—	**Broke down.**
5-15-91	Retest after pumped out for 7 hours in vacuum			
00:10	+500	1.28e-10	1.3e14	
00:11	+1000	2.9e-10	1.1e14	**Current going up with time.**
00:13	+1000	3e-10	1.1e14	
00:14	+1000	3.2e-10	1e14	
00:15	+1000	3.3e-10	9.7e13	
00:16	+1000	3.5e-10	9.1e13	
00:17	+1000	3.6e-10	8.9e13	
00:18	+1520	5.8e-10	8.4e13	
00:19	+1520	6e-10	8.1e13	
00:20	+2010	8.3e-10	7.7e13	**No signs of breakdown.**
00:21	+2010	8.55e-10	7.5e13	
00:22	+2500	1.2e-9	6.7e13	
00:24	+2500	1.3e-9	6.2e13	
00:30	+2500	1.5e-9	5.3e13	
5-15-91	Pumped out for 16 hours in vacuum.			
16:55	+500	1.45e-10	1.1e14	
16:56	+1010	3.2e-10	5.1e13	
16:57	+1010	3.3e-10	4.9e13	
16:58	+1010	3.4e-10	4.6e13	
16:59	+2510	9.4e-10	4.3e13	
17:01	+2510	1e-9	4e13	
17:02	+2510	1.05e-9	3.8e13	
17:02	Heat gun bumps current up ~1e-8Amps from 1e-9Amps.			

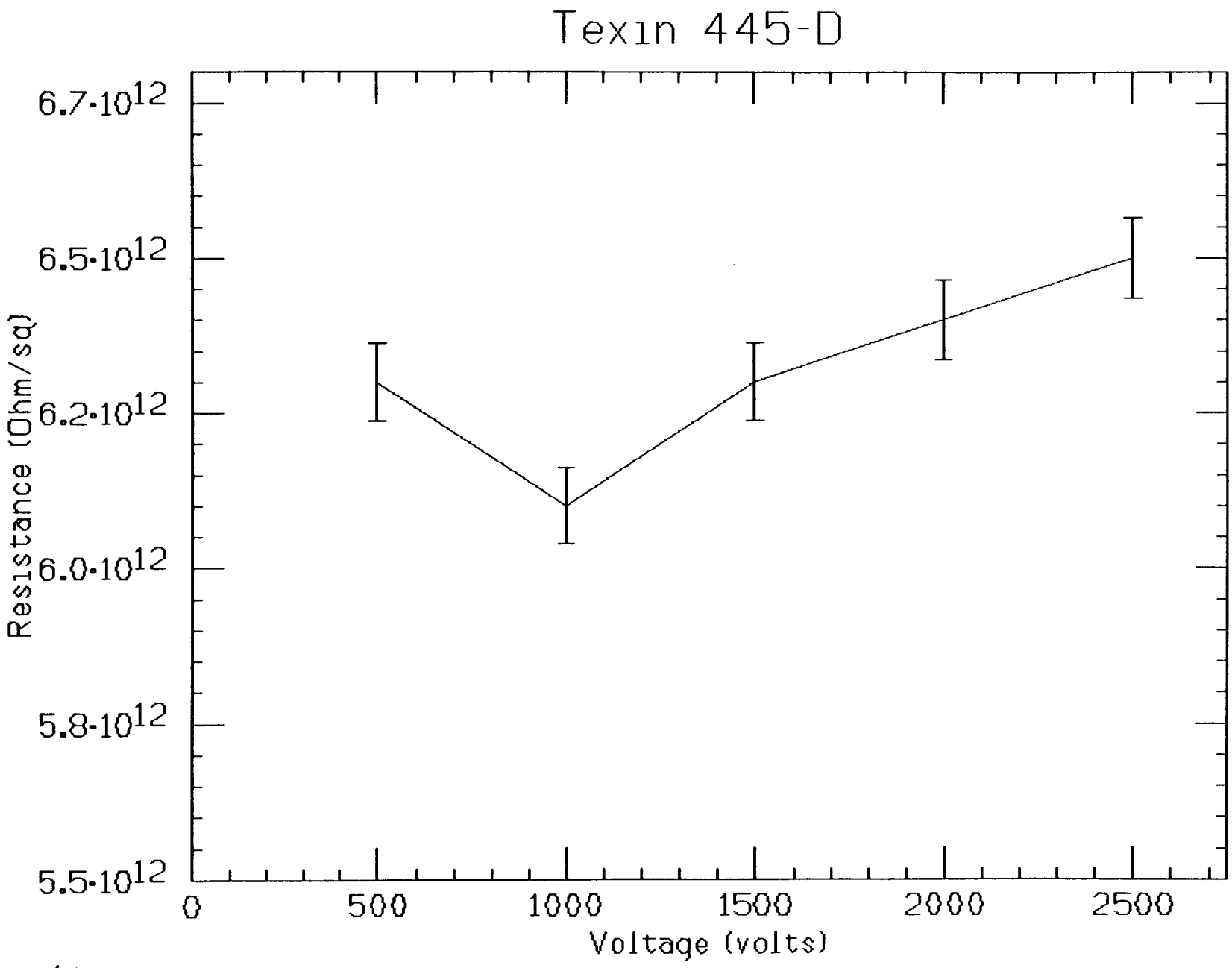
Texin 4215 (Continued) 2inch electrode length X $\frac{1}{16}$inch gap X .01inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
5-15-91				
17:06	+2510	1.23e-9	3.3e13	
17:08	+2510	1.4e-9	2.9e13	
17:12	+2510	1.5e-9	2.7e13	
17:13	+2510	1.6e-9	2.5e13	
17:50	+2510	2.6e-9	1.5e13	
17:51	+2510	2.7e-9	1.5e13	
17:55	+2000	2.15e-9	1.5e13	
21:12	+2000	2.45e-9	1.3e13	
5-16-91				
9:15	+2000	2e-9	1.6e13	**Cool air from heat gun**
18:00	+2000	1.7e-9	1.9e13	**does not affect current.**
23:00	+2000	1.55e-9	2.1e13	**Hot air does.**
5-17-91				
1:00	+2000	1.53e-9	2.1e13	
13:00	+2000	1.5e-9	2.1e13	
16:00	+2000	1.3e-9	2.5e13	


Texin 4215
Resistance (Ohms/sq)
2.2·10^13
2.0·10^13
1.8·10^13
1.5·10^13
1.3·10^13
1.0·10^13
0
500
1000
1500
2000
2500
Voltage (volts)

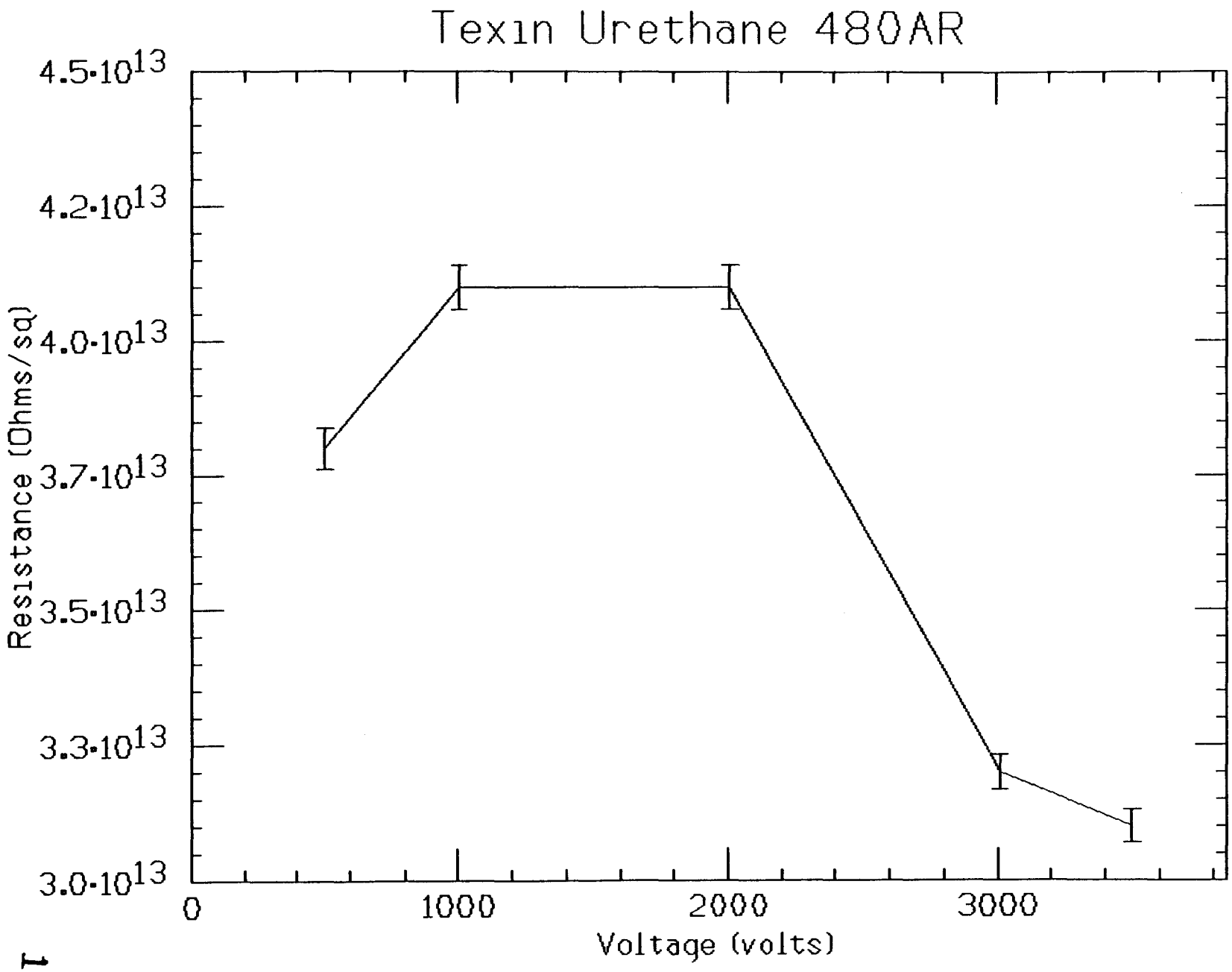

Texin 4215 retest after pumped out for 7hrs.
1.4·10^14
1.2·10^14
1.0·10^14
8.0·10^13
6.0·10^13
4.0·10^13
Resistance (Ohms/sq)
0
500
1000
1500
2000
2500
Voltage (volts)

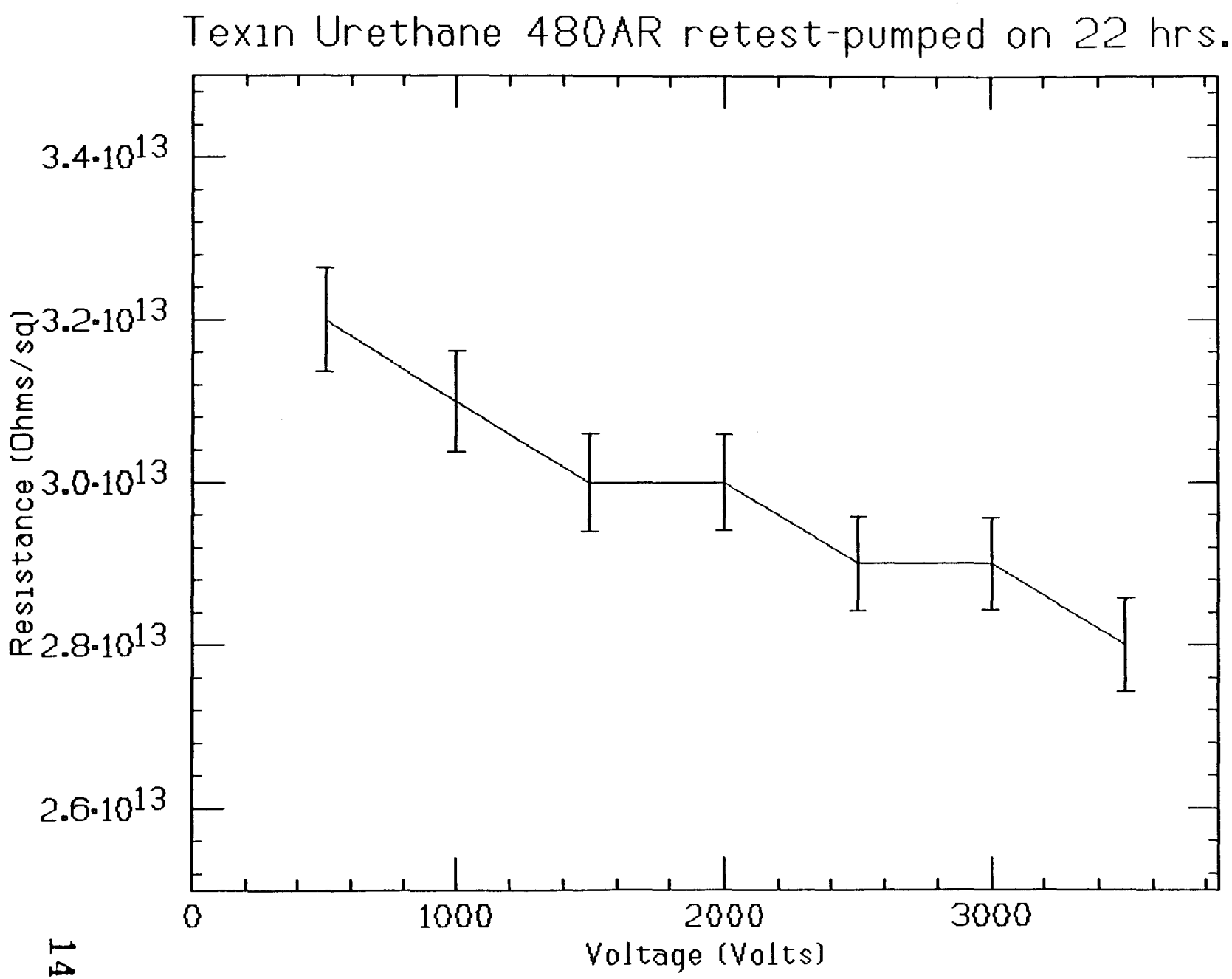

Texin 4215 retest after pumping for 16hrs.
Resistance (Ohm/sq)
2
10^{14}
7
5
3
2
10^{13}
0
500
1000
1500
2000
2500
Voltage (volts)

Texin 445-D 2inch electrode length X $\frac{1}{16}$inch gap X inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
9-13-91				
13:36	+500	2.6e-9	6.2e12	**Stable throughout**
13:40	+500	2.55e-9	6.3e12	
13:41	+1000	5.4e-9	5.9e12	
13:46	+1000	5.25e-9	6.1e12	
13:47	+1500	7.9e-9	6e12	
13:53	+1500	7.6e-9	6.3e12	
13:54	+2000	1e-8	6.4e12	
13:59	+2000	9.95e-9	6.4e12	
14:00	+2500	1.25e-8	6.4e12	
14:10	+2500	1.23e-8	6.5e12	


Texin 445-D
6.7·10^12
6.5·10^12
6.2·10^12
6.0·10^12
5.8·10^12
5.5·10^12
Resistance (Ohm/sq)
0
500
1000
1500
2000
2500
Voltage (volts)

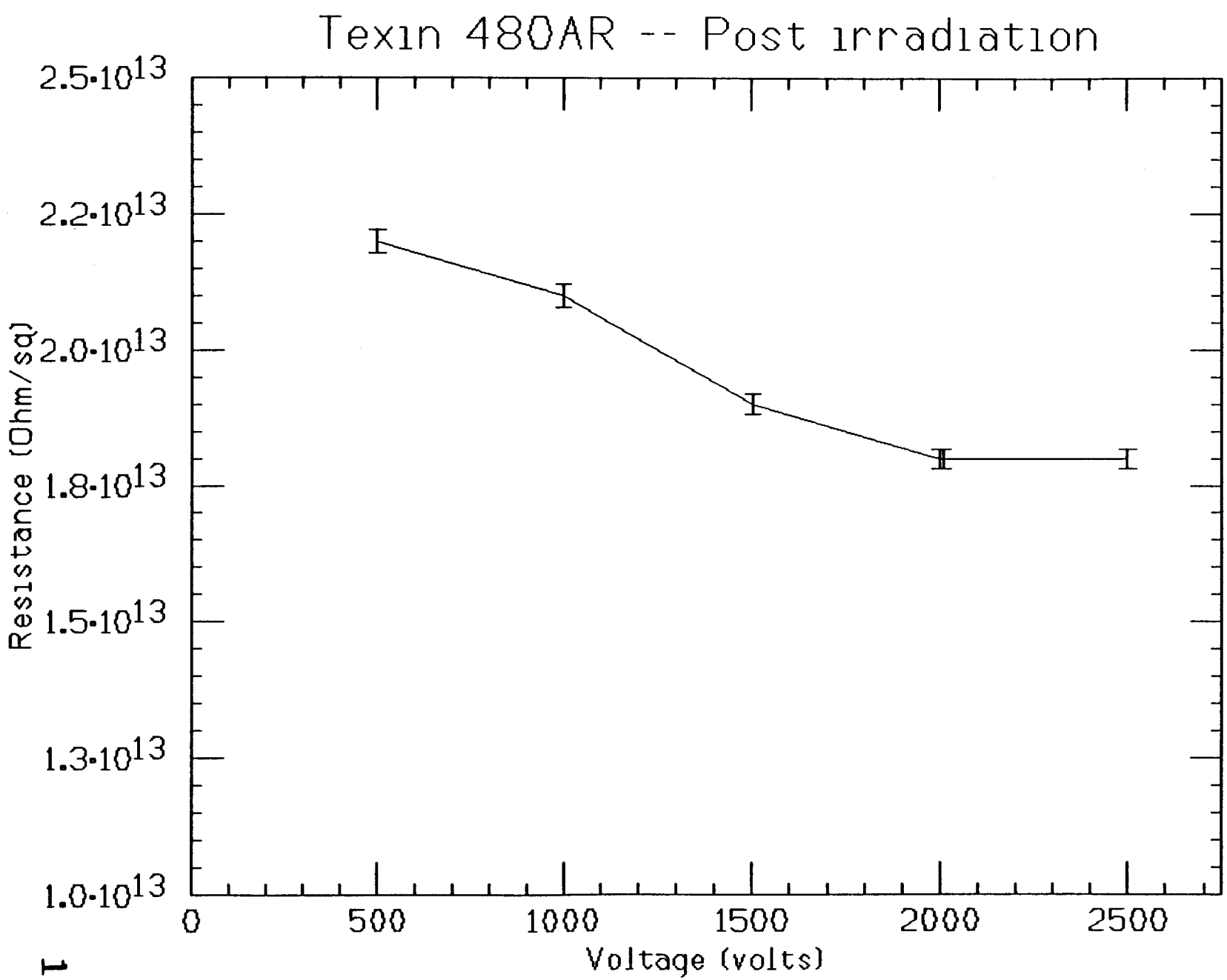
Texin Urethane 480AR 2inch electrode length X $\frac{1}{8}$inch gap X .008inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
5-10-91				
13:00	+504	2.1e-10	3.8e13	
13:20	+1004	4e-10	4e13	
13:50	+1004	3.9e-10	4.1e13	
13:51	+2010	8.2e-10	3.9e13	
14:00	+2010	7.9e-10	4.1e13	
14:01	+3010	1.6e-9	3e13	
14:40	+3010	1.5e-9	3.2e13	
15:05	+3500	1.8e-9	3.1e13	
15:55	+3500	1.8e-9	3.1e13	


Texin Urethane 480AR
4.5·10^13
4.2·10^13
4.0·10^13
3.7·10^13
3.5·10^13
3.3·10^13
3.0·10^13
Resistance (Ohms/sq)
0
1000
2000
3000
Voltage (volts)

