



Barth Electronics, Inc.  
1589 Foothill Dr.  
Boulder City, NV 89005

Jon Barth – Barth Electronics, Inc.  
John Richner – Barth Electronics, Inc.  
Eugene Worley - Qualcomm

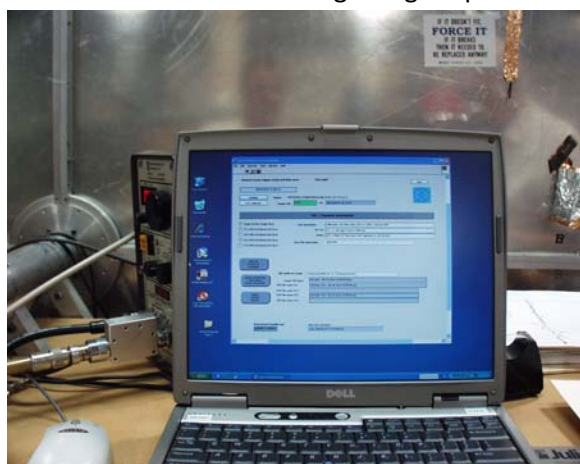
General Test Setup Details:-----



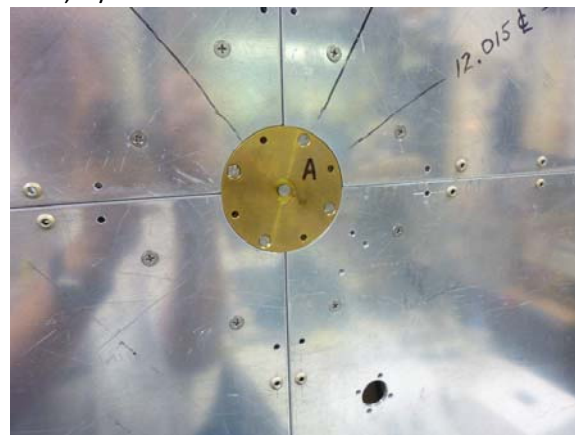
Tektronix TDS 6604 6GHz digitizing scope



E Field 14" TEM horn w/ 0.65" aperture 16.25" from center of target, +36" Semflex low loss coax, w/ BE 142-20 SN 42 10.022VR Pulse atten.



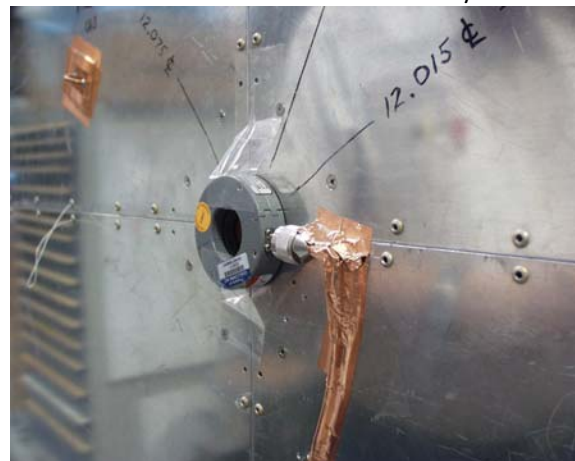
Dell Latitude 610 laptop for automated scope setup and file save control



Barth "A" target > 5GHz BW, through 36" Semflex low loss coax, w/ 40dB or 20dB Midwest atten. Probe atten. = 0.527 V/A



0.190" gap H loop through 36" Semflex low loss coax, + 10" QMI coax, with 0dB SMA atten. 12.015" from target (current probe) center to center line of sensor



Fischer model F-65 current probe, thru 8" Times 142SF coax, + 36" Semflex low loss coax, w/ 20dB HP 2.9mm atten.



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Test setup showing 2M ground plane, IEC Test bench with floor ground plane.



IEC Test bench with floor ground plane.



Capacitance measured table top to ground plane 18.9pF (w/ground resistors disconnected).

