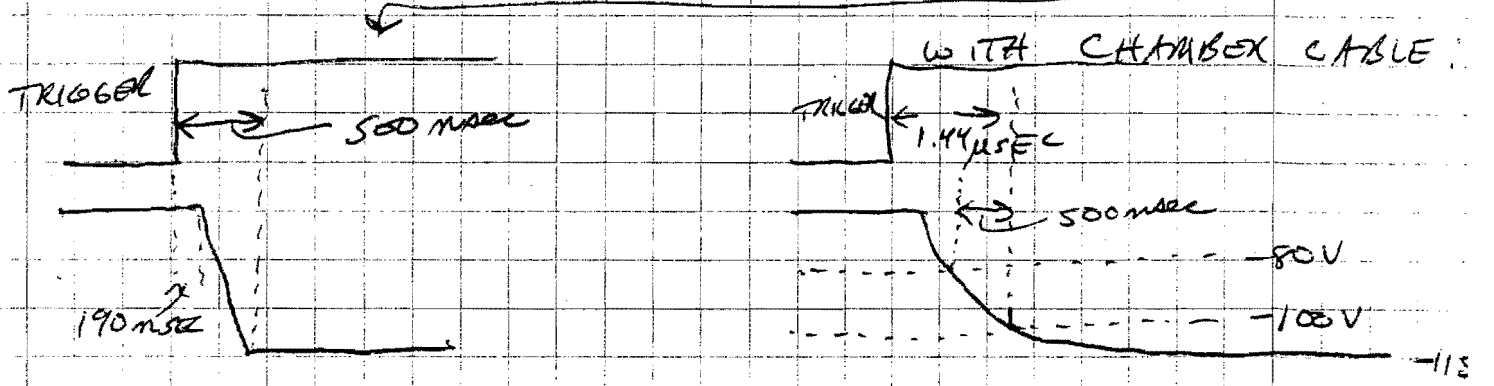
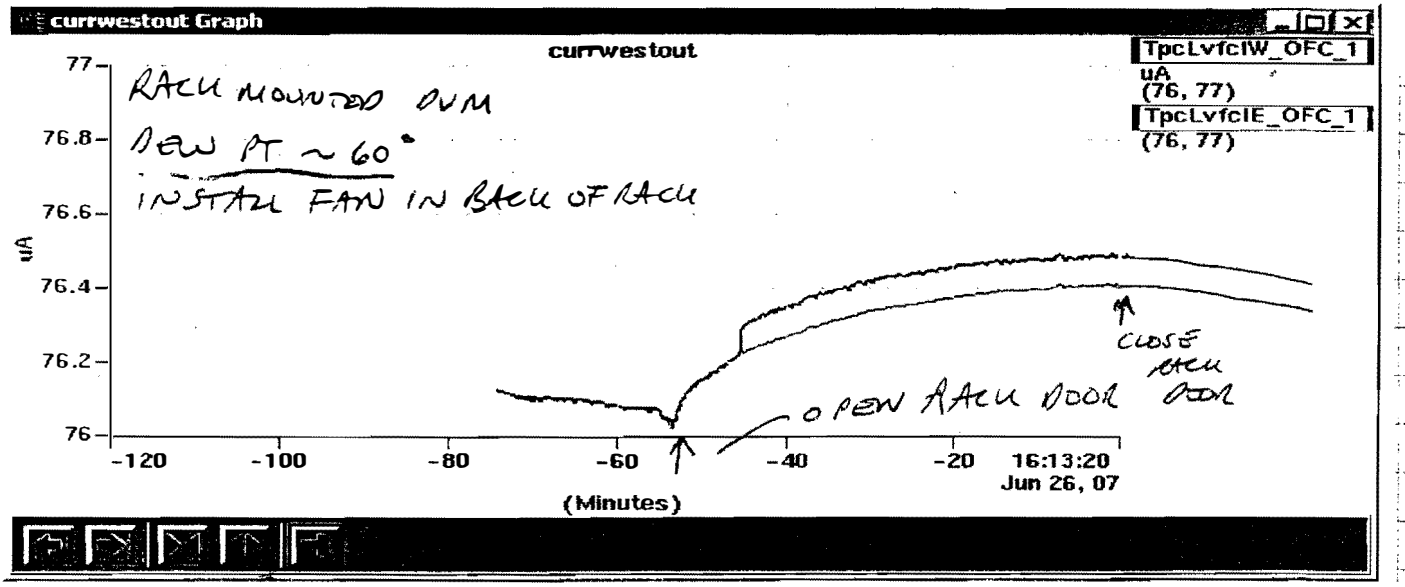
USE BREAK OUT BOX IN RACK TO SEE REAL V.
USE 10X PROBE, 10 MΩ TERMINATION