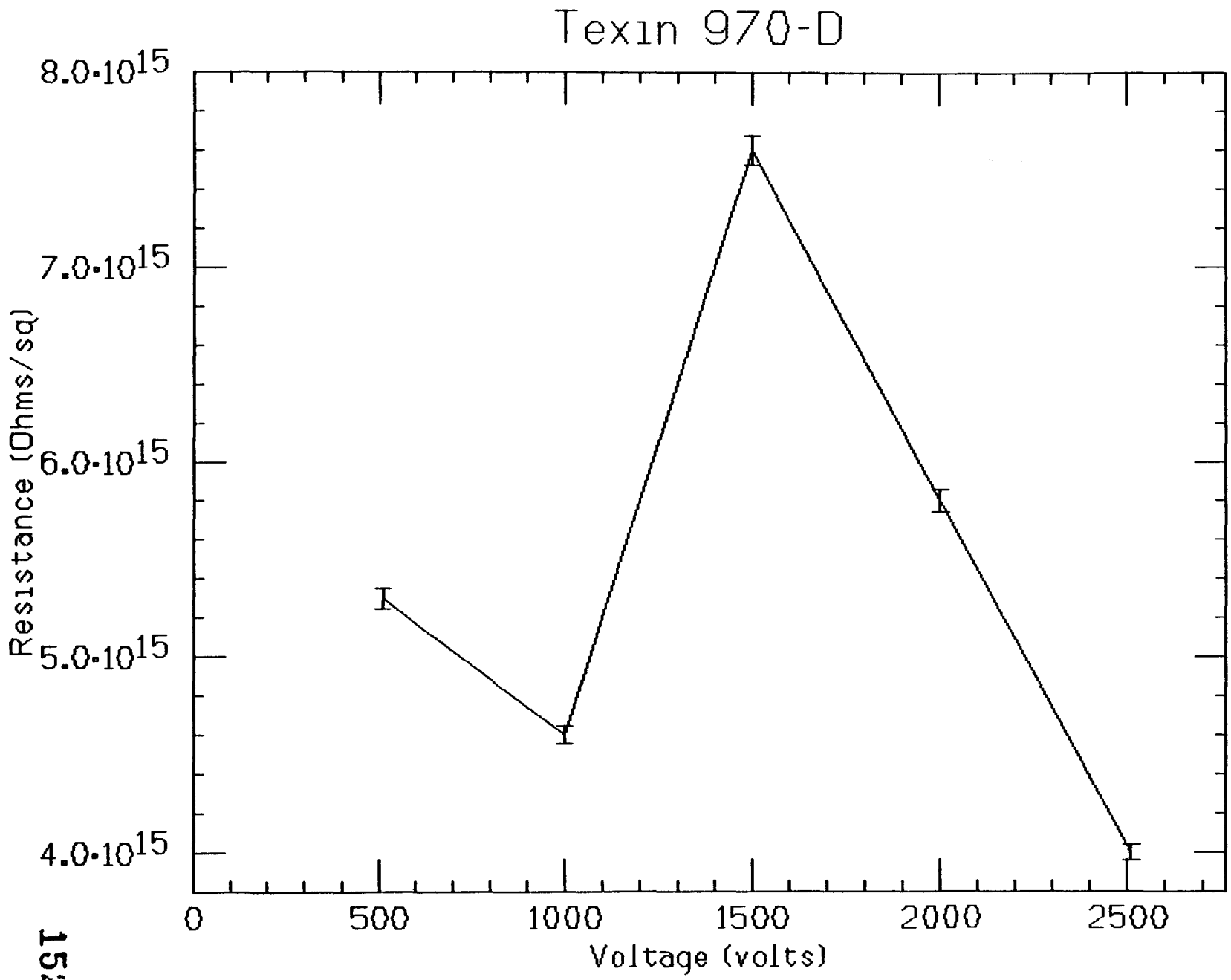

Texin Urethane 480AR retest-pumped on 22 hrs.
Resistance (Ohms/sq)
3.4·10^13
3.2·10^13
3.0·10^13
2.8·10^13
2.6·10^13
0
1000
2000
3000
Voltage (Volts)

Retest after $10^{11} \frac{n}{cm^2}$ irradiation.
Texin 480AR
2inch electrode length X $\frac{1}{8}$inch gap X .008inch thickness

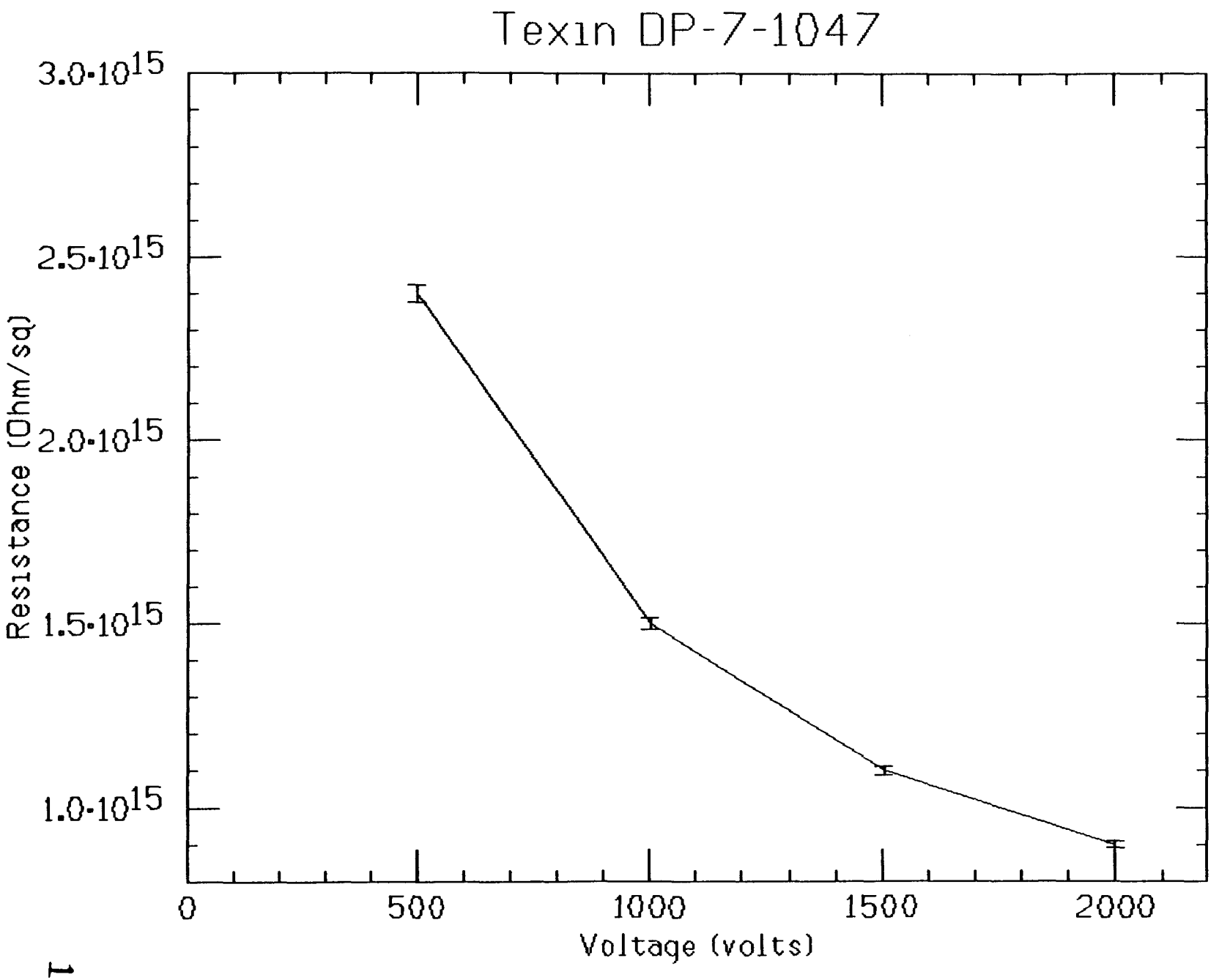
Date & Time	Voltage (volts)	Current (Amps)	Resistance (Ohms/sq)	Notes & Comments
9-22-91				
15:22	+500	3.7e-10	2.2e13	Stable
15:27	+500	3.8e-10	2.2e13	
15:28	+1000	7.6r-10	2.1e13	
15:32	+1000	7.7e-10	2.1e13	
15:32	+1503	1.3e-9	1.9e13	
15:38	+1503	1.3e-9	1.9e13	
15:39	+2000	1.75e-9	1.8e13	
15:45	+2000	1.75e-9	1.8e13	
15:45	+2010	1.77e-9	1.8e13	
15:46	+2500	2.2e-9	1.8e13	
15:50	+2500	2.25e-9	1.8e13	


Texin 480AR -- Post irradiation
Resistance (Ohm/sq)
2.5·10^13
2.2·10^13
2.0·10^13
1.8·10^13
1.5·10^13
1.3·10^13
1.0·10^13
0
500
1000
1500
2000
2500
Voltage (volts)

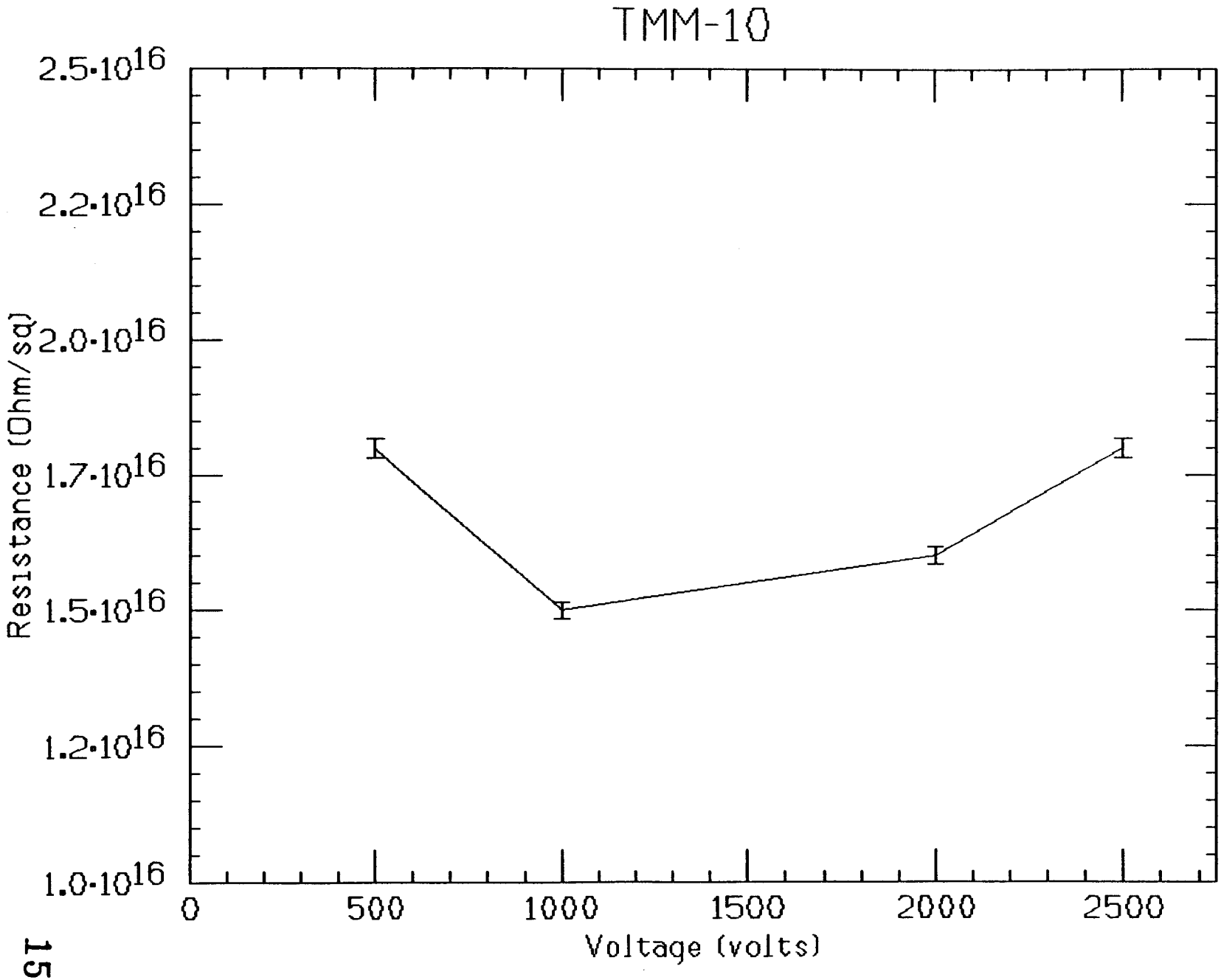
Texin 970-D 2inch electrode length X $\frac{1}{16}$inch gap X ? substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
5-24-91				
14:30	+510	3.1e-12	5.3e15	
14:36	+1000	7e-12	4.6e15	**Heat sensitive with heat gun, (2ft away)**
14:37	+1000			**current jumped up by factor of ~100,**
				but settles right away.
14:39	+1000	2.5e-12	1.3e16	
14:40	+1500	5e-12	9.6e15	
14:42	+1500	5.2e-12	9.2e15	
14:44	+1500	5.5e-12	8.7e15	
14:45	+1500	6.3e-12	7.6e15	
14:45	+2000	1.2e-11	5.3e15	
14:46	+2000	1.1e-11	5.8e15	
14:50	+2510	1.7e-11	4.7e15	
14:51	+2510	1.7e-11	4.7e15	
14:52	+2510	1.7e-11	4.7e15	
14:56	+2510	1.8e-11	4.5e15	
15:03	+2510	2e-11	4e15	**Heated with heat gun, current returns**
				to normal within 1 minute.


Texin 970-D
8.0·10^15
7.0·10^15
6.0·10^15
5.0·10^15
4.0·10^15
Resistance (Ohms/sq)
0
500
1000
1500
2000
2500
Voltage (volts)

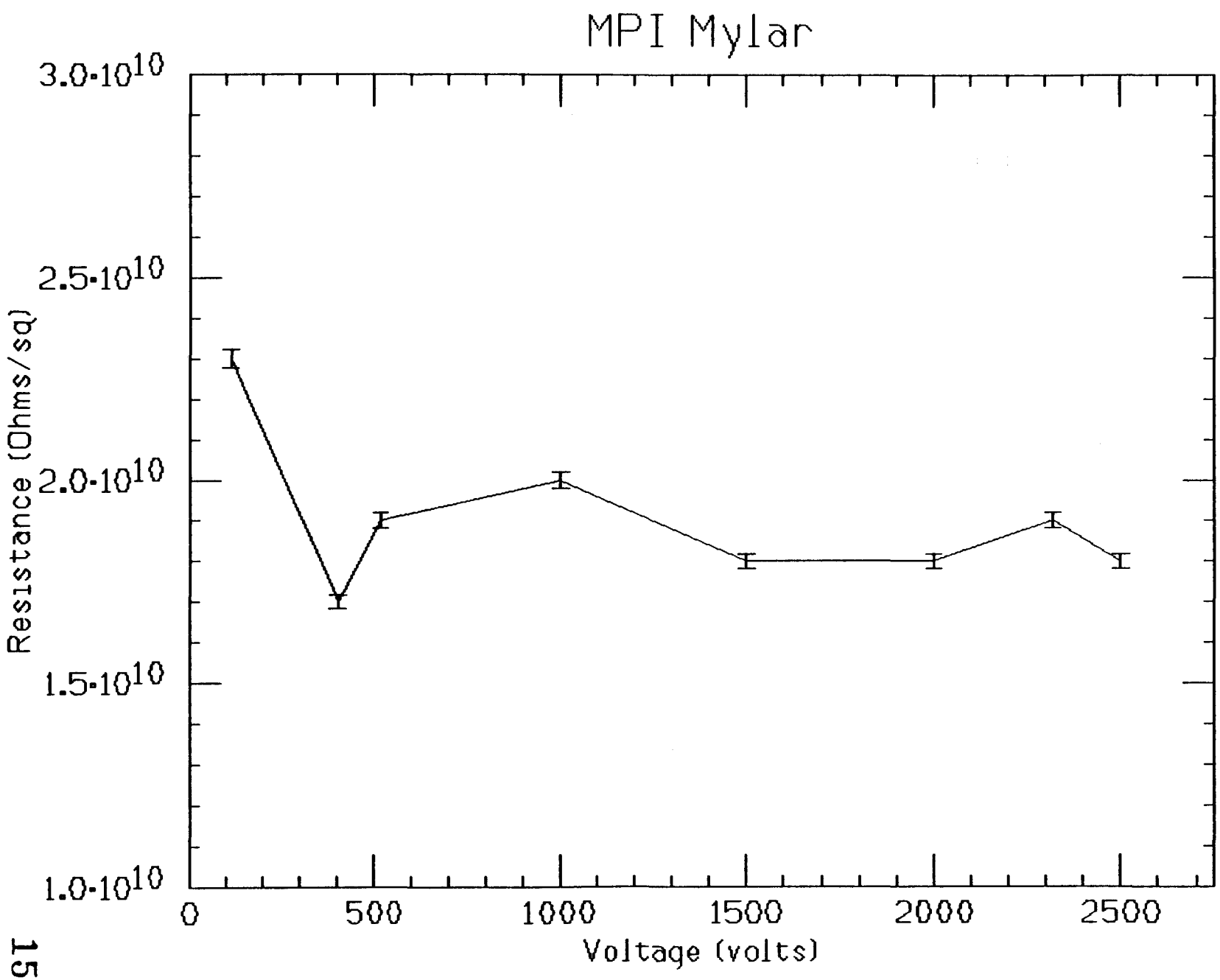
Texin DP-7-1047 2inch electrode length X $\frac{1}{16}$inch gap X inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
9-13-91				
14:15	+500	7.4e-12	2.2e15	
14:20	+500	6.7e-12	2.4e15	**Very unstable**
14:21	+1002	2.2e-11	1.5e15	**RC decay behavior**
14:25	+1503	4.5e-11	1.1e15	
14:30	+2000	7e-11	9e14	
14:50	+2000	7e-11	9e14	


Texin DP-7-1047
3.0·10^15
2.5·10^15
2.0·10^15
1.5·10^15
1.0·10^15
Resistance (Ohm/sq)
0
500
1000
1500
2000
Voltage (volts)

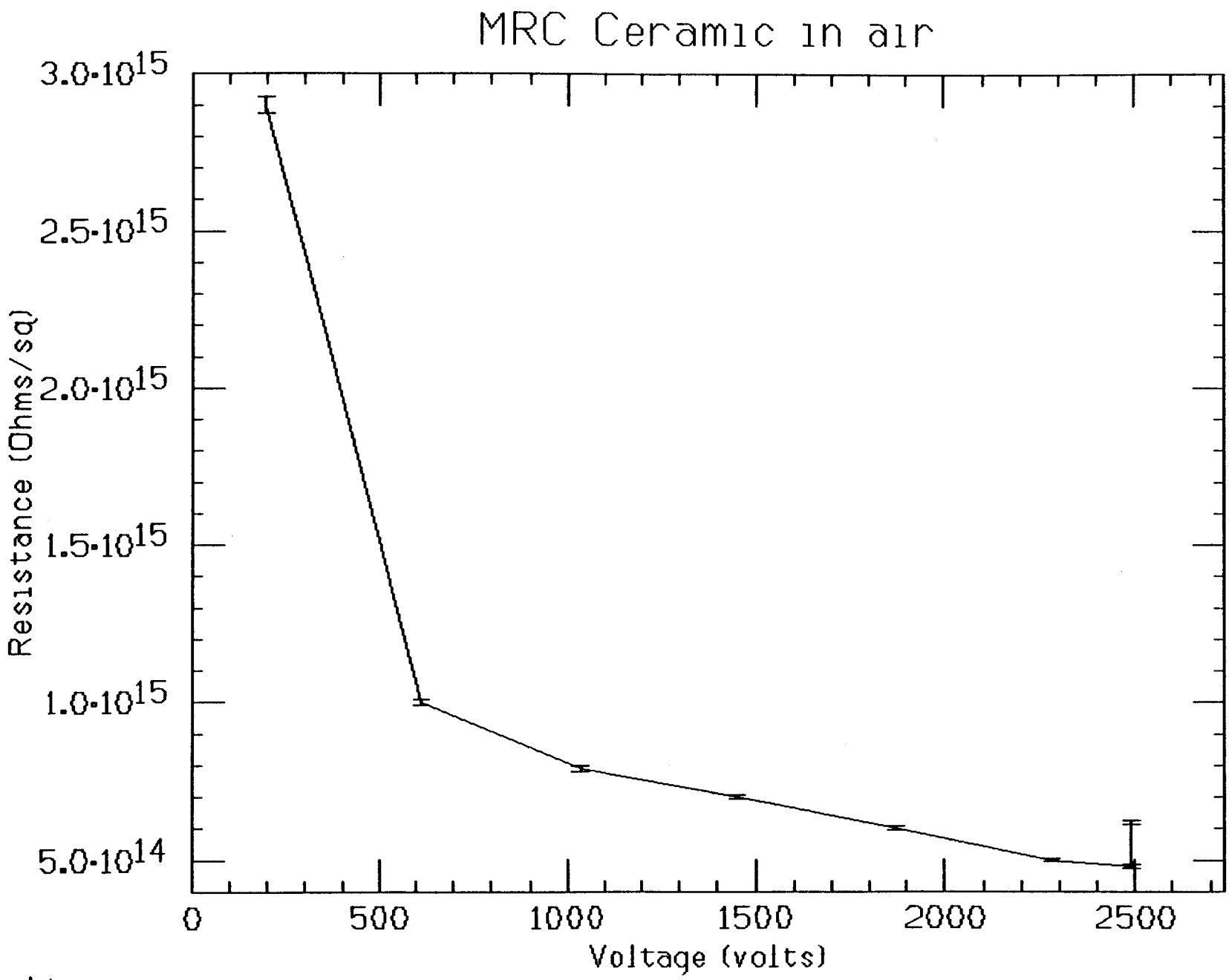
TMM-10 2inch electrode length X $\frac{1}{16}$inch gap X .008inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
6-5-91				
18:24	+500	9e-13	1.78e16	
18:26	+1000	2.2e-12	1.45e16	
18:29	+2000	5.5e-12	1.2e16	
18:30	+2000	4.5e-12	1.4e16	
18:31	+2000	4e-12	1.6e16	
18:31	+2500	6e-12	1.3e16	
18:32	+2500	4.5e-12	1.78e16	