Humidity measured at 34%



Old file photo of Barth 2M round ground plane as measured by Leo G Henry



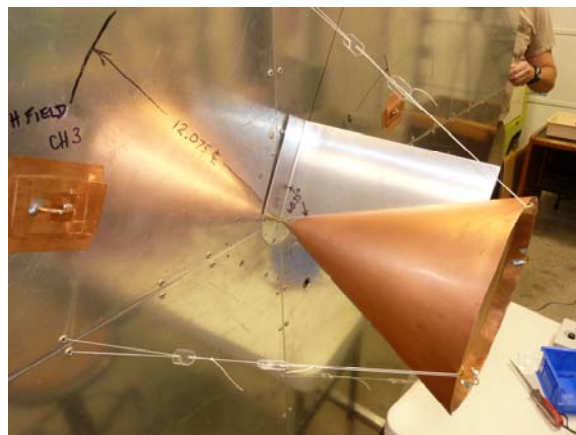
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**Calibration Setup Information, large ground plane:** -----



Barth Model 632, 50ps rise time pulse generator, 5ns pulse width, set at 500V output thru Barth 142-8, S/N 5, 2.505VR HV pulse attenuator providing 200 V pulse output from 50 ohm source into apex of 100 ohm calibration cone.



Barth 100 ohm calibration cone.

**Configuration A: Pulse Calibration w/ Cone, H loop and TEM Horn:** -----



CH1: 0.190" gap H loop through 36" Semflex low loss coax, + 10" QMI coax, w 0dB SMA atten. 12.015" from target (current probe) center to center line of sensor



CH3: E Field 14" TEM horn with 0.65" aperture, w/ BE 142-20 SN 42 10.022VR Pulse atten., through 36" Semflex low loss coax . Aperture of sensor located 16.25" from center of target.

- Cal cone 08-16-2010 10'49'31.bmp
- Cal cone Ch1 08-16-2010 10'49'31.csv
- Cal cone Ch3 08-16-2010 10'49'31.csv
- Cal cone 08-16-2010 10'56'49.bmp
- Cal cone Ch1 08-16-2010 10'56'49.csv
- Cal cone Ch3 08-16-2010 10'56'49.csv

- Cal cone 08-16-2010 11'08'56.bmp
- Cal cone Ch1 08-16-2010 11'08'56.csv
- Cal cone Ch3 08-16-2010 11'08'56.csv
- Cal cone 08-16-2010 11'11'09.bmp
- Cal cone Ch1 08-16-2010 11'11'09.csv
- Cal cone Ch3 08-16-2010 11'11'09.csv



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**Configuration B: Pulse Calibration w/ Cone, H loop and Current sensor: -----**



CH1: 0.190" gap H loop through 36" Semflex low loss coax, + 10" QMI coax, w 0dB SMA atten. 12.015" from target (current probe) center to center line of sensor



CH3: Fischer current probe, thru 8" times 142SF coax, + 36" Semflex low loss coax, w/ 20dB HP 2.9mm Total Ch3 Atten. = 1.0 V/A

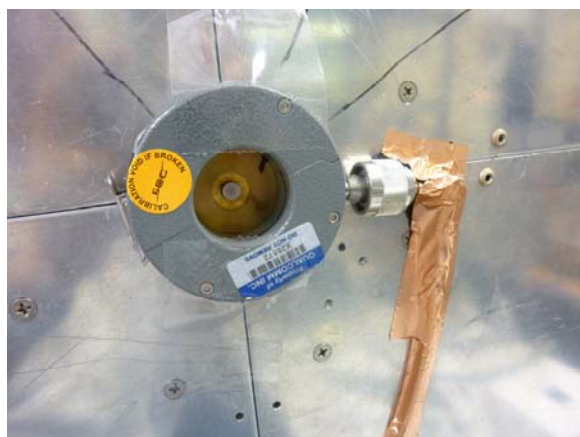
- Cal cone 08-16-2010 11'56'26.bmp
- Cal cone Ch1 08-16-2010 11'56'26.csv
- Cal cone Ch3 08-16-2010 11'56'26.csv
- Cal cone 08-16-2010 11'58'03.bmp
- Cal cone Ch1 08-16-2010 11'58'03.csv
- Cal cone Ch3 08-16-2010 11'58'03.csv
- Cal cone 08-16-2010 11'59'14.bmp
- Cal cone Ch1 08-16-2010 11'59'14.csv
- Cal cone Ch3 08-16-2010 11'59'14.csv