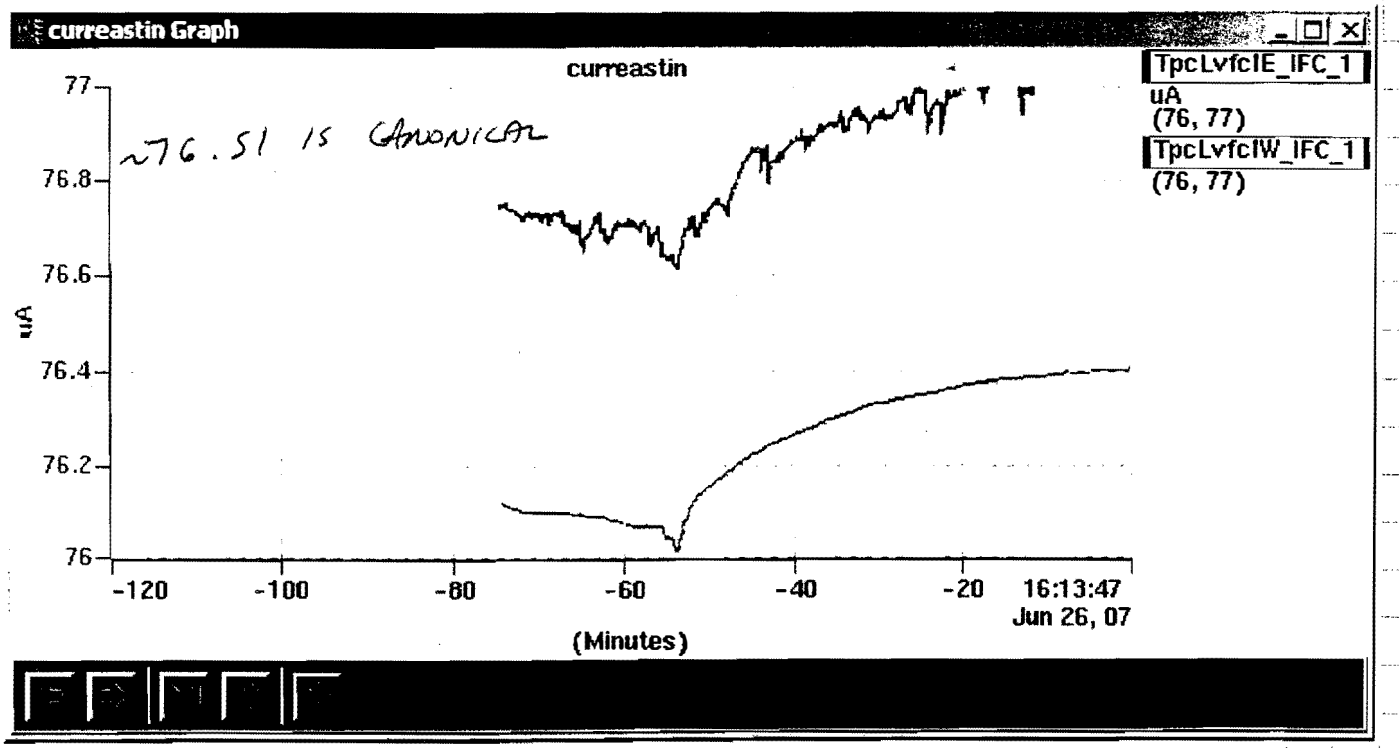
II - 21

WITH CHAMBER CABLE NOT ATTACHED)