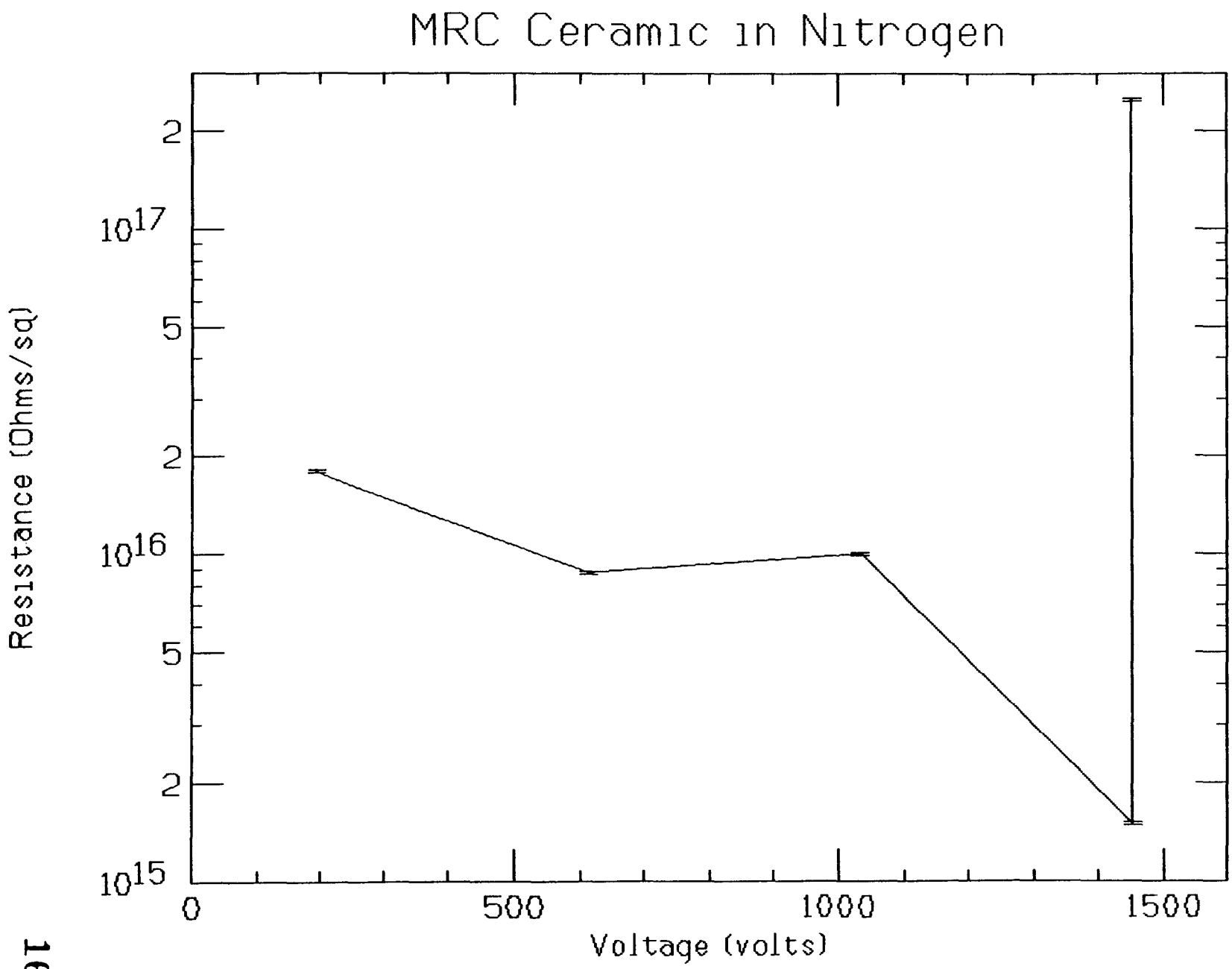

TMM-10
Resistance (Ohm/sq)
2.5·10^16
2.2·10^16
2.0·10^16
1.7·10^16
1.5·10^16
1.2·10^16
1.0·10^16
0
500
1000
1500
2000
2500
Voltage (volts)

MPI Mylar 1.25inch electrode length X $\frac{1}{16}$inch gap X inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
5-1-91				
18:45	+113	1e-7	2.3e10	
18:46	+402	4.7e-7	1.7e10	
18:47	+518	5.6e-7	1.85e10	
18:48	+1002	1e-6	2e10	
18:49	+1500	1.7e-6	1.77e10	
18:51	+2000	2.2e-6	1.86e10	
18:53	+2500	2.7e-6	1.8e10	**Signs of breakdown**

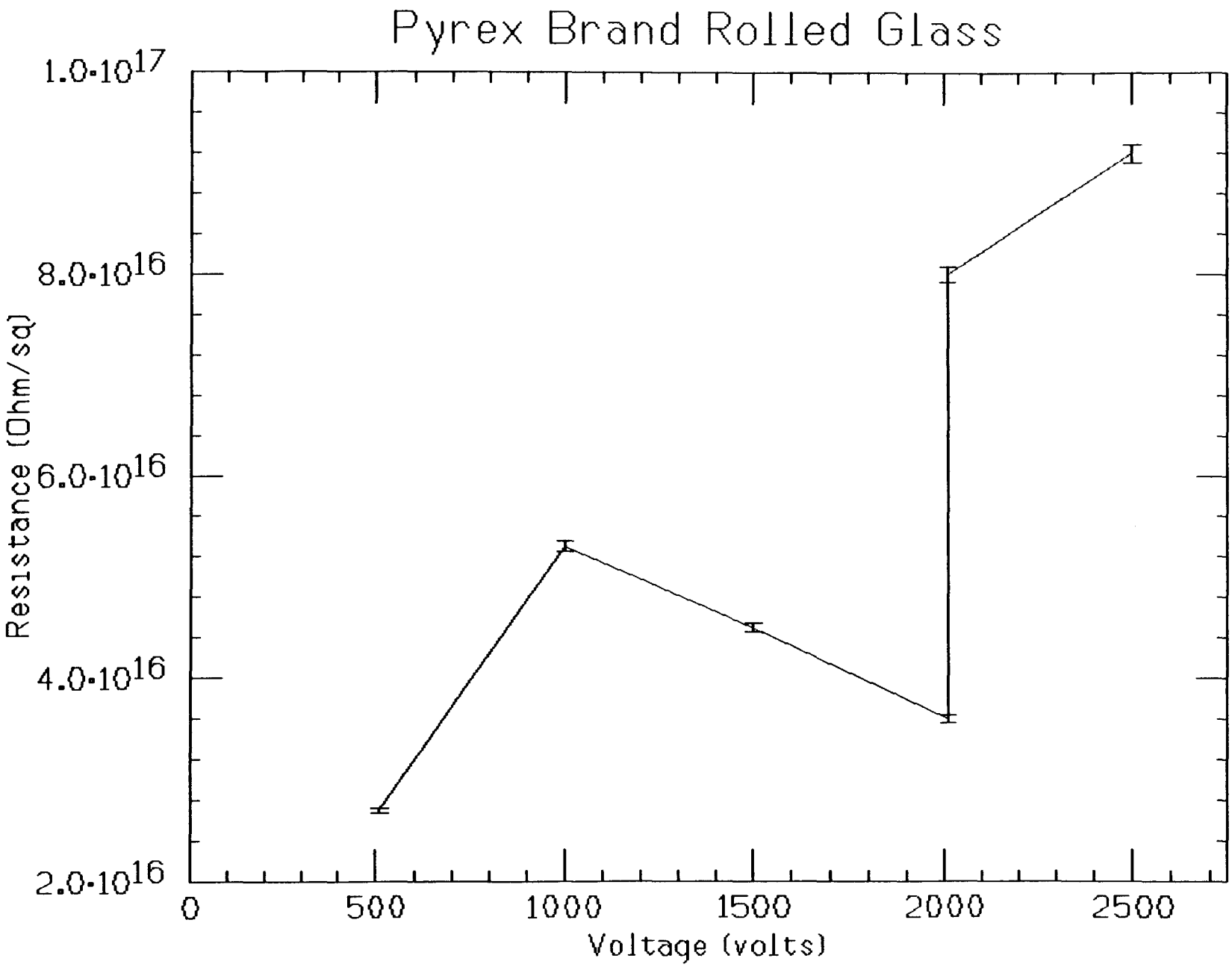

MPI Mylar
3.0·10^10
2.5·10^10
2.0·10^10
1.5·10^10
1.0·10^10
Resistance (Ohms/sq)
0
500
1000
1500
2000
2500
Voltage (volts)

MRC ceramic 1.63inch electrode length X $\frac{1}{16}$inch gap X .01inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
6-25-92	Tested in air			
16:24	+195	1.5e-12	2.9e15	
16:25	+614	1.6e-11	1e15	
16:27	+1034	3.4e-11	7.9e14	
16:28	+1452	5.4e-11	7e14	
16:30	+1871	8.1e-11	6e14	
16:32	+2280	1.2e-10	5e14	
16:34	+2490	1.35e-10	4.8e14	±.1e-10Amps.
16:45	+2490	1.05e-10	6.2e14	Very stable.
6-26-92	Tested in UHP nitrogen			
15:30	+195	2.8e-13	1.8e16	
15:32	+614	1.8e-12	8.8e15	
15:33	+1034	2.5e-12	1e16	
15:34	+1452	2.5e-12	1.5e15	
15:43	+1452	1.3e-12	2.9e16	
15:55	+1452	1.5e-13	2.5e17	


MRC Ceramic in air
Resistance (Ohms/sq)
3.0·10^15
2.5·10^15
2.0·10^15
1.5·10^15
1.0·10^15
5.0·10^14
0
500
1000
1500
2000
2500
Voltage (volts)

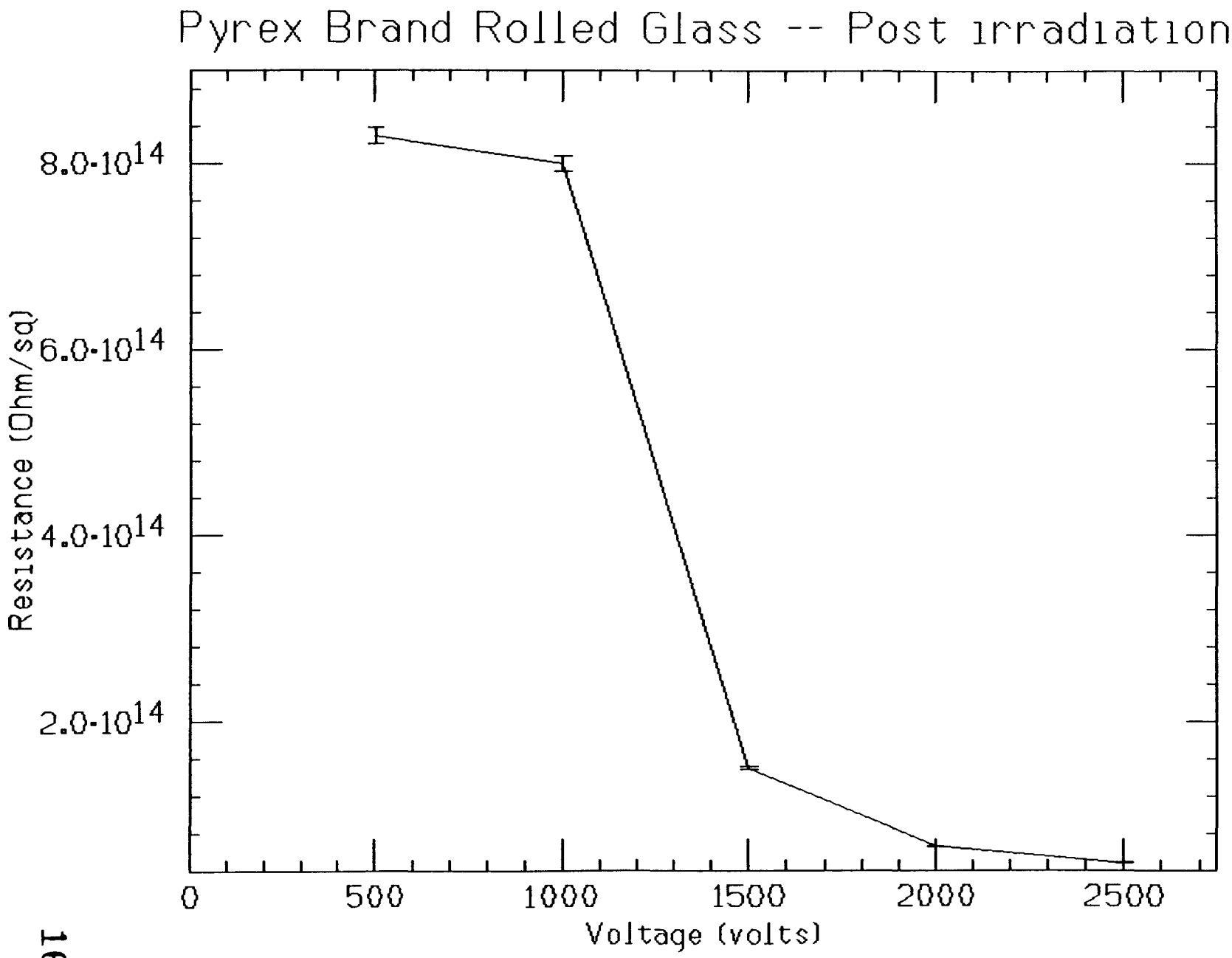

MRC Ceramic in Nitrogen
Resistance (Ohms/sq)
2
10^{17}
5
2
10^{16}
5
2
10^{15}
0
500
1000
1500
Voltage (volts)

Pyrex Brand Rolled Glass 3inch electrode length X $\frac{1}{16}$inch gap X $\frac{3}{32}$inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
8-28-91				
13:15	+510	9e-13	2.7e16	
13:18	+1000	2.5e-12	1.9e16	
13:20	+1000	1.6e-12	3e16	
13:25	+1000	9e-13	5.3e16	
13:26	+1500	3.5e-12	2.1e16	**Smooth RC decay.**
13:30	+1500	1.6e-12	4.5e16	
13:31	+1500	2.7e-12	3.6e16	
13:34	+2010	2.3e-12	4.2e16	
14:00	+2010	1.2e-12	8e16	
14:01	+2500	1.8e-12	6.7e16	
14:30	+2500	1.3e-12	9.2e16	


Pyrex Brand Rolled Glass
1.0·10^17
8.0·10^16
6.0·10^16
4.0·10^16
2.0·10^16
Resistance (Ohm/sq)
0
500
1000
1500
2000
2500
Voltage (volts)

Retest after $10^{11}\frac{n}{cm^2}$ irradiation.
Pyrex Brand Rolled Glass
3inch electrode length X $\frac{1}{16}$inch gap X .094inch thickness

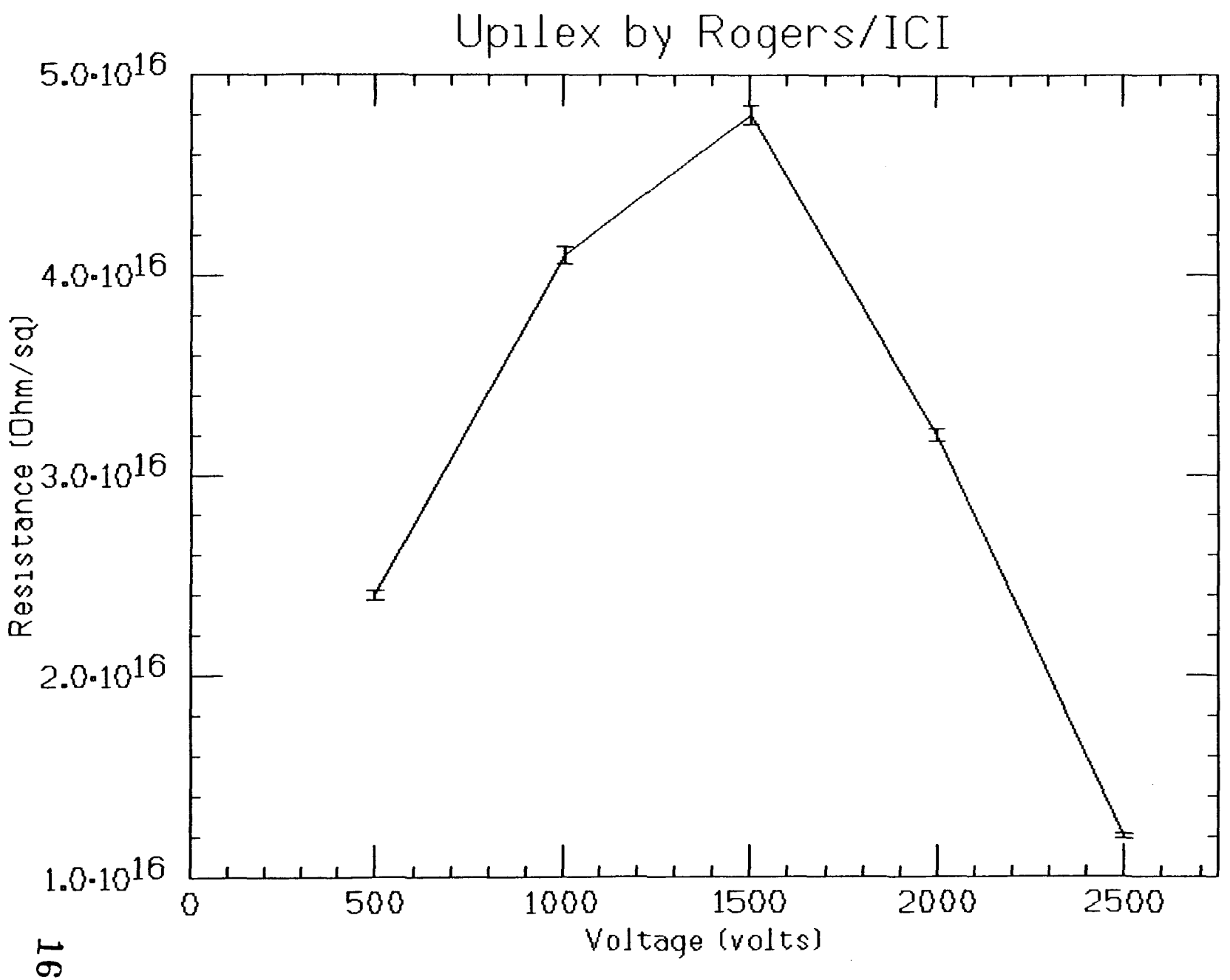
Date & Time	Voltage (volts)	Current (Amps)	Resistance (Ohms/sq)	Notes & Comments
9-22-91				
15:57	+502	3.1e-11	7.8e14	
16:05	+502	2.9e-11	8.3e14	
16:06	+1002	6.6e-11	7.3e14	Sensitive to air currents
16:12	+1002	6e-11	8e14	
16:13	+1500	4.5e-10	1.6e14	±.5e-10Amps
16:20	+1500	4.9e-10	1.5e14	±.1e-10Amps
16:21	+2000	1.4e-9	6.8e13	±.1e-9Amps
16:25	+2000	1.45e-9	6.6e13	±.1e-9Amps
16:25	+2500	3.3e-9	3.6e13	±.5e-9Amps
16:30	+2500	2.5e-9	4.8e13	±.1e-9Amps


Pyrex Brand Rolled Glass -- Post irradiation
Resistance (Ohm/sq)
8.0·10^14
6.0·10^14
4.0·10^14
2.0·10^14
0
500
1000
1500
2000
2500
Voltage (volts)