- Cal cone 08-16-2010 12'00'09.bmp
- Cal cone Ch1 08-16-2010 12'00'09.csv
- Cal cone Ch3 08-16-2010 12'00'09.csv

w/ cu tape added to hole in GND plane with coax from probe:

- Cal cone 08-16-2010 12'02'40.bmp
- Cal cone Ch1 08-16-2010 12'02'40.csv
- Cal cone Ch3 08-16-2010 12'02'40.csv

**Configuration C: Air Discharge Test, Current sensor measurement comparison: -----**



CH1: Barth "A" target bw > 5GHz, through 36" Semflex low loss coax, w/ 40dB Midwest atten. Total Ch1 Atten = 0.00527V/A

CH3: Fischer current probe, thru 8" times 142SF coax, + 36" Semflex low loss coax, w/ 20dB HP 2.9mm Total Ch3 Atten. = 0.1 V/A



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**Schaffner NG 438**



Schaffner model NSG 438 gun set at various test voltages

**8Kv Air Discharge (8 pulse average)**

NSG 438 08-16-2010 12'29'10.bmp  
 NSG 438 Ch1 08-16-2010 12'29'10.csv  
 NSG 438 Ch3 08-16-2010 12'29'10.csv  
 NSG 438 08-16-2010 12'31'28.bmp  
 NSG 438 Ch1 08-16-2010 12'31'28.csv  
 NSG 438 Ch3 08-16-2010 12'31'28.csv

**Configuration D: Air Discharge Test, Current sensor measurement comparison: -----**

CH1: Barth "A" target bw > 5GHz, through 36" Semflex low loss coax, w/ 20dB Midwest atten.  
 Total Ch1 Atten = 0.0527V/A (Attenuation reduced 20 dB from previous configuration)

CH3: Fischer current probe, thru 8" times 142SF coax, + 36" Semflex low loss coax, w/ 20dB HP 2.9mm  
 Total Ch3 Atten. = 0.1 V/A

**8Kv Air Discharge (8 pulse average)**

NSG 438 08-16-2010 12'34'26.bmp  
 NSG 438 Ch1 08-16-2010 12'34'26.csv  
 NSG 438 Ch3 08-16-2010 12'34'26.csv  
 NSG 438 08-16-2010 12'43'11.bmp  
 NSG 438 Ch1 08-16-2010 12'43'11.csv  
 NSG 438 Ch3 08-16-2010 12'43'11.csv

**12kv Air Discharge (8 pulse average)**

NSG 438 08-16-2010 12'46'24.bmp  
 NSG 438 Ch1 08-16-2010 12'46'24.csv  
 NSG 438 Ch3 08-16-2010 12'46'24.csv

**6kv Air Discharge (8 pulse average)**

NSG 438 08-16-2010 12'49'30.bmp  
 NSG 438 Ch1 08-16-2010 12'49'30.csv  
 NSG 438 Ch3 08-16-2010 12'49'30.csv

**6kv Air Discharge (single pulse)**

NSG 438 08-16-2010 12'51'19.bmp  
 NSG 438 Ch1 08-16-2010 12'51'19.csv  
 NSG 438 Ch3 08-16-2010 12'51'19.csv

**NSG 438 08-16-2010 12'53'10.bmp**

NSG 438 Ch1 08-16-2010 12'53'10.csv  
 NSG 438 Ch3 08-16-2010 12'53'10.csv

NSG 438 08-16-2010 12'59'54.bmp  
 NSG 438 Ch1 08-16-2010 12'59'54.csv  
 NSG 438 Ch3 08-16-2010 12'59'54.csv  
 NSG 438 08-16-2010 13'01'07.bmp  
 NSG 438 Ch1 08-16-2010 13'01'07.csv  
 NSG 438 Ch3 08-16-2010 13'01'07.csv

**8kv Air Discharge (single pulse)**

NSG 438 08-16-2010 13'02'00.bmp  
 NSG 438 Ch1 08-16-2010 13'02'00.csv  
 NSG 438 Ch3 08-16-2010 13'02'00.csv  
 NSG 438 08-16-2010 13'02'42.bmp  
 NSG 438 Ch1 08-16-2010 13'02'42.csv  
 NSG 438 Ch3 08-16-2010 13'02'42.csv  
 NSG 438 08-16-2010 13'04'21.bmp  
 NSG 438 Ch1 08-16-2010 13'04'21.csv  
 NSG 438 Ch3 08-16-2010 13'04'21.csv  
 NSG 438 08-16-2010 13'06'14.bmp  
 NSG 438 Ch1 08-16-2010 13'06'14.csv  
 NSG 438 Ch3 08-16-2010 13'06'14.csv

**12kv Air Discharge (single pulse)**

NSG 438 08-16-2010 13'09'37.bmp  
 NSG 438 Ch1 08-16-2010 13'09'37.csv  
 NSG 438 Ch3 08-16-2010 13'09'37.csv



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NSG 438 08-16-2010 13'15'00.bmp  
NSG 438 Ch1 08-16-2010 13'15'00.csv  
NSG 438 Ch3 08-16-2010 13'15'00.csv

**4kv Air Discharge (single pulse)**

NSG 438 08-16-2010 13'16'36.bmp  
NSG 438 Ch1 08-16-2010 13'16'36.csv  
NSG 438 Ch3 08-16-2010 13'16'36.csv  
NSG 438 08-16-2010 13'17'20.bmp  
NSG 438 Ch1 08-16-2010 13'17'20.csv  
NSG 438 Ch3 08-16-2010 13'17'20.csv  
NSG 438 08-16-2010 13'18'00.bmp

NSG 438 Ch1 08-16-2010 13'18'00.csv  
NSG 438 Ch3 08-16-2010 13'18'00.csv  
NSG 438 08-16-2010 13'18'31.bmp  
NSG 438 Ch1 08-16-2010 13'18'31.csv  
NSG 438 Ch3 08-16-2010 13'18'31.csv  
NSG 438 08-16-2010 13'19'48.bmp  
NSG 438 Ch1 08-16-2010 13'19'48.csv  
NSG 438 Ch3 08-16-2010 13'19'48.csv

**Keytek Minizap Air Discharge**



Thermo-Keytek Minizap model gun set at various test voltages

Minizap 08-16-2010 13'26'33.bmp  
Minizap Ch1 08-16-2010 13'26'33.csv  
Minizap Ch3 08-16-2010 13'26'33.csv  
Minizap 08-16-2010 13'27'41.bmp  
Minizap Ch1 08-16-2010 13'27'41.csv  
Minizap Ch3 08-16-2010 13'27'41.csv  
Minizap 08-16-2010 13'28'18.bmp  
Minizap Ch1 08-16-2010 13'28'18.csv  
Minizap Ch3 08-16-2010 13'28'18.csv

**8kv Air Discharge (single pulse)**

Minizap 08-16-2010 13'29'30.bmp  
Minizap Ch1 08-16-2010 13'29'30.csv  
Minizap Ch3 08-16-2010 13'29'30.csv  
Minizap 08-16-2010 13'30'03.bmp  
Minizap Ch1 08-16-2010 13'30'03.csv  
Minizap Ch3 08-16-2010 13'30'03.csv

**4kv Air Discharge (single pulse)**

Minizap 08-16-2010 13'24'58.bmp  
Minizap Ch1 08-16-2010 13'24'58.csv  
Minizap Ch3 08-16-2010 13'24'58.csv  
Minizap 08-16-2010 13'25'41.bmp  
Minizap Ch1 08-16-2010 13'25'41.csv  
Minizap Ch3 08-16-2010 13'25'41.csv

**12kv Air Discharge (single pulse)**

Minizap 08-16-2010 13'30'48.bmp  
Minizap Ch1 08-16-2010 13'30'48.csv  
Minizap Ch3 08-16-2010 13'30'48.csv  
Minizap 08-16-2010 13'32'09.bmp  
Minizap Ch1 08-16-2010 13'32'09.csv  
Minizap Ch3 08-16-2010 13'32'09.csv