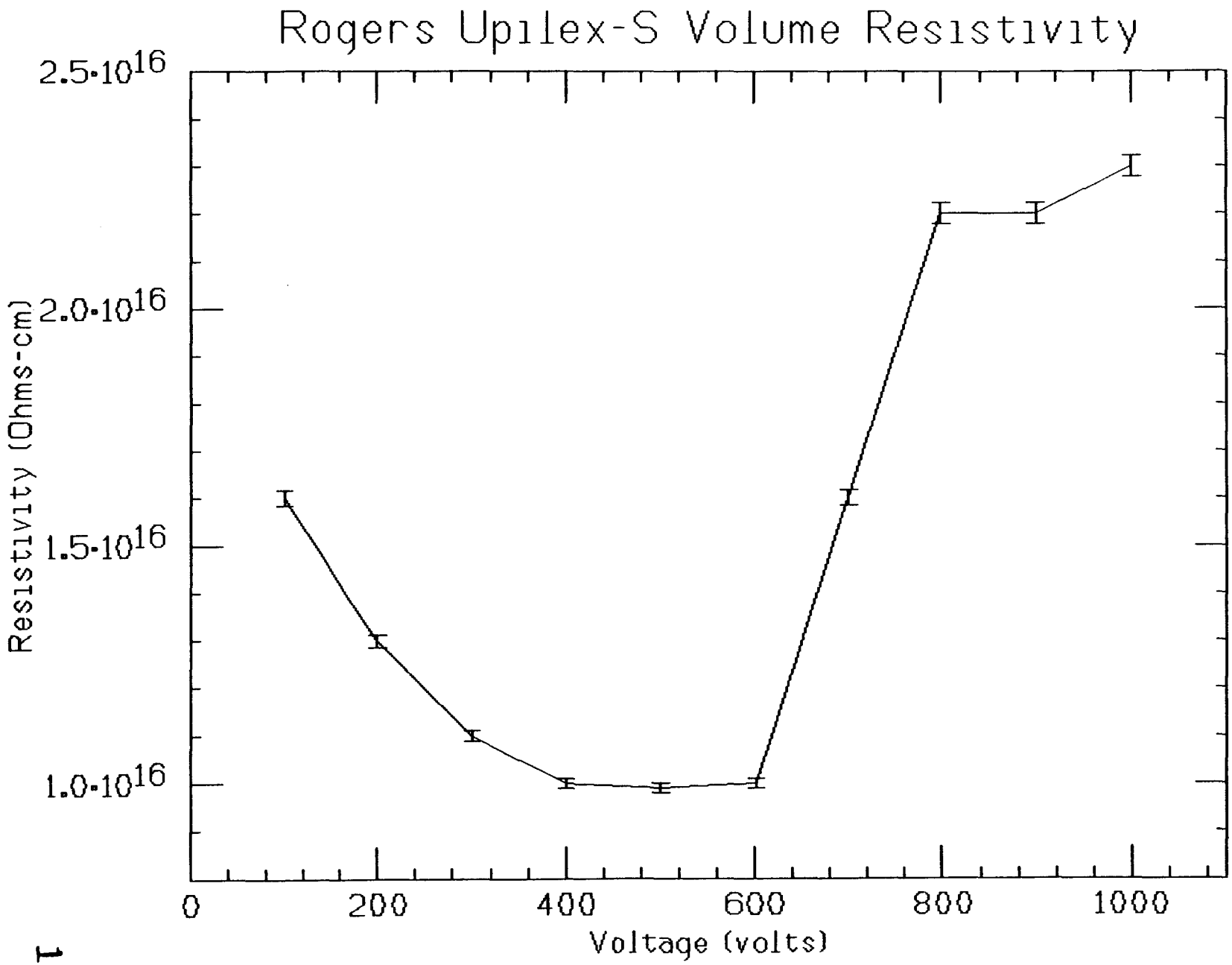
Upilex by Rogers/ICI

2inch electrode length X $\frac{1}{16}$inch gap X .001inch substrate thickness

Date & Time	Voltage (volts)	Current (Amps)	Resistance (Ohms/sq)	Notes & Comments
8-1-91				
17:35	+500	1e-12	1.6e16	
17:37	+500	6.7e-13	2.4e16	
17:40	+1005	7.8e-13	4.1e16	
17:47	+1503	1e-12	4.8e16	
17:50	+2000	2e-12	3.2e16	Discharges
17:51	+2500	3.6e-12	2.2e16	Sensitive to air currents.
17:54	+2500	3.4e-12	2.3e16	
17:57	+2500	6.6e-11	1.2e15	3 min. after blowing
8-2-91				on sample.
10:30	+2500	3.5e-11	2.3e15	
8-2-91	Retest of Upilex			
18:27	+520	2.4e-12	1e16	
18:29	+1050	4.6e-12	1.1e16	
18:31	+1500	7.1e-12	1e16	
18:32	+1500	6.6e-12	1.1e16	
18:33	+2010	1.7e-11	5.6e15	
18:35	+2510	3.5e-11	3.4e15	
18:36	+2510	3.45e-11	3.5e15	
18:42	+2510	3.4e-11	3.5e15	
18:45	+3000	5.2e-11	2.8e15	±.1e-11Amps
18:48	+3000	5e-11	2.9e15	

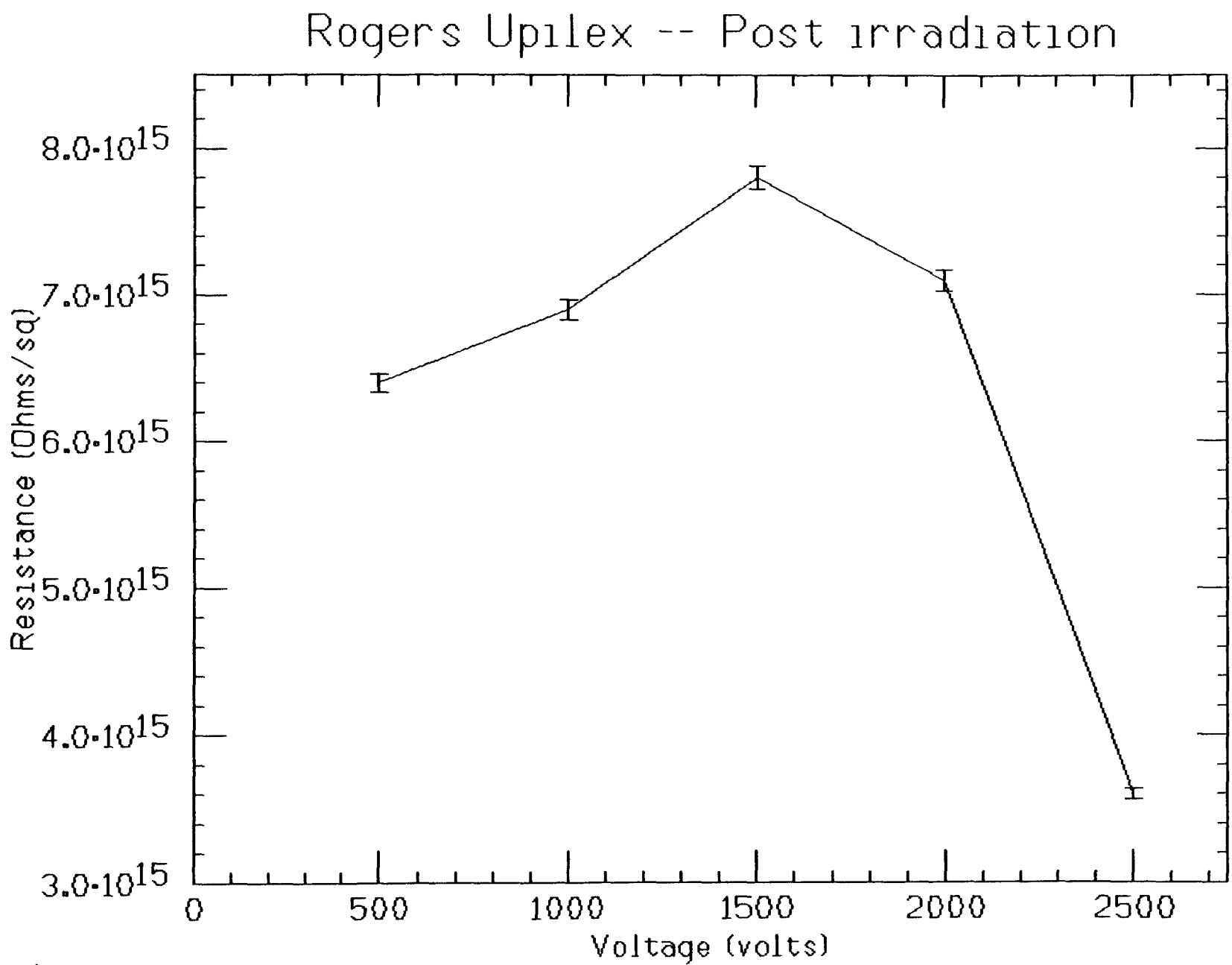

Upilex by Rogers/ICI
5.0·10^16
4.0·10^16
3.0·10^16
2.0·10^16
1.0·10^16
Resistance (Ohm/sq)
0
500
1000
1500
2000
2500
Voltage (volts)

Rogers Upilex-S Volume Resistivity Test .155inch^{2}electrode area X .001inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistivity (Ohm-cm)**	**Notes & Comments**
11-20-91				
13:00	+100	2.5e-12	1.6e16	±.1e-12Amps.
13:05	+200	6e-12	1.3e16	Same fluctations throughout.
13:07	+301	1.1e-11	1.1e16	
13:09	+401	1.5e-11	1e16	
13:11	+501	3e-11	9.9e15	
13:13	+602	2.3e-11	1e16	
13:17	+700	1.7e-11	1.6e16	
13:20	+800	1.4e-11	2.2e16	
13:22	+900	1.6e-11	2.2e16	
13:24	+1001	1.7e-11	2.3e16	

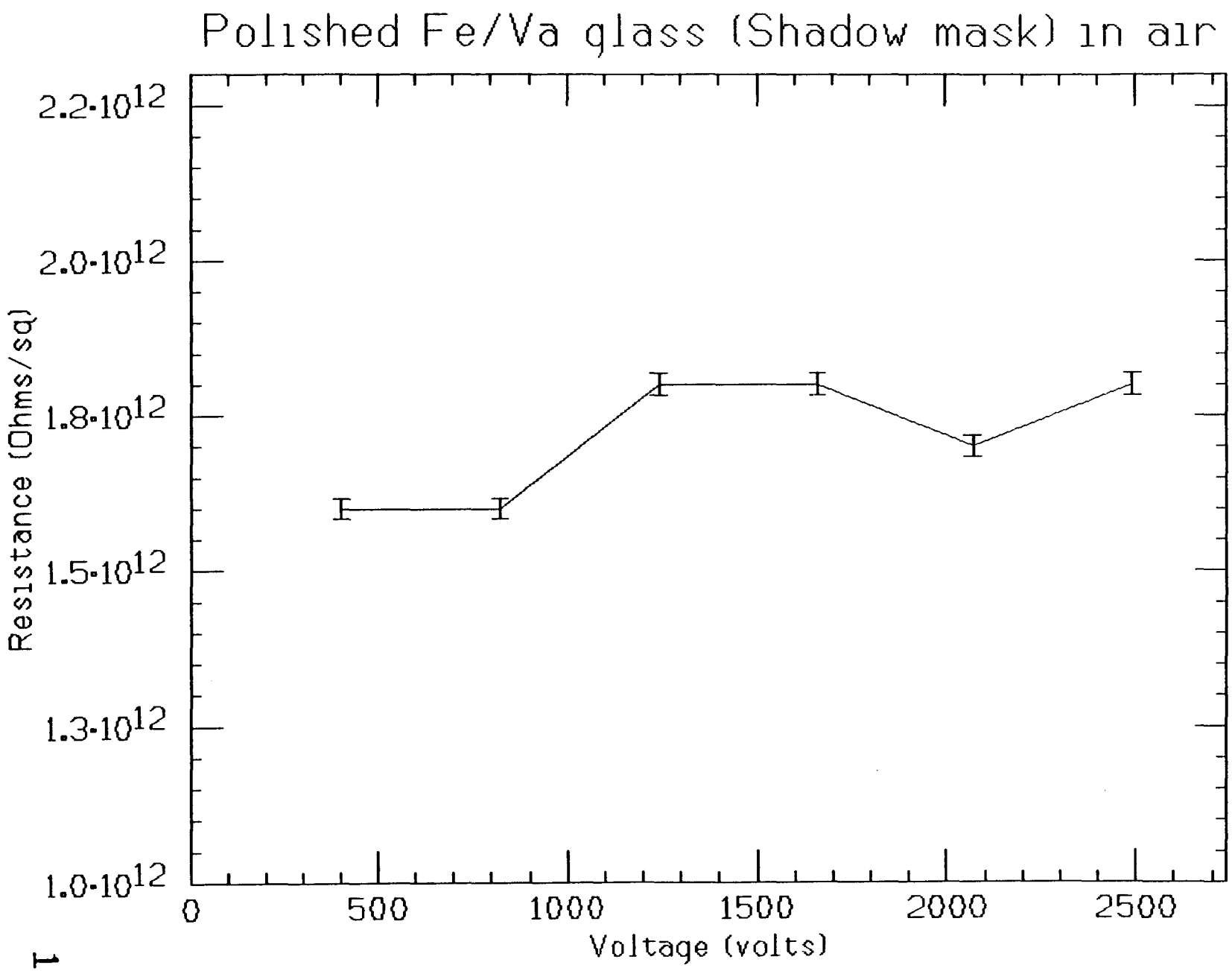

Rogers Upilex-S Volume Resistivity
2.5·10^16
2.0·10^16
1.5·10^16
1.0·10^16
Resistivity (Ohms-cm)
0
200
400
600
800
1000
Voltage (volts)

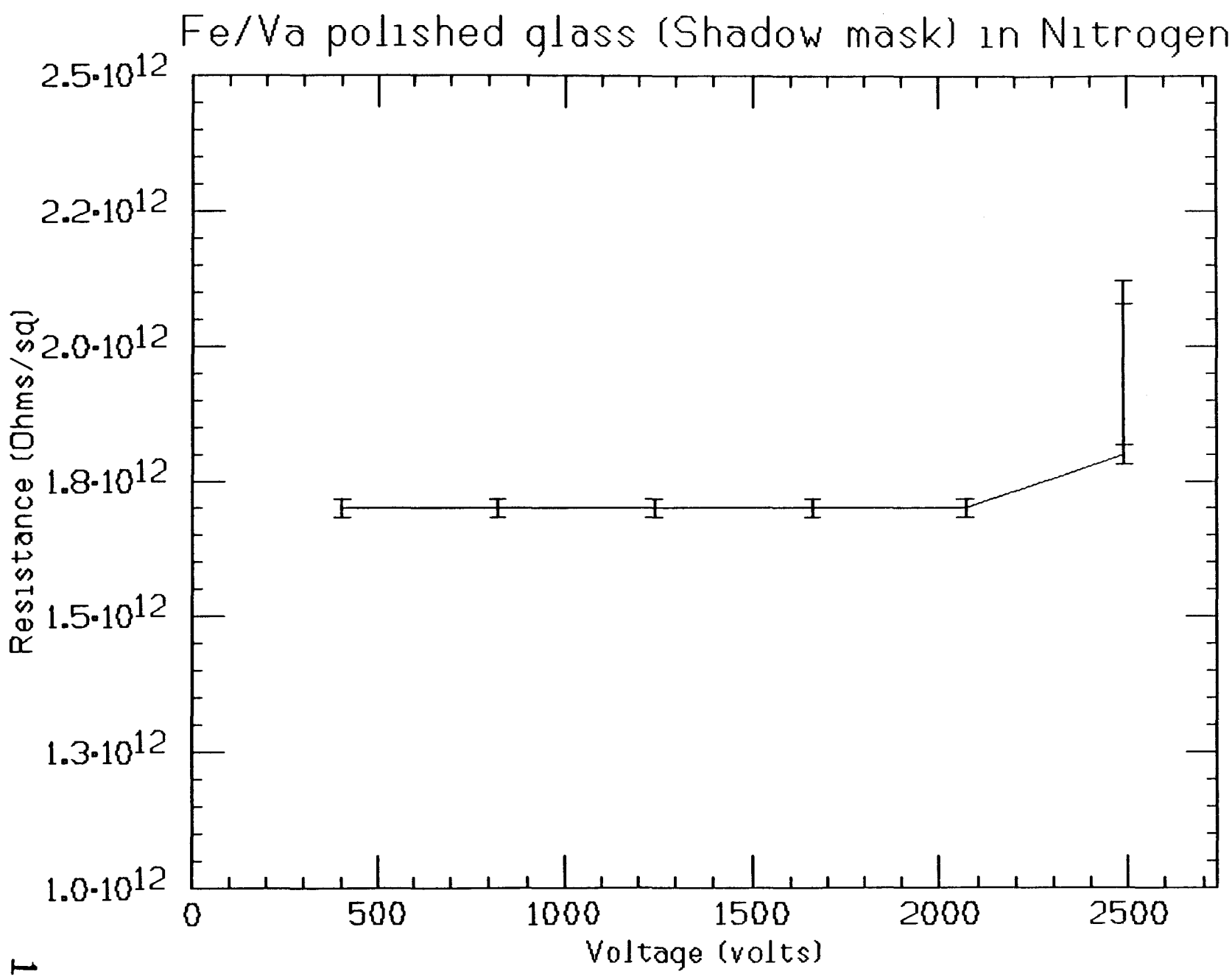
Retest after $10^{11} \frac{n}{cm^2}$ irradiation.
Rogers Upilex
2inch electrode length X $\frac{1}{16}$inch gap X .001inch thickness

Date & Time	Voltage (volts)	Current (Amps)	Resistance (Ohms/sq)	Notes & Comments
9-29-91				
13:45	+500	2.5e-12	6.4e15	±.1e-12Amps throughout.
13:52	+500	2.4e-12	6.4e15	
13:55	+500	2.4e-12	6.4e15	Sensitive to air movement.
13:55	+1002	4.9e-12	6.5e15	
14:00	+1002	4.6e-12	6.9e15	
14:01	+1503	6.5e-12	7.4e15	
14:05	+1503	6.2e-12	7.8e15	
14:05	+2000	9e-12	7.1e15	
14:10	+2000	9e-12	7.1e15	
14:11	+2500	2.2e-11	3.6e15	
14:15	+2500	2.2e-11	3.6e15	

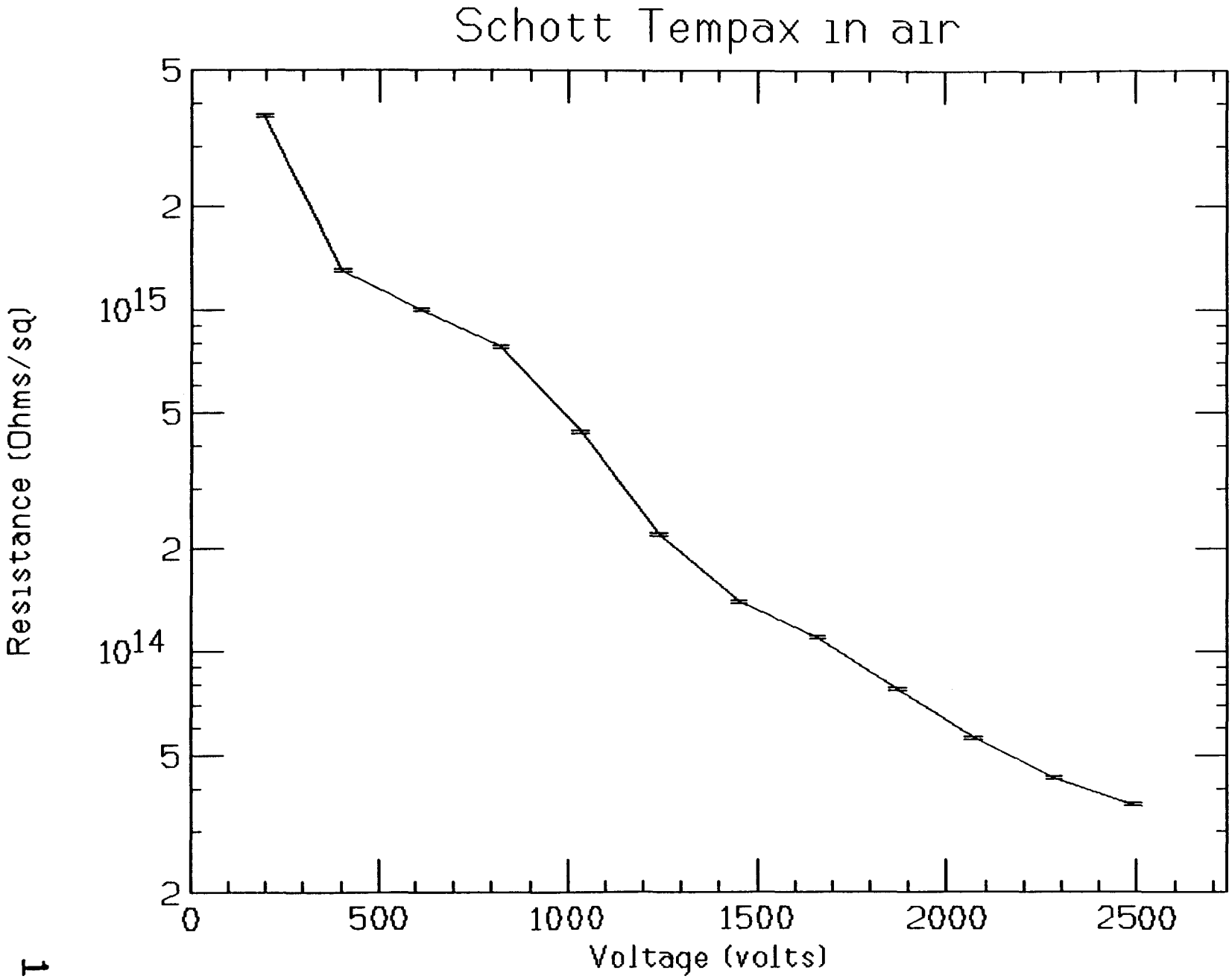

Rogers Upilex -- Post irradiation
Resistance (Ohms/sq)
8.0·10^15
7.0·10^15
6.0·10^15
5.0·10^15
4.0·10^15
3.0·10^15
0
500
1000
1500
2000
2500
Voltage (volts)

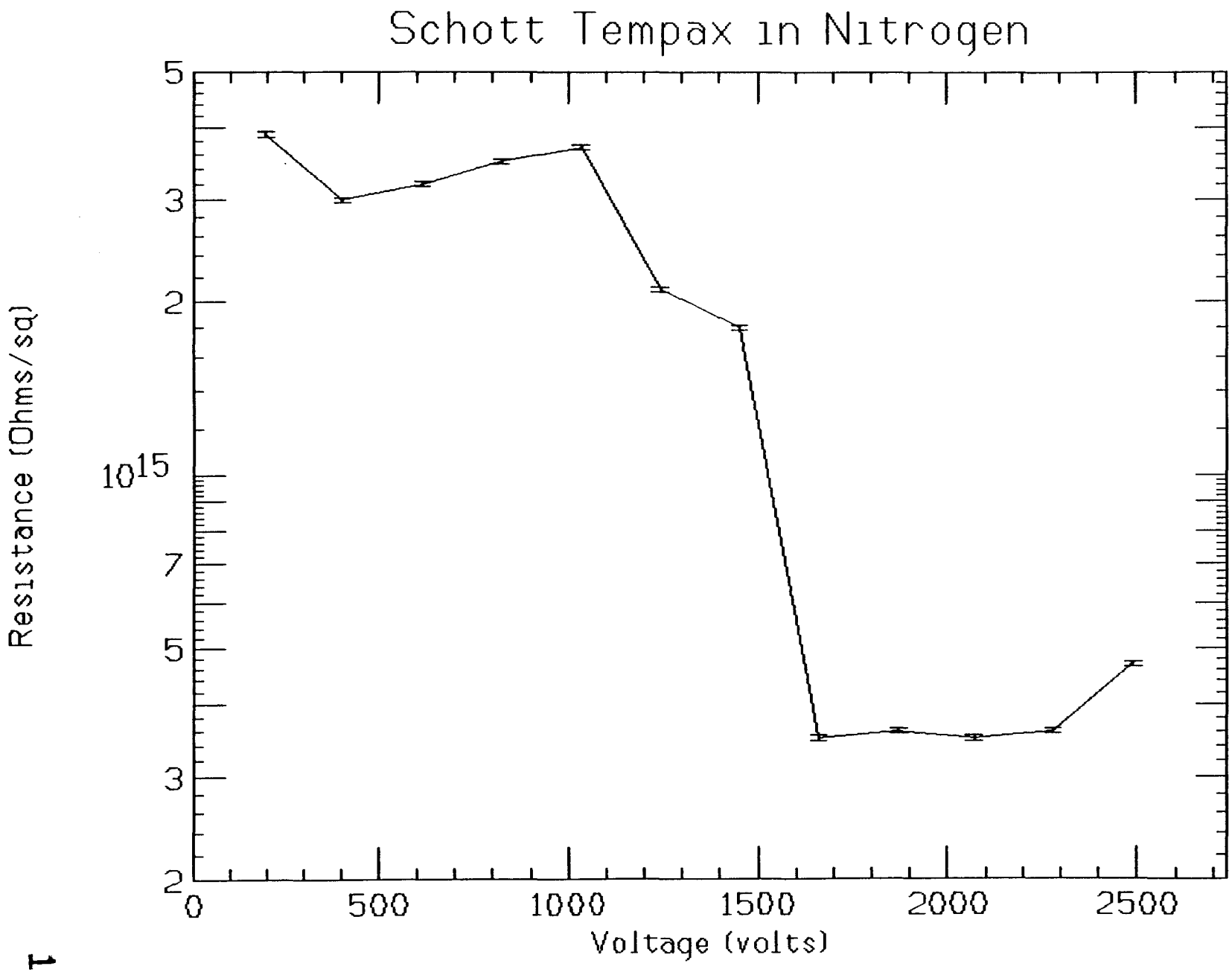
Polished Fe/Va glass (Shadow mask)*				
1inch electrode length X $\frac{1}{32}$inch gap X ~.04inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
6-12-92	Tested in air			
16:00	+404	7.8e-9	1.6e12	
16:01	+823	1.6e-8	1.6e12	
16:01	+1242	2.2e-8	1.8e12	
16:02	+1661	3e-8	1.8e12	
16:02	+2070	3.8e-8	1.7e12	
16:03	+2490	4.5e-8	1.8e12	
6-12-92	Tested in UHP nitrogen			
16:21	+404	7.5e-9	1.7e12	
16:22	+823	1.55e-8	1.7e12	
16:23	+1242	2.3e-8	1.7e12	
16:24	+1661	3.1e-8	1.7e12	
16:25	+2070	3.9e-8	1.7e12	
16:26	+2490	4.7e-8	1.7e12	
16:30	+2490	4.35e-8	1.8e12	
6-14-92				
16:30	+2490	3.68e-8	2.2e12	
*Shadow mask was used to pattern evaporated Al electrode lines. No tape involved.				


Polished Fe/Va glass (Shadow mask) in air
Resistance (Ohms/sq)
2.2·10^12
2.0·10^12
1.8·10^12
1.5·10^12
1.3·10^12
1.0·10^12
0
500
1000
1500
2000
2500
Voltage (volts)


Fe/Va polished glass (Shadow mask) in Nitrogen
Resistance (Ohms/sq)
2.5·10^12
2.2·10^12
2.0·10^12
1.8·10^12
1.5·10^12
1.3·10^12
1.0·10^12
0
500
1000
1500
2000
2500
Voltage (volts)

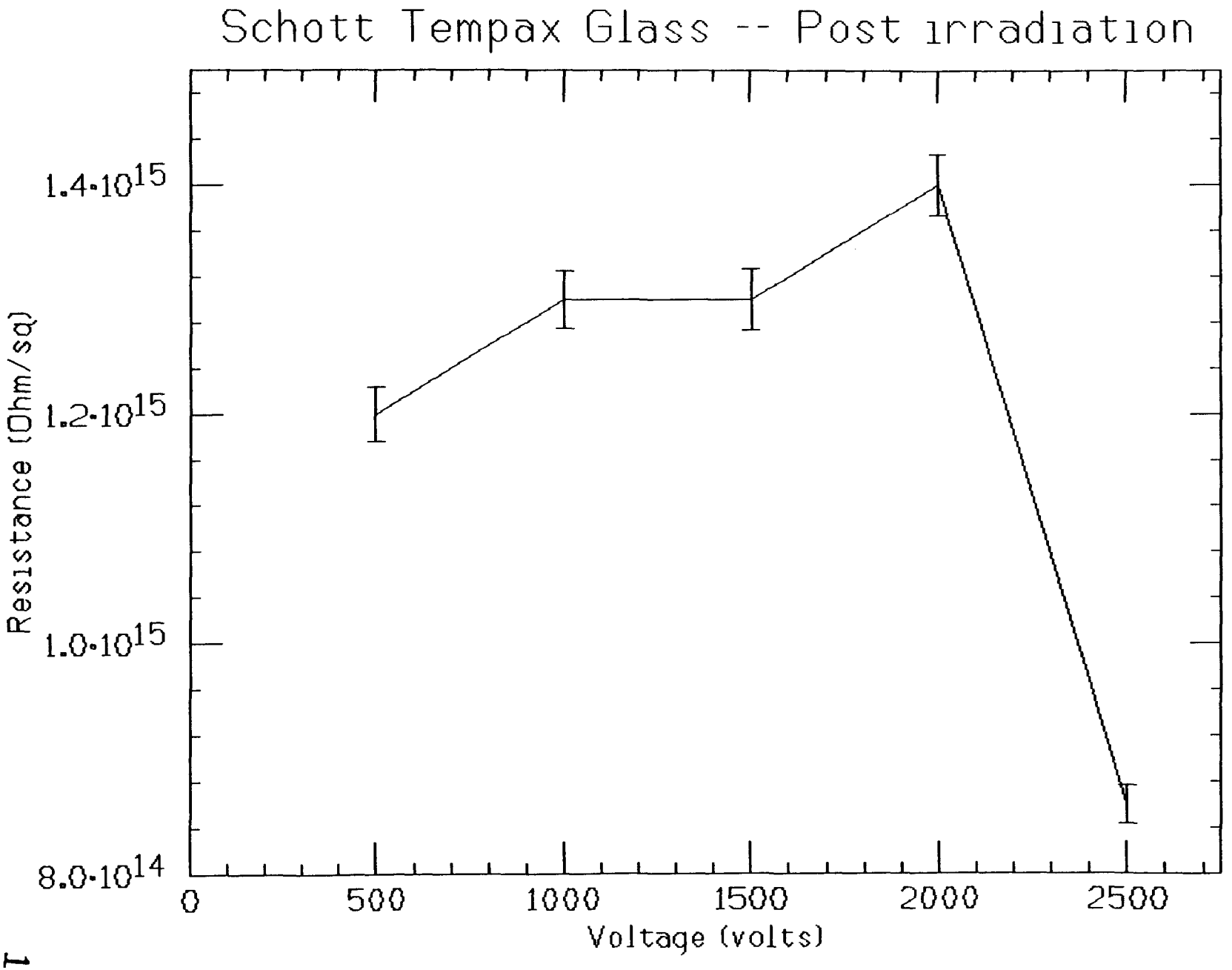
Schott Tempax 1.2inch electrode length X $\frac{1}{16}$inch gap X $\frac{1}{16}$inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
6-11-92	Tested in air.			
13:30	+195	1e-12	3.7e15	
13:32	+404	6e-12	1.3e15	
13:33	+614	1.1e-11	1e15	
13:33	+823	2e-11	7.8e14	
13:34	+1034	4.5e-11	4.4e14	
13:35	+1242	1.07e-10	2.2e14	
13:36	+1452	1.9e-10	1.4e14	
13:36	+1661	2.8e-10	1.1e14	
13:37	+1871	5e-10	7.8e13	±.1e-10Amps
13:38	+2070	7e-10	5.6e13	±.1e-10Amps
13:38	+2280	1e-9	4.3e13	±.1e-10Amps
13:39	+2490	1.3e-9	3.6e13	±.2e-10Amps
6-11-92	Tested in UHP nitrogen.			
13:57	+195	9.5e-13	3.9e15	
13:58	+404	2.5e-12	3e15	RC decay behavior.
13:59	+614	3.6e-12	3.2e15	
14:02	+823	4.5e-12	3.5e15	Current settles before
14:04	+1034	5.3e-12	3.7e15	measurement is taken.
14:07	+1242	1.15e-11	2.1e15	
14:09	+1452	1.5e-11	1.8e15	
14:10	+1661	9e-11	3.5e14	
14:11	+1871	1e-10	3.6e14	
14:12	+2070	1.1e-10	3.5e14	
14:13	+2280	1.2e-10	3.6e14	
14:14	+2490	1.3e-10	3.5e14	
14:15	+2490	1e-10	4.7e14	
6-12-92				
18:00	+2490	5.25e-12	9e15	


Schott Tempax in air
Resistance (Ohms/sq)
5
2
10^{15}
5
2
10^{14}
5
2
0
500
1000
1500
2000
2500
Voltage (volts)

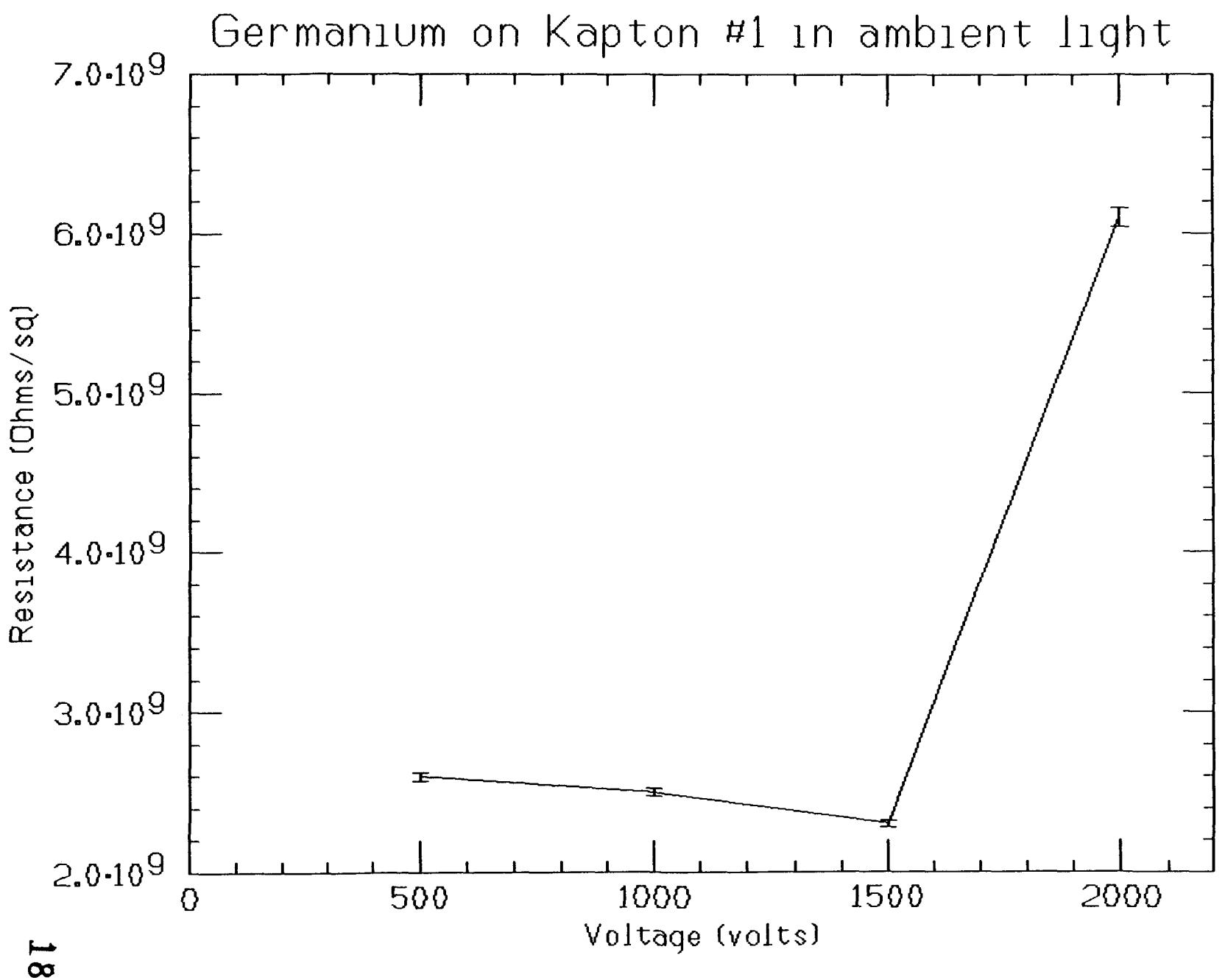

Schott Tempax in Nitrogen
Resistance (Ohms/sq)
5
3
2
10^{15}
7
5
3
2
0
500
1000
1500
2000
2500
Voltage (volts)

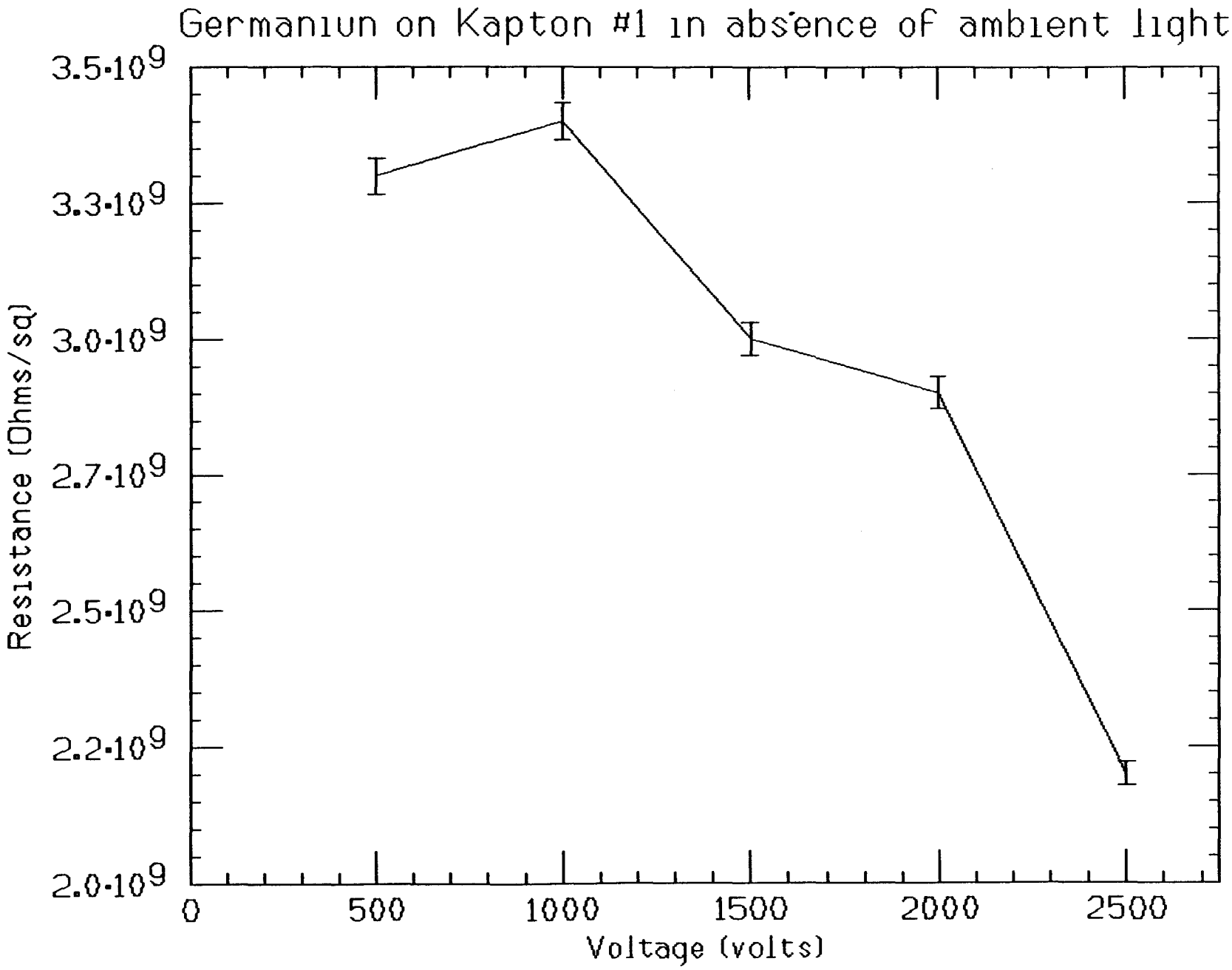
Retest after $10^{11} \frac{n}{cm^2}$ irradiation.
Schott Tempax Glass
1.5inch electrode length X $\frac{1}{16}$inch gap X .119inch thickness

Date & Time	Voltage (volts)	Current (Amps)	Resistance (Ohms/sq)	Notes & Comments
9-20-91				
14:42	+500	1.1e-11	1.1e15	
14:45	+500	1e-11	1.2e15	Sensitive to air currents.
14:46	+1002	2.1e-11	1.1e15	
14:50	+1002	1.9e-11	1.3e15	
14:51	+1501	3e-11	1.2e15	
14:55	+1501	2.7e-11	1.3e15	±.1e-11Amps
14:56	+2000	4e-11	1.3e15	±.1e-11Amps
15:03	+2000	3.5e-11	1.4e15	±.1e-11Amps
15:04	+2500	9e-11	6.7e14	±.1e-11Amps
15:10	+2500	7e-11	8.6e14	±.1e-11Amps

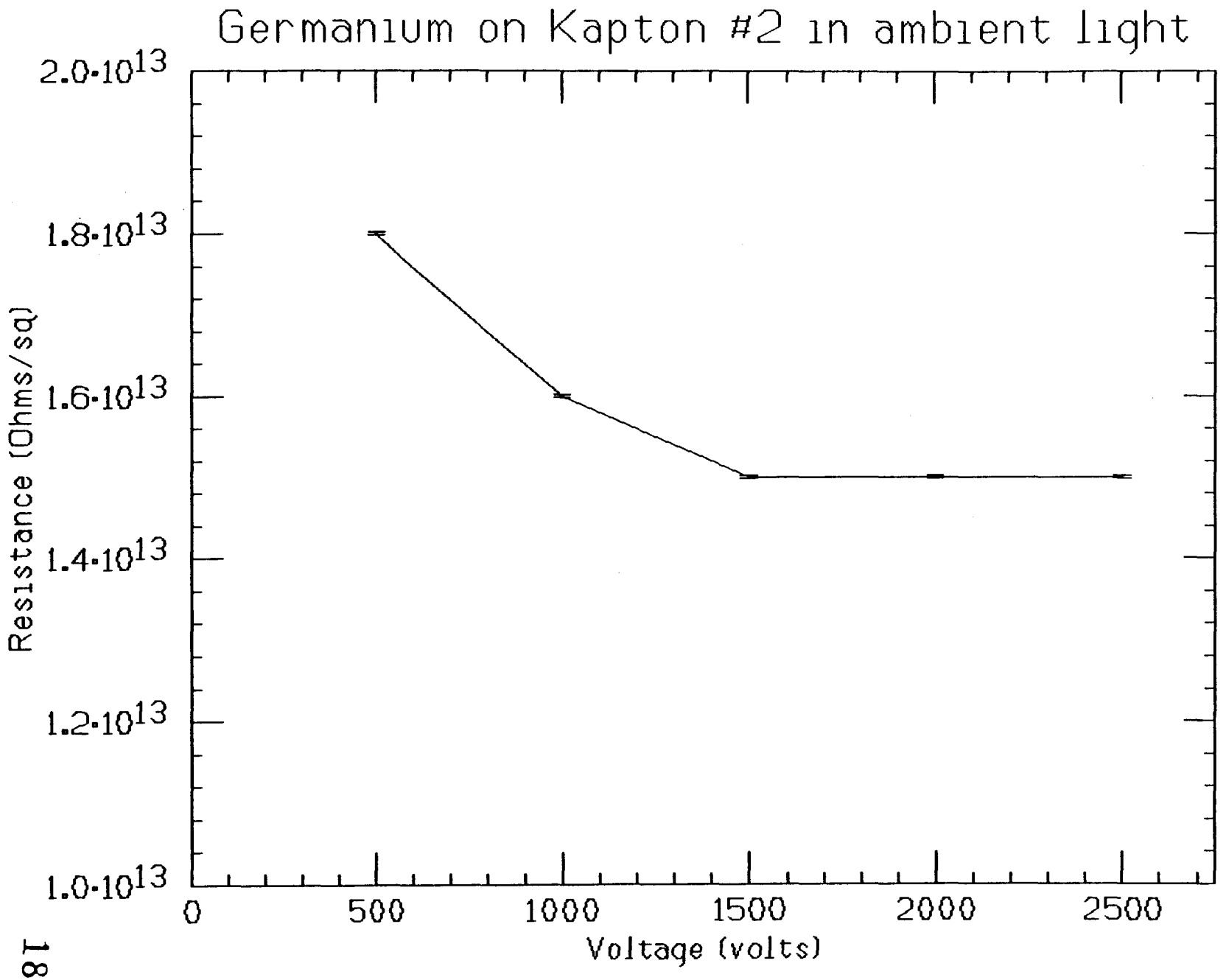

Schott Tempax Glass -- Post irradiation
Resistance (Ohm/sq)
1.4·10^15
1.2·10^15
1.0·10^15
8.0·10^14
0
500
1000
1500
2000
2500
Voltage (volts)