**Configuration E: Air Discharge, Current + Radiation measurement, large ground plane:-----**

CH1: Barth "A" target bw > 5GHz, through 36" Semflex low loss coax, w/ 20dB Midwest atten.  
Total Ch1 Atten = 0.0527V/A

CH3: 0.190" gap H loop through 36" Semflex low loss coax, + 10" QMI coax, w 0dB SMA atten. 12.015" from target (current probe) center to center line of sensor

**Keytek Minizap Air Discharge:****12kv Air Discharge (single pulse)**

Minizap 08-16-2010 13'41'26.bmp  
 Minizap Ch1 08-16-2010 13'41'26.csv  
 Minizap Ch3 08-16-2010 13'41'26.csv  
 Minizap 08-16-2010 13'42'42.bmp  
 Minizap Ch1 08-16-2010 13'42'42.csv  
 Minizap Ch3 08-16-2010 13'42'42.csv

**Schaffner NG 438 Air Discharge:****16kv Air Discharge (single pulse)**

NSG 438 08-16-2010 13'47'18.bmp  
 NSG 438 Ch1 08-16-2010 13'47'18.csv  
 NSG 438 Ch3 08-16-2010 13'47'18.csv  
 NSG 438 08-16-2010 13'47'52.bmp  
 NSG 438 Ch1 08-16-2010 13'47'52.csv  
 NSG 438 Ch3 08-16-2010 13'47'52.csv

**Keytek Minizap Air Discharge:****12kv Air Discharge (single pulse)**

Minizap 08-16-2010 13'52'52.bmp  
 Minizap Ch1 08-16-2010 13'52'52.csv  
 Minizap Ch3 08-16-2010 13'52'52.csv  
 Minizap 08-16-2010 13'54'03.bmp  
 Minizap Ch1 08-16-2010 13'54'03.csv  
 Minizap Ch3 08-16-2010 13'54'03.csv

**Schaffner NG 438 Air Discharge:****8kv Air Discharge (single pulse)**

NSG 438 08-16-2010 13'57'46.bmp  
 NSG 438 Ch1 08-16-2010 13'57'46.csv  
 NSG 438 Ch3 08-16-2010 13'57'46.csv  
 NSG 438 08-16-2010 13'59'08.bmp  
 NSG 438 Ch1 08-16-2010 13'59'08.csv  
 NSG 438 Ch3 08-16-2010 13'59'08.csv

**Keytek Minizap Air Discharge:****8kv Air Discharge (single pulse)**

Minizap 08-16-2010 14'01'47.bmp  
 Minizap Ch1 08-16-2010 14'01'47.csv  
 Minizap Ch3 08-16-2010 14'01'47.csv

**Schaffner NG 438 Air Discharge:****4kv Air Discharge (single pulse)**

NSG 438 08-16-2010 14'05'21.bmp  
 NSG 438 Ch1 08-16-2010 14'05'21.csv  
 NSG 438 Ch3 08-16-2010 14'05'21.csv

**16kv Air Discharge (single pulse)**

Minizap 08-16-2010 13'44'00.bmp  
 Minizap Ch1 08-16-2010 13'44'00.csv  
 Minizap Ch3 08-16-2010 13'44'00.csv

**12kv Air Discharge (single pulse)**

NSG 438 08-16-2010 13'49'22.bmp  
 NSG 438 Ch1 08-16-2010 13'49'22.csv  
 NSG 438 Ch3 08-16-2010 13'49'22.csv  
 NSG 438 08-16-2010 13'50'35.bmp  
 NSG 438 Ch1 08-16-2010 13'50'35.csv  
 NSG 438 Ch3 08-16-2010 13'50'35.csv

Minizap 08-16-2010 13'54'58.bmp  
 Minizap Ch1 08-16-2010 13'54'58.csv  
 Minizap Ch3 08-16-2010 13'54'58.csv

**8kv Air Discharge (single pulse)**

Minizap 08-16-2010 13'55'57.bmp  
 Minizap Ch1 08-16-2010 13'55'57.csv  
 Minizap Ch3 08-16-2010 13'55'57.csv

NSG 438 08-16-2010 14'00'36.bmp  
 NSG 438 Ch1 08-16-2010 14'00'36.csv  
 NSG 438 Ch3 08-16-2010 14'00'36.csv