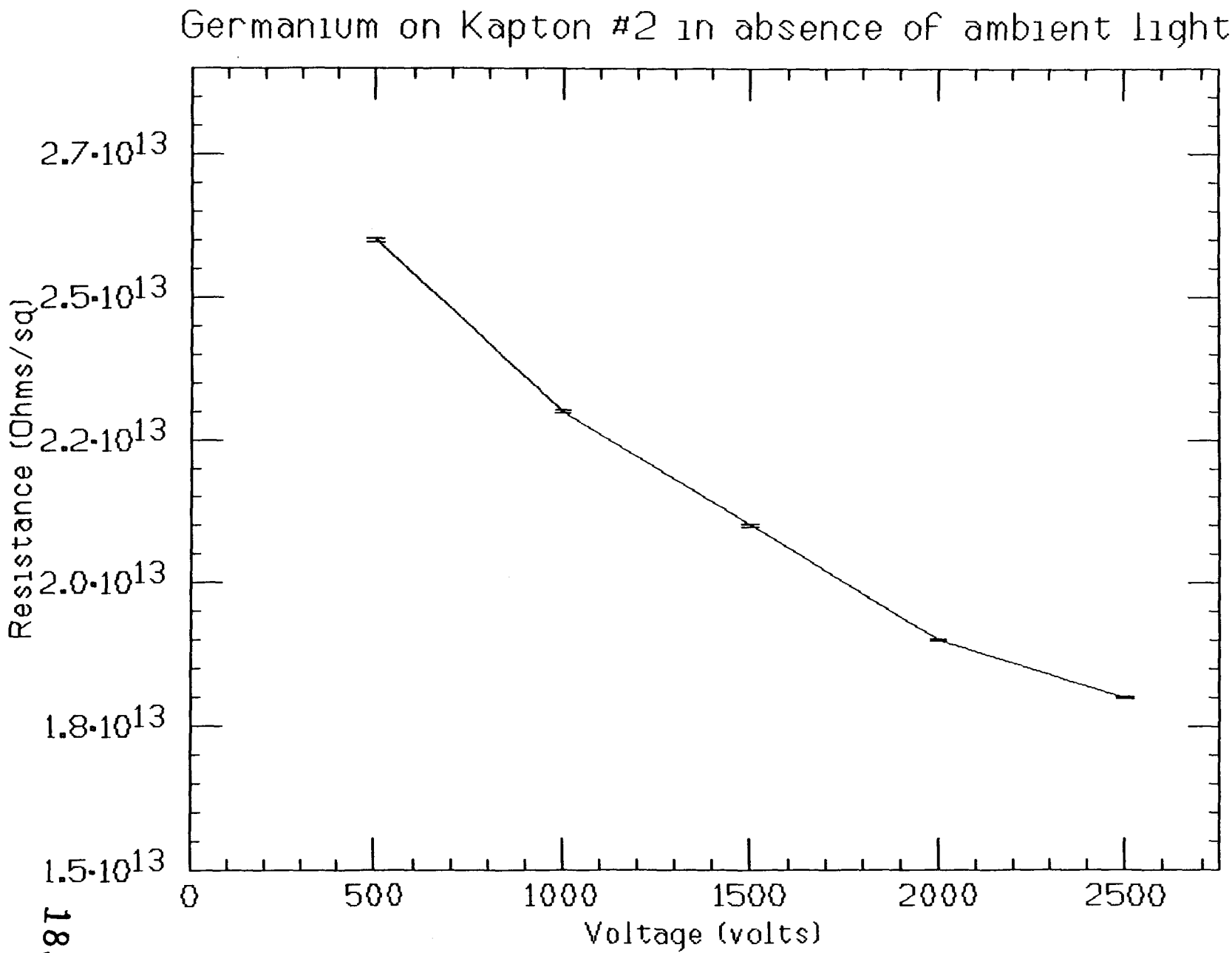
Germanium on Kapton #1 2inch electrode length X $\frac{1}{16}$inch gap X .002inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
3-13-92	Tested in ambient light.			
15:25	-501		2.6e9	**Stable.**
15:27	-1000	6.2e-6	2.5e9	
15:29	-1501	1.3e-5	2.3e9	
15:31	-2000	2.1e-5	6.1e9	
16:33	-2400	——	——	**Sparked three times.**
3-16-92	Tested in absence of ambient light.			
13:13	-500	4.8e-6	3.3e9	
13:15	-1000	9.3e-6	3.4e9	
13:17	-1501	1.6e-5	3e9	
13:19	-2000	2.2e-5	2.9e9	
13:21	-2500	3.6e-5	2.2e9	


Germanium on Kapton #1 in ambient light
7.0·10^9
6.0·10^9
5.0·10^9
4.0·10^9
3.0·10^9
2.0·10^9
Resistance (Ohms/sq)
0
500
1000
1500
2000
Voltage (volts)


Germanium on Kapton #1 in absence of ambient light
3.5·10^9
3.3·10^9
3.0·10^9
2.7·10^9
2.5·10^9
2.2·10^9
2.0·10^9
Resistance (Ohms/sq)
0
500
1000
1500
2000
2500
Voltage (volts)

Germanium on Kapton #2 2inch electrode length X $\frac{1}{16}$inch gap X .002inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
3-13-92	Tested in ambient light.			
14:50	-500	8.7e-10	1.8e13	**Stable.**
14:52	-1000	2e-9	1.6e13	
14:55	-1501	3.2e-9	1.5e13	
14:57	-2000	4.4e-9	1.5e13	
15:00	-2500	5.3e-9	1.5e13	
3-16-92	Tested in absence of ambient light.			
13:23	-501	6.4e-10	2.5e13	
13:27	-501	6.2e-10	2.6e13	
13:29	-1000	1.4e-9	2.3e13	
13:31	-1501	2.3e-9	2.1e13	
13:32	-2000	3.3e-9	1.9e13	
13:35	-2500	4.3e-9	1.8e13	
3-23-92				
00:30	-2500	1.11e-9	7.2e13	**±.03e-9amps**
09:00	-2500	7e-10	1.4e14	**HV off, to inspect. Sample**
				looks fine, "peel offs" repaired.
16:55	-2500	7.65e-11	1e14	
18:20	-2500	6.7e-11	1.2e14	**Some fluctuations.**

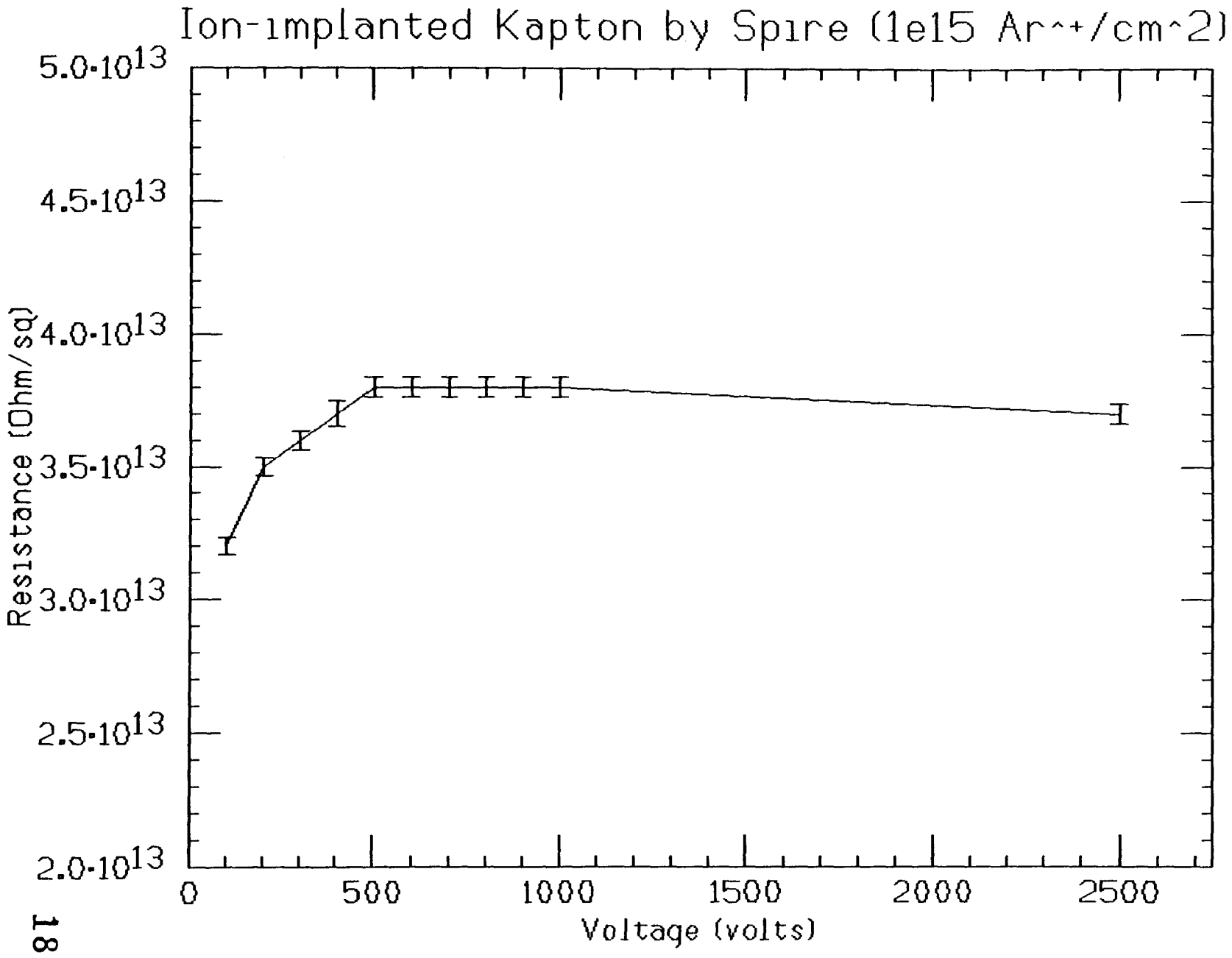

Germanium on Kapton #2 in ambient light
2.0·10^13
1.8·10^13
1.6·10^13
1.4·10^13
1.2·10^13
1.0·10^13
Resistance (Ohms/sq)
0
500
1000
1500
2000
2500
Voltage (volts)


Germanium on Kapton #2 in absence of ambient light
Resistance (Ohms/sq)
2.7·10^13
2.5·10^13
2.2·10^13
2.0·10^13
1.8·10^13
1.5·10^13
0
500
1000
1500
2000
2500
Voltage (volts)

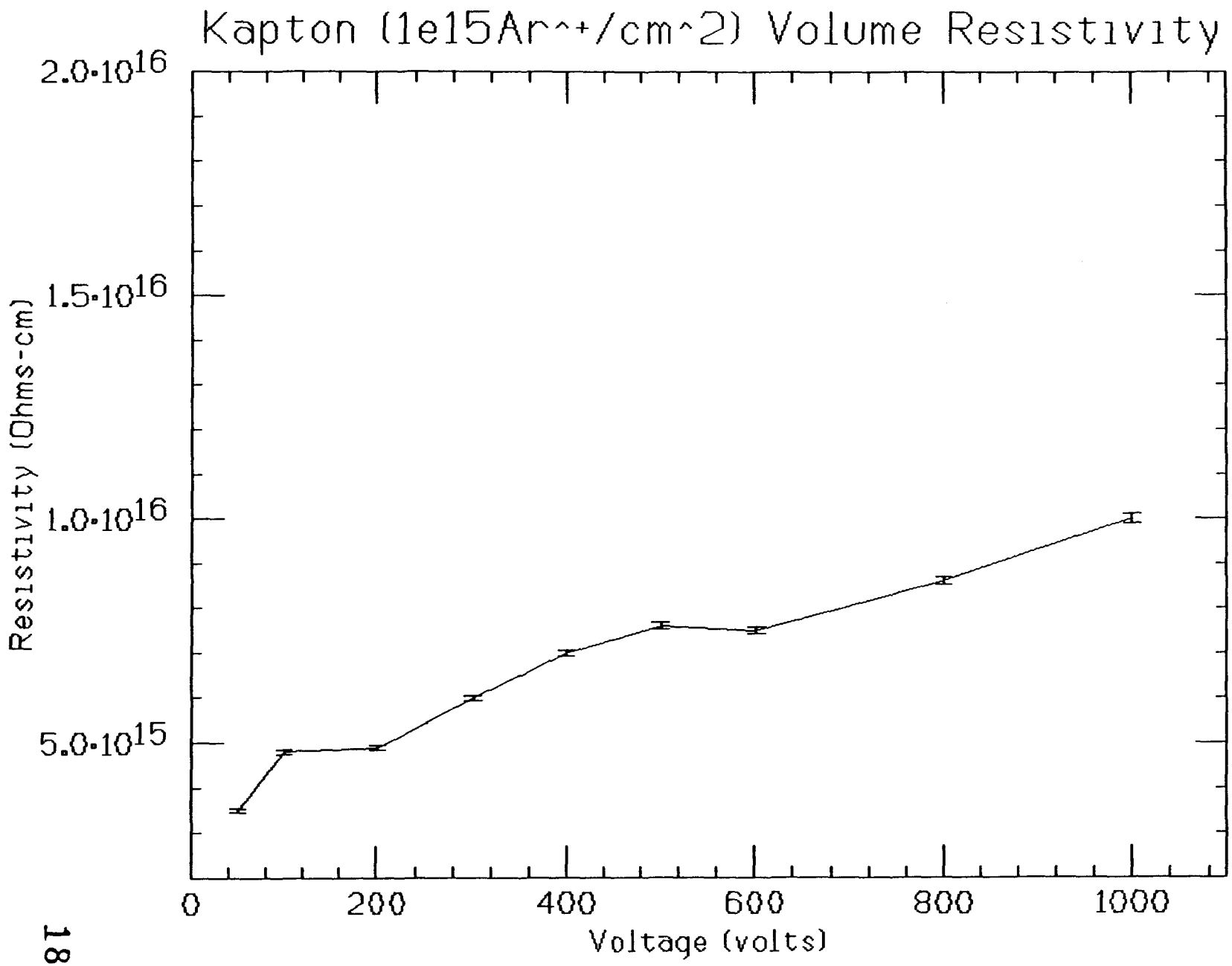
Ion-implanted Kapton by Spire (1e15 $\frac{Ar^+}{cm^2}$)

2inch electrode length X $\frac{1}{16}$inch gap X .005inch substrate thickness

Date & Time	Voltage (volts)	Current (Amps)	Resistance (Ohms/sq)	Notes & Comments
3-17-92				
13:37	-102	1.02e-10	3.2e13	
13:38	-201	1.82e-10	3.5e13	
13:39	-300	2.61e-10	3.6e13	
13:40	-401	3.44e-10	3.7e13	
13:41	-501	4.24e-10	3.8e13	
13:42	-600	5.03e-10	3.8e13	
13:43	-702	5.87e-10	3.8e13	
13:44	-802	6.68e-10	3.8e13	
13:45	-900	7.49e-10	3.8e13	
13:46	-1000	8.3e-10	3.8e13	HV left on.
3-18-92				
10:30	-1000	8.96e-10	3.6e13	HV off for inpection. No Damage.
16:45	-2500	2.15e-9	3.7e13	Reconnect HV at 16:40.
3-19-92				
8:35	-2500	2.14e-9	3.7e13	
8:50	-2500	2.07e-9	3.9e13	Wind from open HVbay door.
16:13	-2500	2.54e-9	3.2e13	HV off for inspection. Beginning of damage.


Ion-implanted Kapton by Spire (1e15 Ar^+/cm^2)
5.0·10^13
4.5·10^13
4.0·10^13
3.5·10^13
3.0·10^13
2.5·10^13
2.0·10^13
Resistance (Ohm/sq)
0
500
1000
1500
2000
2500
Voltage (volts)

Kapton Volume Test (1e15 $\frac{Ar^+}{cm^2}$) .095inch^2 electrode area X .005inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistivity (Ohm-cm)**	**Notes & Comments**
7-9-92				
14:30	+50	7e-13	3.5e15	
14:31	+100	1e-12	4.8e15	
14:33	+201	2e-12	4.9e15	**Small flux**
14:34	+302	2.4e-12	6e15	
14:35	+400	2.8e-12	7e15	
14:36	+501	3.2e-12	7.6e15	
14:38	+602	3.9e-12	7.5e15	
14:45	+800	4.5e-12	8.6e15	
14:55	+1000	4.6e-12	1e16	**Current very stable.**

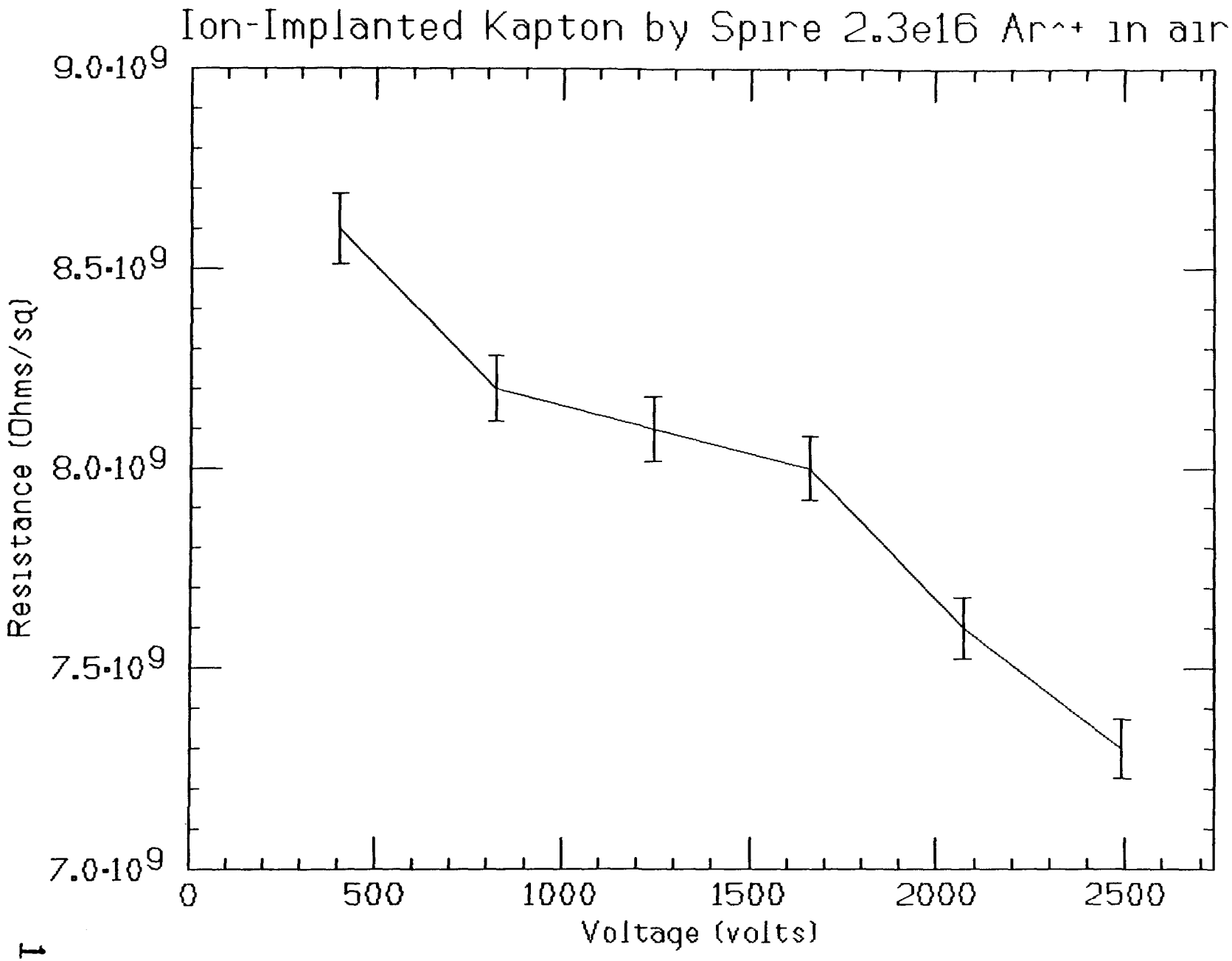

Kapton (1e15Ar^+/cm^2) Volume Resistivity
2.0·10^16
1.5·10^16
1.0·10^16
5.0·10^15
Resistivity (Ohms-cm)
0
200
400
600
800
1000
Voltage (volts)

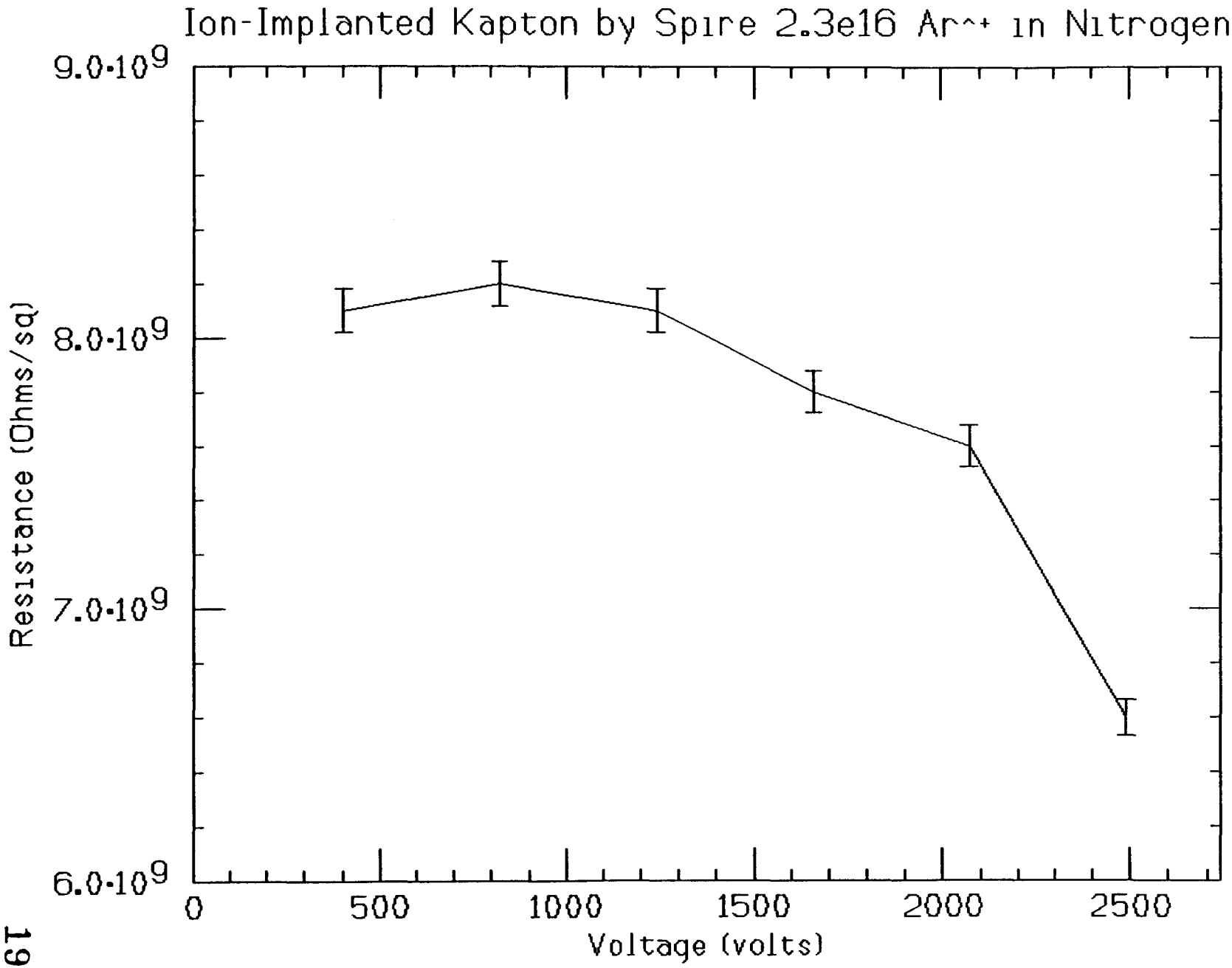
Ion-Implanted Kapton by Spire 2.3e16 Ar^+

$1.2\frac{\mu}{cm^2}$ 80KeV 14±1RPM 52060207.TAM

2inch electrode length X $\frac{1}{16}$inch gap X .005inch substrate thickness

Date & Time	Voltage (volts)	Current (Amps)	Resistance (Ohms/sq)	Notes & Comments
6-12-92	Tested in air			
14:20	+404	.15e-5	8.6e9	Stable
14:21	+823	.32e-5	8.2e9	
14:22	+1242	.49e-5	8.1e9	
14:23	+1661	.67e-5	8e9	
14:26	+2070	.87e-5	7.6e9	
14:28	+2490	1.08e-5	7.4e9	
14:35	+2490	1.09e-5	7.3e9	
6-12-92	Tested in UHP nitrogen			
15:09	+404	1.6e-6	8.1e9	Stable
15:10	+823	3.2e-6	8.2e9	
15:11	+1242	4.9e-6	8.1e9	
15:11	+1661	6.8e-6	7.8e9	
15:12	+2070	8.7e-6	7.6e9	
15:13	+2490	1.1e-6	7.2e9	
15:18	+2490	1.2e-6	6.6e9	


Ion-Implanted Kapton by Spire 2.3e16 Ar^+ in air
9.0·10^9
8.5·10^9
8.0·10^9
7.5·10^9
7.0·10^9
Resistance (Ohms/sq)
0
500
1000
1500
2000
2500
Voltage (volts)

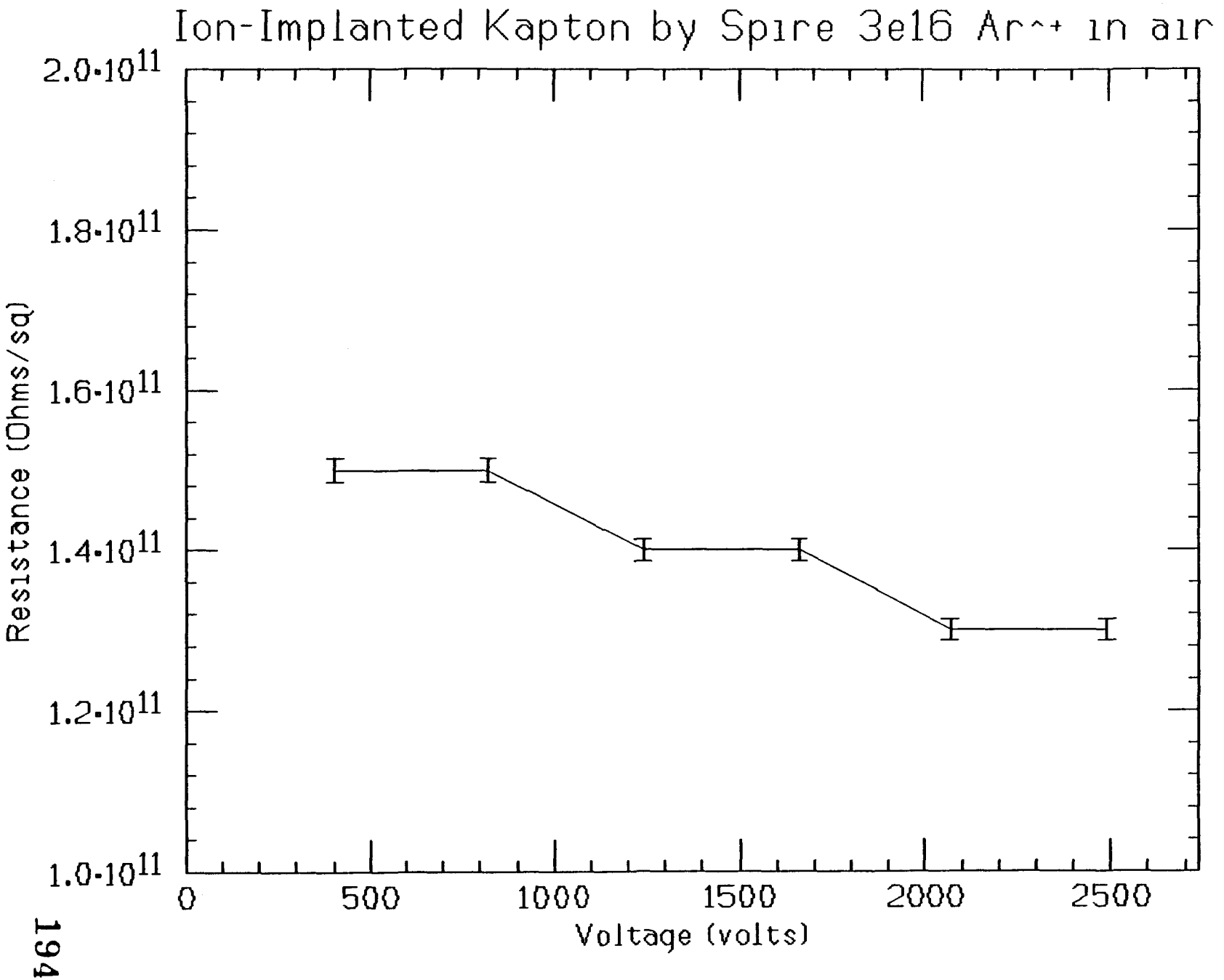

Ion-Implanted Kapton by Spire 2.3e16 Ar^+ in Nitrogen
9.0·10^9
8.0·10^9
7.0·10^9
6.0·10^9
Resistance (Ohms/sq)
0
500
1000
1500
2000
2500
Voltage (volts)

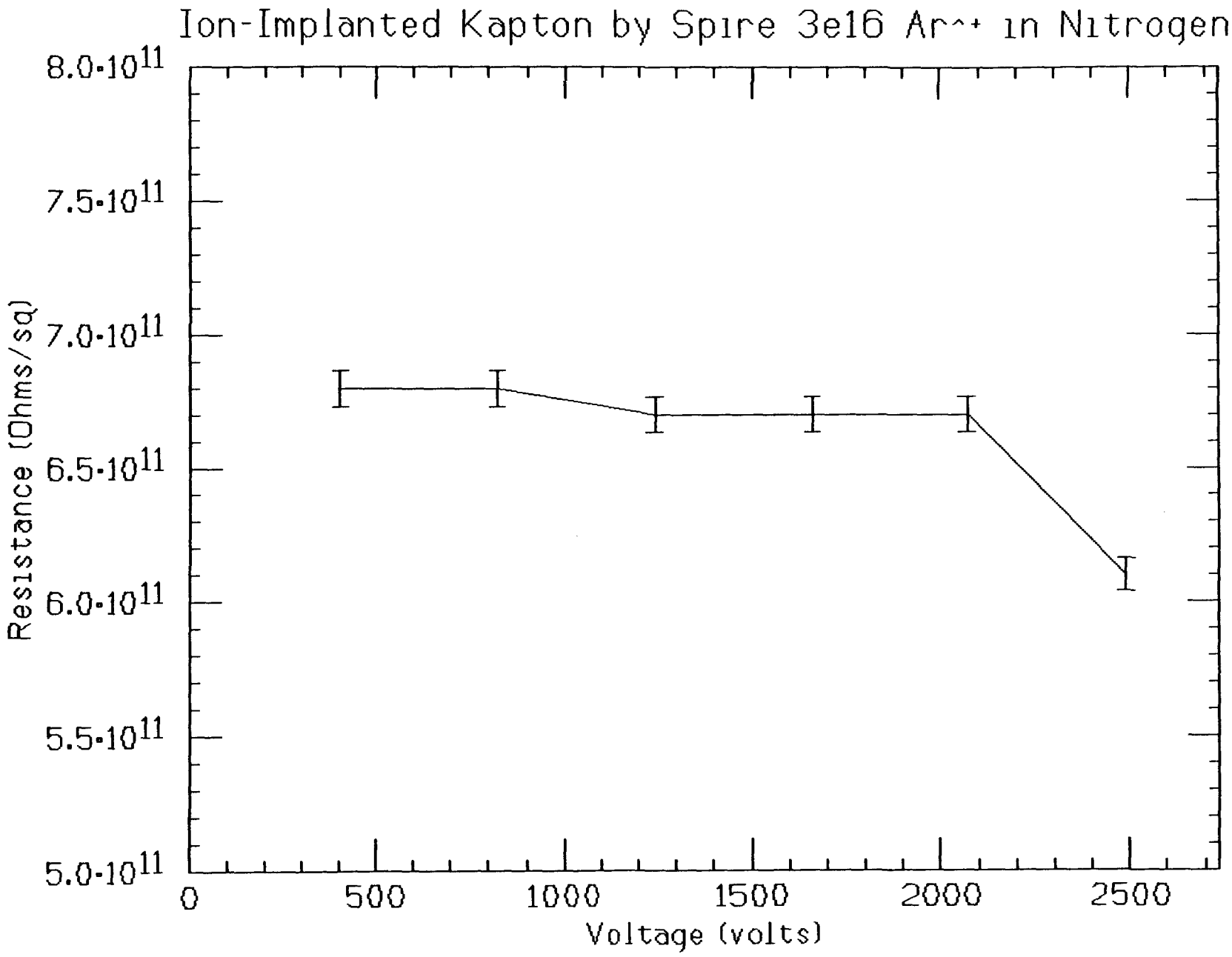
Ion-Implanted Kapton by Spire 3e16 Ar^+

$1.2\frac{\mu}{cm^2}$ 80KeV 14±1RPM 52060208.TAM

2inch electrode length **X** $\frac{1}{16}$inch gap **X** .005inch substrate thickness

Date & Time	Voltage (volts)	Current (Amps)	Resistance (Ohms/sq)	Notes & Comments
6-12-92	Tested in air			
15:58	+404	.17e-7	1.5e11	Stable
16:00	+823	.36e-7	1.5e11	
16:01	+1242	.55e-7	1.4e11	
16:02	+1661	.74e-7	1.4e11	
16:03	+2070	.97e-7	1.3e11	
16:04	+2490	1.19e-7	1.3e11	
6-12-92	Tested in UHP nitrogen			
16:38	+404	1.9e-8	6.8e11	Stable
16:39	+823	3.9e-8	6.8e11	
16:40	+1242	5.9e-8	6.7e11	
16:41	+1661	7.9e-8	6.7e11	
16:41	+2070	9.9e-8	6.7e11	
16:42	+2490	1.2e-7	6.6e11	
16:47	+2490	1.3e-7	6.1e11	


Ion-Implanted Kapton by Spire 3e16 Ar^+ in air
2.0·10^11
1.8·10^11
1.6·10^11
1.4·10^11
1.2·10^11
1.0·10^11
Resistance (Ohms/sq)
0
500
1000
1500
2000
2500
Voltage (volts)

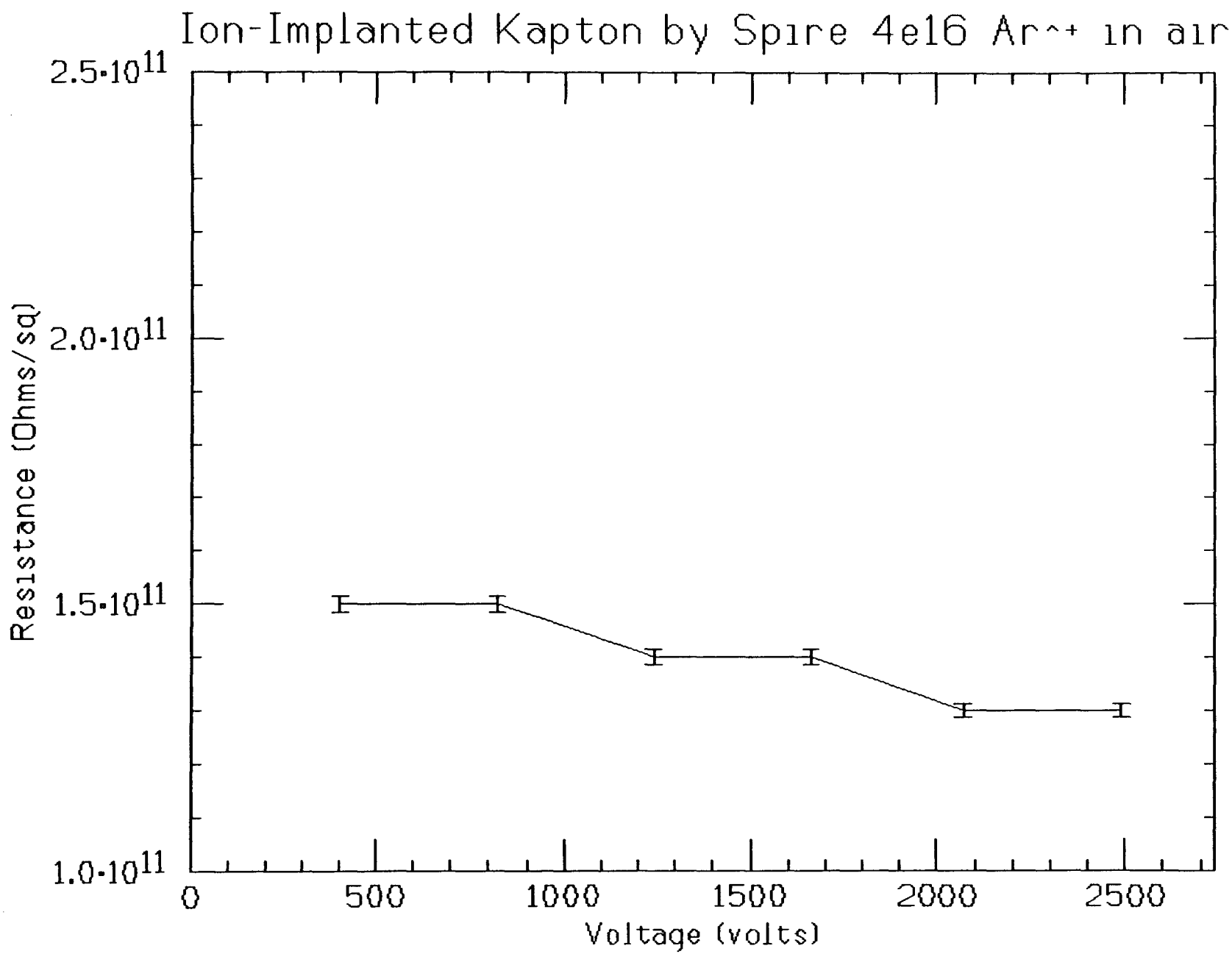

Ion-Implanted Kapton by Spire 3e16 Ar^+ in Nitrogen
8.0·10^11
7.5·10^11
7.0·10^11
6.5·10^11
6.0·10^11
5.5·10^11
5.0·10^11
Resistance (Ohms/sq)
0
500
1000
1500
2000
2500
Voltage (volts)