**4kv Air Discharge (single pulse)**

Minizap 08-16-2010 14'03'41.bmp  
 Minizap Ch1 08-16-2010 14'03'41.csv  
 Minizap Ch3 08-16-2010 14'03'41.csv  
 Minizap 08-16-2010 14'04'22.bmp  
 Minizap Ch1 08-16-2010 14'04'22.csv  
 Minizap Ch3 08-16-2010 14'04'22.csv

NSG 438 08-16-2010 14'05'55.bmp  
 NSG 438 Ch1 08-16-2010 14'05'55.csv  
 NSG 438 Ch3 08-16-2010 14'05'55.csv



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**Configuration F: Contact Discharge, + Radiation measurement, large ground plane: -----**

CH1: Barth "A" target bw > 5GHz, through 36" Semflex low loss coax, w/ 20dB Midwest atten.  
Total Ch1 Atten = 0.0527V/A

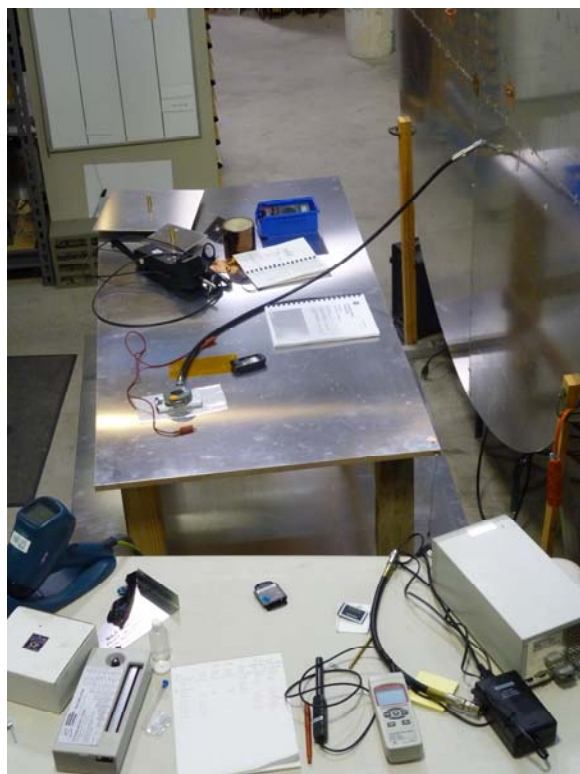
CH3: 0.190" gap H loop through 36" Semflex low loss coax, + 10" QMI coax, w 20dB SMA atten.

**Schaffner NG 438 Air Discharge:**

**8kvContact Discharge (single pulse)**

- NSG 438 08-16-2010 16'05'26.bmp
  - NSG 438 Ch1 08-16-2010 16'05'26.csv
  - NSG 438 Ch3 08-16-2010 16'05'26.csv
- NSG 438 08-16-2010 16'07'48.bmp
  - NSG 438 Ch1 08-16-2010 16'07'48.csv
  - NSG 438 Ch3 08-16-2010 16'07'48.csv
- NSG 438 08-16-2010 16'08'27.bmp
  - NSG 438 Ch1 08-16-2010 16'08'27.csv
  - NSG 438 Ch3 08-16-2010 16'08'27.csv

**Configuration G: Cell Phone Discharges, ESD Table, Current measurement:-----**



CH1: Fischer model F-65 current probe, thru  
48" Rg-214 coax + 36" Semflex low loss coax, w/  
20dB HP 2.9mm atten.  
Total Ch1 Atten. = 0.1 V/A

CH3: N/A

**-----Small Phone Contact -----**

**Schaffner NG 438 Contact Discharge:**

**8kv Contact Discharge (single pulse)**

- NSG 438 08-16-2010 16'34'05.bmp
  - NSG 438 Ch1 08-16-2010 16'34'05.csv





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**Keytek Minizap Contact Discharge:**