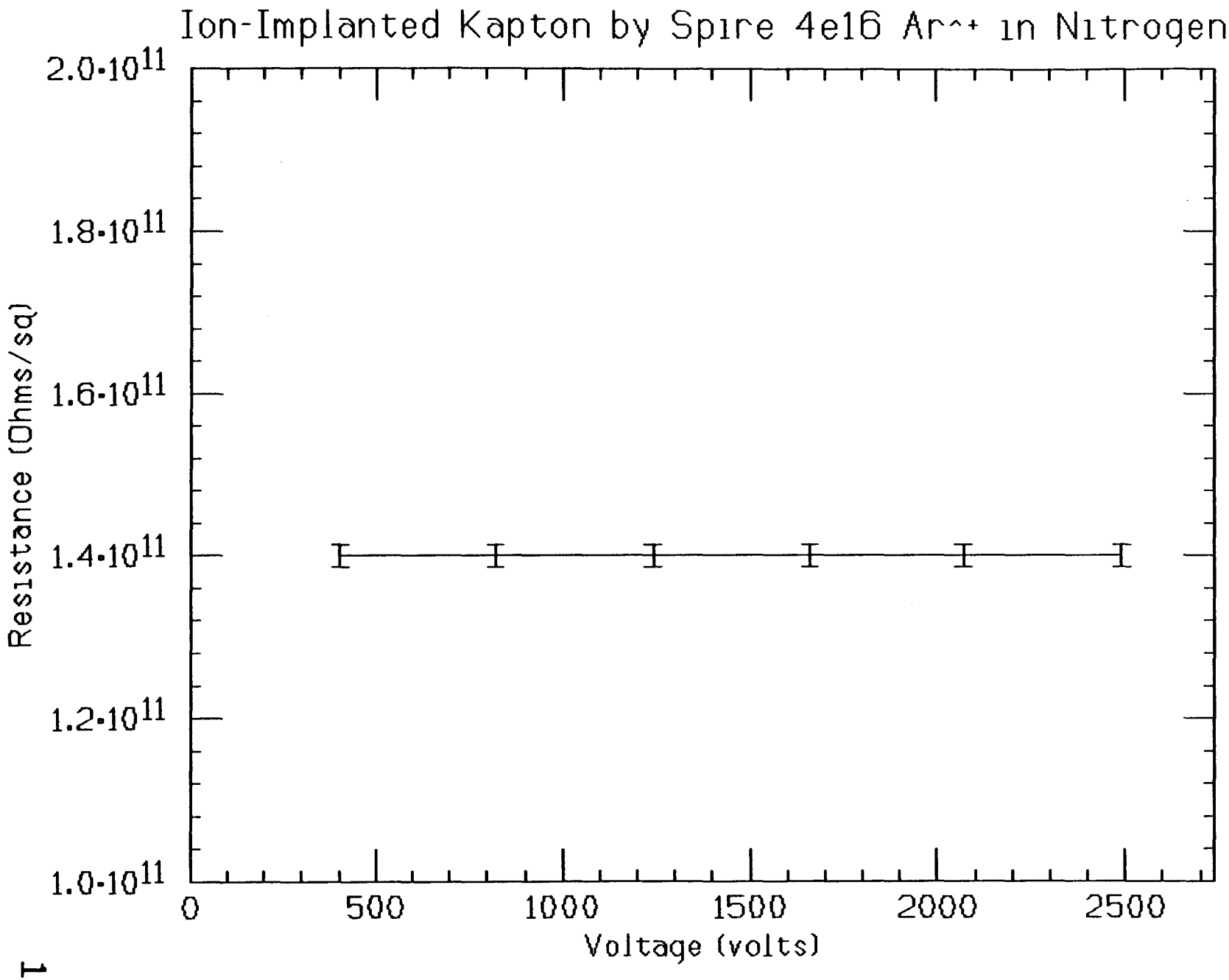
Ion-Implanted Kapton by Spire 4e16 Ar^+

$1.2\frac{\mu}{cm^2}$ 80KeV 14±1RPM 52060209.TAM

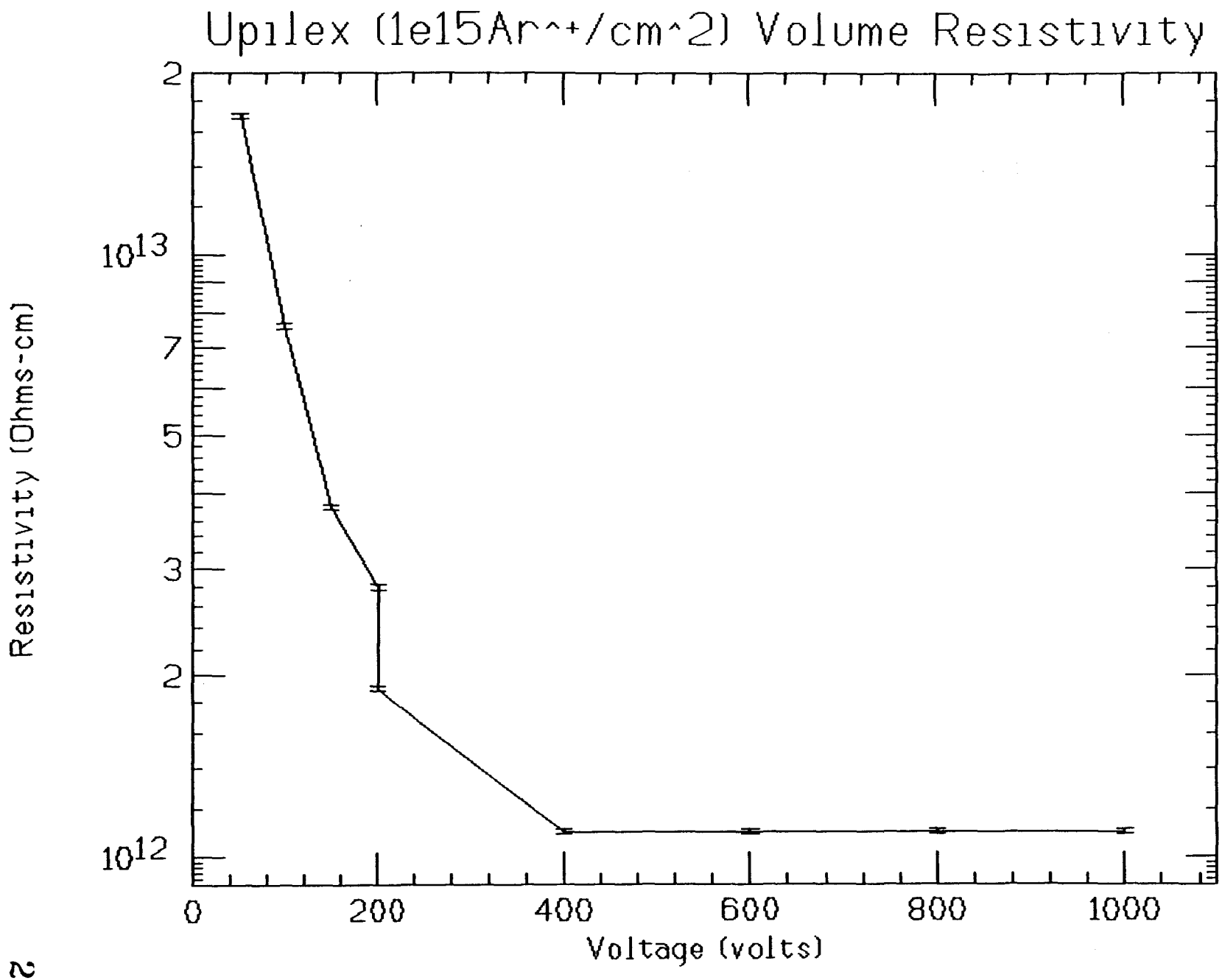
2inch electrode length X $\frac{1}{16}$inch gap X .005inch thickness

Date & Time	Voltage (volts)	Current (Amps)	Resistance (Ohms/sq)	Notes & Comments
6-12-92	Tested in air			
14:06	+404	.85e-7	1.5e11	Stable
14:07	+823	1.8e-7	1.5e11	
14:08	+1242	.28e-6	1.4e11	
14:09	+1661	.39e-6	1.4e11	
14:10	+2070	.5e-6	1.3e11	
14:11	+2490	.62e-6	1.3e11	
14:15	+2490	.614e-6	1.3e11	
6-12-92	Tested in UHP nitrogen			
14:40	+404	9e-8	1.4e11	Stable
14:41	+823	1.9e-7	1.4e11	
14:42	+1242	2.8e-7	1.4e11	
14:43	+1661	3.8e-7	1.4e11	
14:44	+2070	4.8e-7	1.4e11	
14:45	+2490	5.8e-7	1.4e11	
14:50	+2490	5.8e-7	1.4e11	

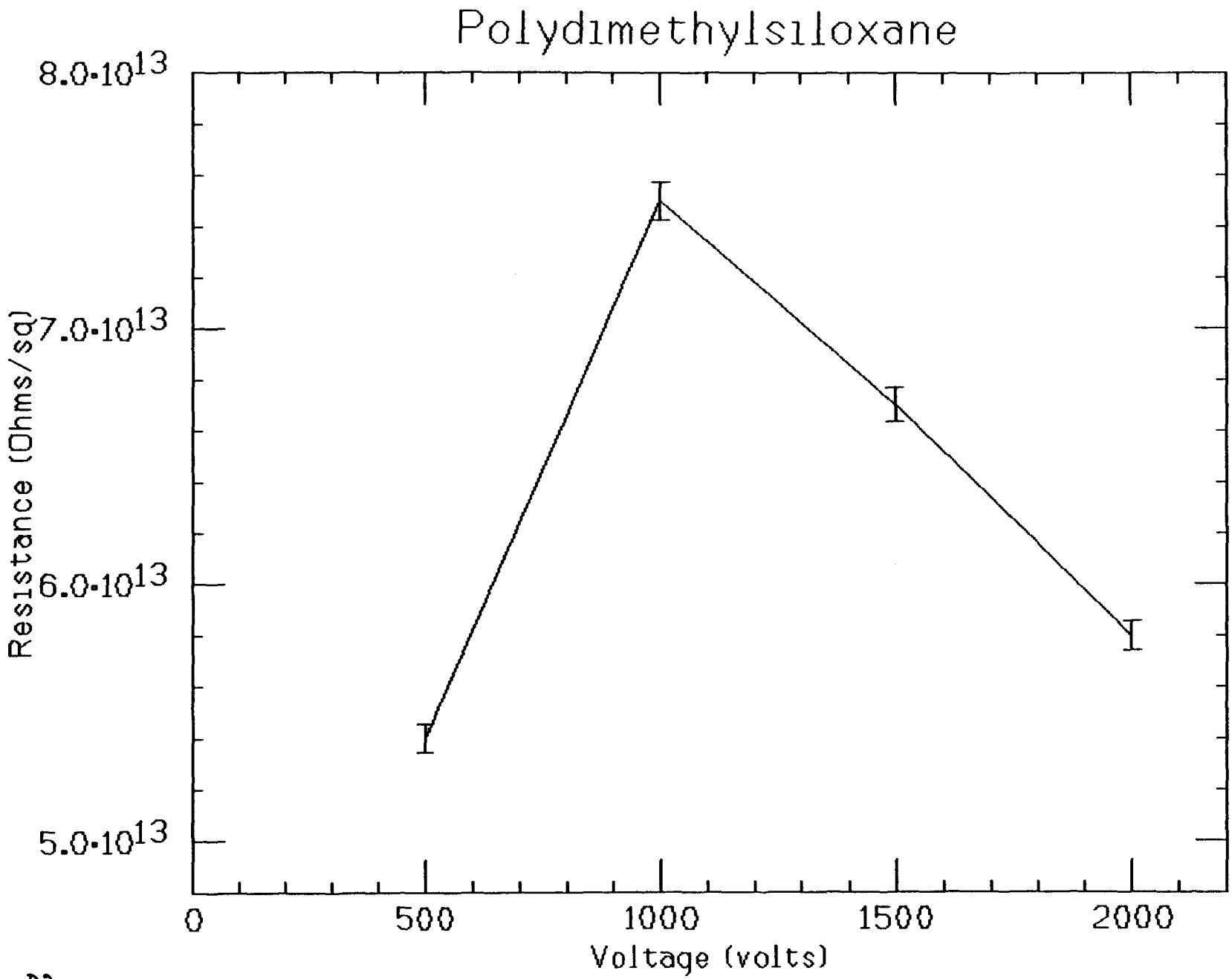

Ion-Implanted Kapton by Spire 4e16 Ar^+ in air
Resistance (Ohms/sq)
2.5·10^11
2.0·10^11
1.5·10^11
1.0·10^11
0
500
1000
1500
2000
2500
Voltage (volts)


Ion-Implanted Kapton by Spire 4e16 Ar^+ in Nitrogen
2.0·10^11
1.8·10^11
1.6·10^11
1.4·10^11
1.2·10^11
1.0·10^11
Resistance (Ohms/sq)
0
500
1000
1500
2000
2500
Voltage (volts)

Upilex Volume Test (1e15 $\frac{Ar^+}{cm^2}$) .115inch^{2}electrode area X .005inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistivity (Ohm-cm)**	**Notes & Comments**
7-6-92				
16:25	+51	1.7e-10	1.7e13	Current is jumpy
16:27	+100	7.4e-10	7.6e12	
16:29	+149	2.3e-9	3.8e12	
16:31	+201	4e-9	2.8e12	
16:32	+201	6e-9	1.9e12	
16:33	+400	2e-8	1.1e12	Current stablized
16:35	+600	3e-8	1.1e12	
16:36	+800	4e-8	1.1e12	
16:37	+1000	5e-8	1.1e12	

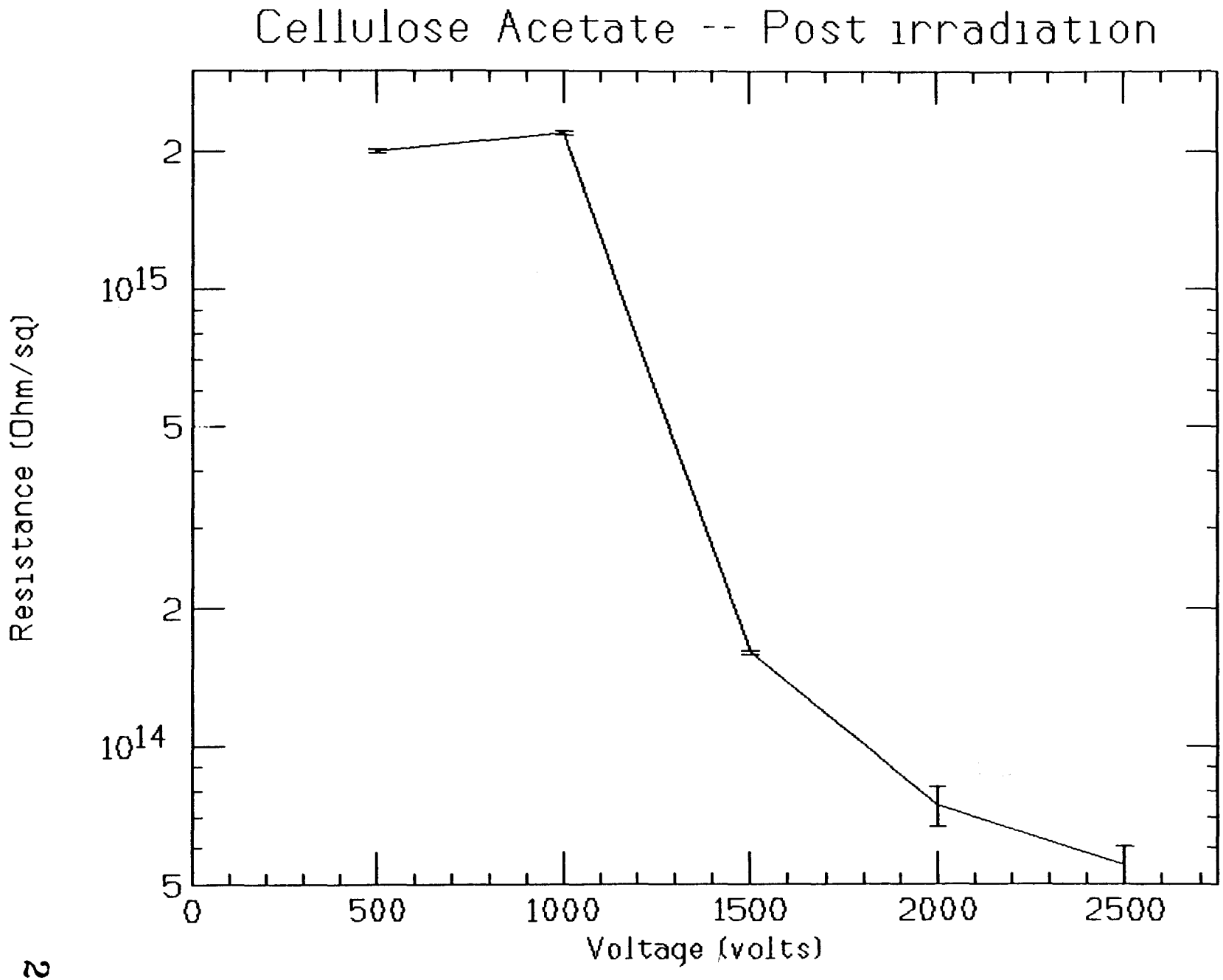

Upilex (1e15Ar^+/cm^2) Volume Resistivity
Resistivity (Ohms-cm)
2
10^13
7
5
3
2
10^12
0
200
400
600
800
1000
Voltage (volts)

Polydimethylsiloxane 2inch electrode length X $\frac{1}{16}$inch gap X $\frac{1}{8}$inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
12-6-92				
14:50	+502	3.1e-10	5.2e13	**Current decreasing**
14:55	+502	2.2e-10	5.4e13	
14:55	+1001	5.3e-10	6e13	
15:00	+1001	4.3e-10	7.5e13	
15:01	+1500	8.1e-10	5.9e13	**Signs of breakdown, ±.1e-10Amps**
15:05	+1500	7.1e-10	6.7e13	**±.1e-10Amps**
15:07	+1500	6.6e-10	7.3e13	**±.1e-10Amps**
15:08	+2000	1.2e-9	5.3e13	**±.1e-9Amps**
15:12	+2000	1.1e-9	5.8e13	**±.1e-9Amps**
15:12+	+2000+	——	——	**Unable to reach higher voltage due to sparking**

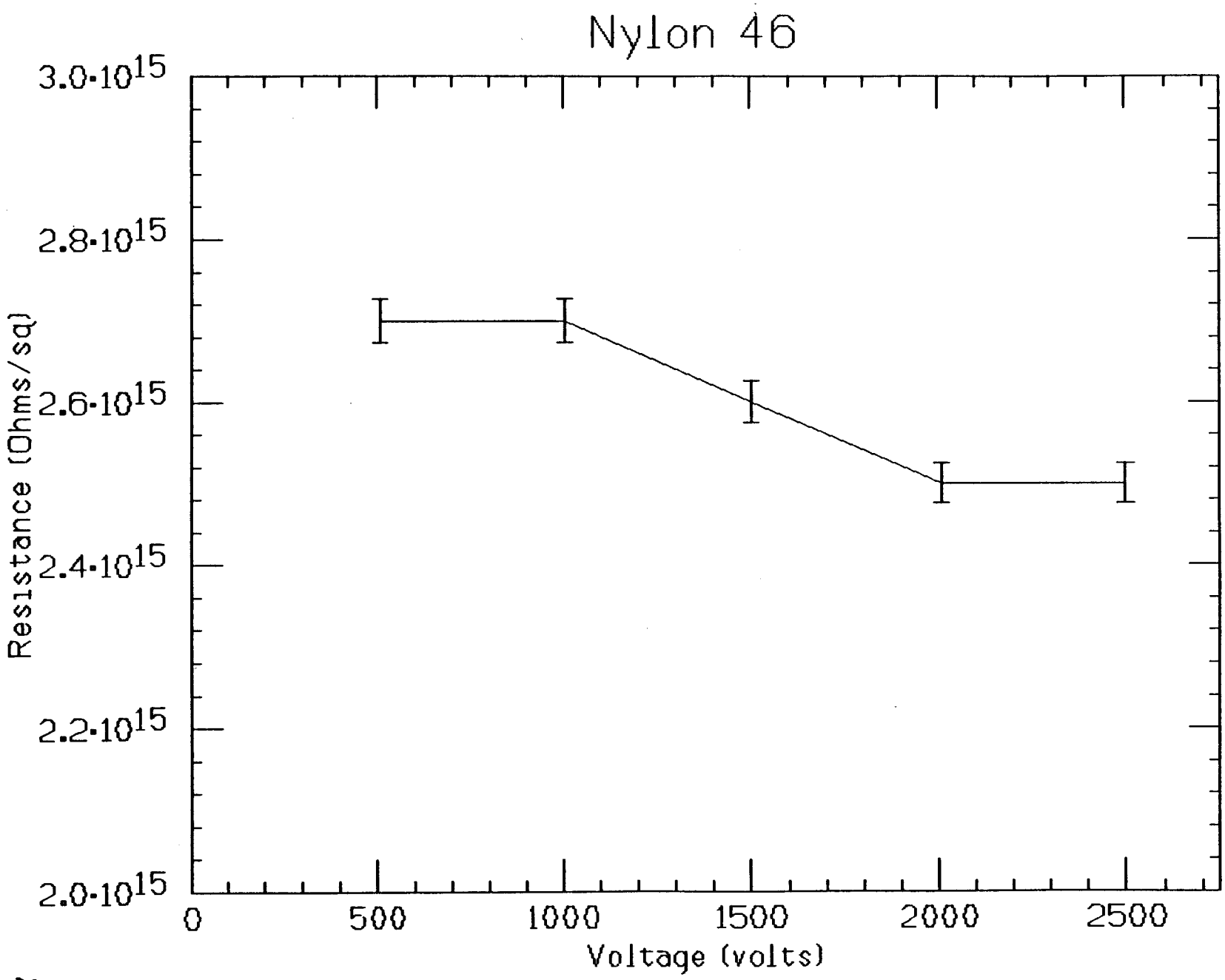

Polydimethylsiloxane
8.0·10^13
7.0·10^13
6.0·10^13
5.0·10^13
Resistance (Ohms/sq)
0
500
1000
1500
2000
Voltage (volts)

Retest after $10^{11} \frac{n}{cm^2}$ irradiation.
Cellulose Acetate
3inch electrode length **X** $\frac{1}{16}$inch gap **X** .075inch thickness

Date & Time	Voltage (volts)	Current (Amps)	Resistance (Ohms/sq)	Notes & Comments
9-22-91				
16:55	+500	1.2e-11	2e15	
17:00	+500	1.15e-11	2e15	
17:01	+1002	2.4e-11	2e15	
17:05	+1002	2.2e-11	2.2e15	
17:06	+1501	3.9e-10	1.8e14	±.2e-10Amps
17:12	+1501	4.4e-10	1.6e14	±.1e-10Amps
17:13	+2000	1.25e-9	7.6e13	±.1e-9Amps
17:15	+2000	1.3e-9	7.4e13	Current settled.
17:18	+2500	2.1e-9	5.7e13	
17:24	+2500	2.2e-9	5.5e13	


Cellulose Acetate -- Post irradiation
Resistance (Ohm/sq)
2
10^{15}
5
2
10^{14}
5
0
500
1000
1500
2000
2500
Voltage (volts)

Nylon 46 2inch electrode length X $\frac{1}{16}$inch gap X .0006inch substrate thickness				
Date & Time	**Voltage (volts)**	**Current (Amps)**	**Resistance (Ohms/sq)**	**Notes & Comments**
5-1-91				
17:44	+507	6e-12	2.7e15	
17:45	+1005	1.2e-11	2.7e15	
17:47	+1502	1.85e-11	2.6e15	
17:48	+2010	2.5e-11	2.6e15	
17:50	+2010	2.6e-11	2.5e15	
17:53	+2010	2.6e-11	2.5e15	
17:54	+2500	3.25e-11	2.5e15	


Nylon 46
3.0·10^15
2.8·10^15
2.6·10^15
2.4·10^15
2.2·10^15
2.0·10^15
Resistance (Ohms/sq)
0
500
1000
1500
2000
2500
Voltage (volts)