Small phone to gnd capacitance measured 21pF

**8kv Contact Discharge (single pulse)**

minizap 08-16-2010 16'49'20.bmp  
minizap Ch1 08-16-2010 16'49'20.csv

minizap 08-16-2010 16'50'21.bmp  
minizap Ch1 08-16-2010 16'50'21.csv

-----Small Phone Air:-----

**Keytek Minizap Air Discharge:**

**8kv Air Discharge (single pulse)**  
minizap 08-16-2010 16'53'01.bmp  
minizap Ch1 08-16-2010 16'53'01.csv

**Schaffner NG 438 Air Discharge:**

**8kv Air Discharge (single pulse)**  
NSG 438 08-16-2010 16'56'03.bmp  
NSG 438 Ch1 08-16-2010 16'56'03.csv

-----Large Phone Air:-----



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**Schaffner NG 438 Air Discharge:**



Large phone to gnd capacitance measured  
132pF

**8kv Air Discharge (single pulse)**

NSG 438 08-16-2010 17'09'38.bmp  
NSG 438 Ch1 08-16-2010 17'09'38.csv  
NSG 438 08-16-2010 17'10'31.bmp  
NSG 438 Ch1 08-16-2010 17'10'31.csv

NSG 438 08-16-2010 17'11'18.bmp  
NSG 438 Ch1 08-16-2010 17'11'18.csv

-----**Small Phone Air:**-----

**Schaffner NG 438 Air Discharge:**

**8kv Air Discharge (single pulse)**

NSG 438 08-16-2010 17'12'32.bmp  
NSG 438 Ch1 08-16-2010 17'12'32.csv

NSG 438 08-16-2010 17'14'37.bmp  
NSG 438 Ch1 08-16-2010 17'14'37.csv

**Keytek Minizap Air Discharge:**

**8kv Air Discharge (single pulse)**

Minizap 08-16-2010 17'16'09.bmp  
Minizap Ch1 08-16-2010 17'16'09.csv

Minizap 08-16-2010 17'17'24.bmp  
Minizap Ch1 08-16-2010 17'17'24.csv

-----**Large Phone Air:**-----

**Keytek Minizap Air Discharge:**

**8kv Air Discharge (single pulse)**

Minizap 08-16-2010 17'18'53.bmp  
Minizap Ch1 08-16-2010 17'18'53.csv

Minizap 08-16-2010 17'20'34.bmp  
Minizap Ch1 08-16-2010 17'20'34.csv



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**Keytek Minizap Air Discharge:**

**12kv Air Discharge (single pulse)**

Minizap 08-16-2010 17'29'42.bmp  
Minizap Ch1 08-16-2010 17'29'42.csv  
Minizap 08-16-2010 17'32'33.bmp  
Minizap Ch1 08-16-2010 17'32'33.csv

Minizap 08-16-2010 17'34'13.bmp  
Minizap Ch1 08-16-2010 17'34'13.csv

**Schaffner NG 438 Air Discharge:**

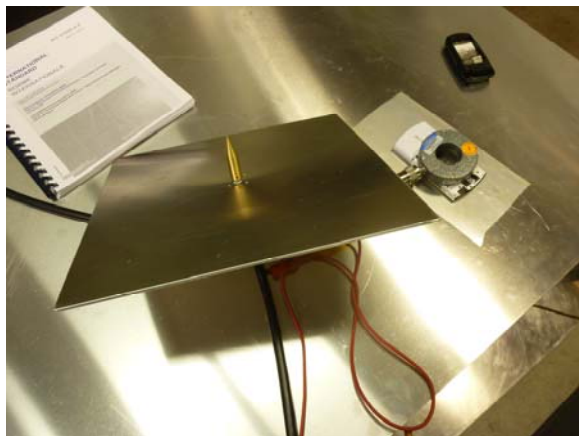
**12kv Air Discharge (single pulse)**

NSG 438 08-16-2010 17'41'51.bmp  
NSG 438 Ch1 08-16-2010 17'41'51.csv

NSG 438 08-16-2010 17'42'53.bmp  
NSG 438 Ch1 08-16-2010 17'42'53.csv

-----Large Phone Contact:-----

**Barth 4702 Contact Discharge:**



**12kv Contact Discharge (single pulse)**

Barth 4702 08-16-2010 18'04'34.bmp  
Barth 4702 Ch1 08-16-2010 18'04'34.csv