07



CH6 @ 500V .471 – .481 .305
TRIP @ 1040

CH7 @ 500V .469 – .481 .306
TRIP @

0/98 1600) N_2 PURGE STARTED – 2 BROKEN SECTORS REPLACED – S
INNER+OUTER WEST 12 O'CLOCK SECTOR SHORT TO STRIPE
TEST ALL SECTORS (~~WEST~~) @ 200 V

((Tested new spark gaps prior to installation on field cag
nominal 600 V gaps ~~tripped at~~ 560 – 630 volts
selected 4 [606, 625, 612, 582]

1700) FIND ONE SECTION NOT DRAWING CURRENT S4 #5

FIRST FIND CABLES MISLABELED S4#5 AND S4#8
RELABEL @ TPC END.

REPLACE PIGTAIL + LONG HV CABLE – S4#5 STILL NO
ON RAMP UP
SWAP PS AT DISTRIBUTION BOX – STAYS WITH S4#5.

STOP N_2 PURGE + GO HOME ....

1/98) 0900 – INVESTIGATE S4#5 SOME MORE – MEASURE
CAP ETC. SWAP WITH S3#5 – NOW SEEMS
RESTORE ALL ORIGINAL CABLES – STILL ON. SO – ?

9LS) (INSTALL NEW SPARK GAPS. 600 V GAPS INSTALLED FR
STRIPES 181 + 182 TO GROUND ON EAST + WEST END OF OFC

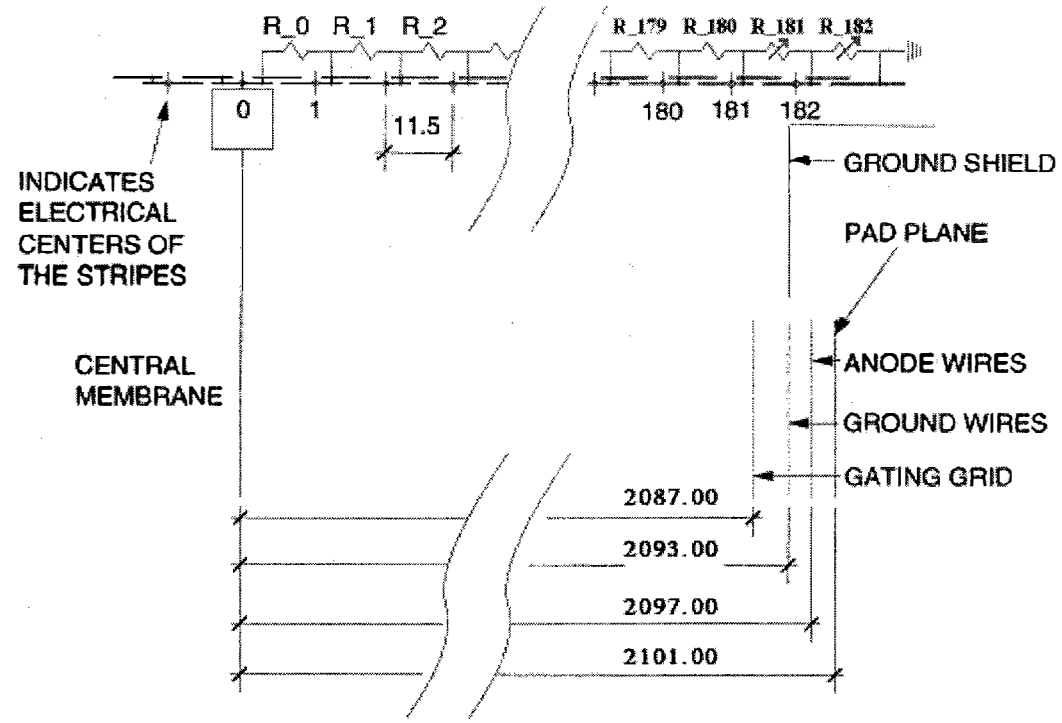
7/98) 0945 BCS TPC SEALED + BAD SECTORS REPLACED. PIO IN
TURN ON WEST SECTORS 1–12

0950	500 V		
055	800 V		
110	1000 V	INNER	1200 V OUTER
1300	1100 V		1300
1330	1150		1400

2030 1.1.18 TRIP) Tripped or previously disabled, not

Tuning the Voltage Divider

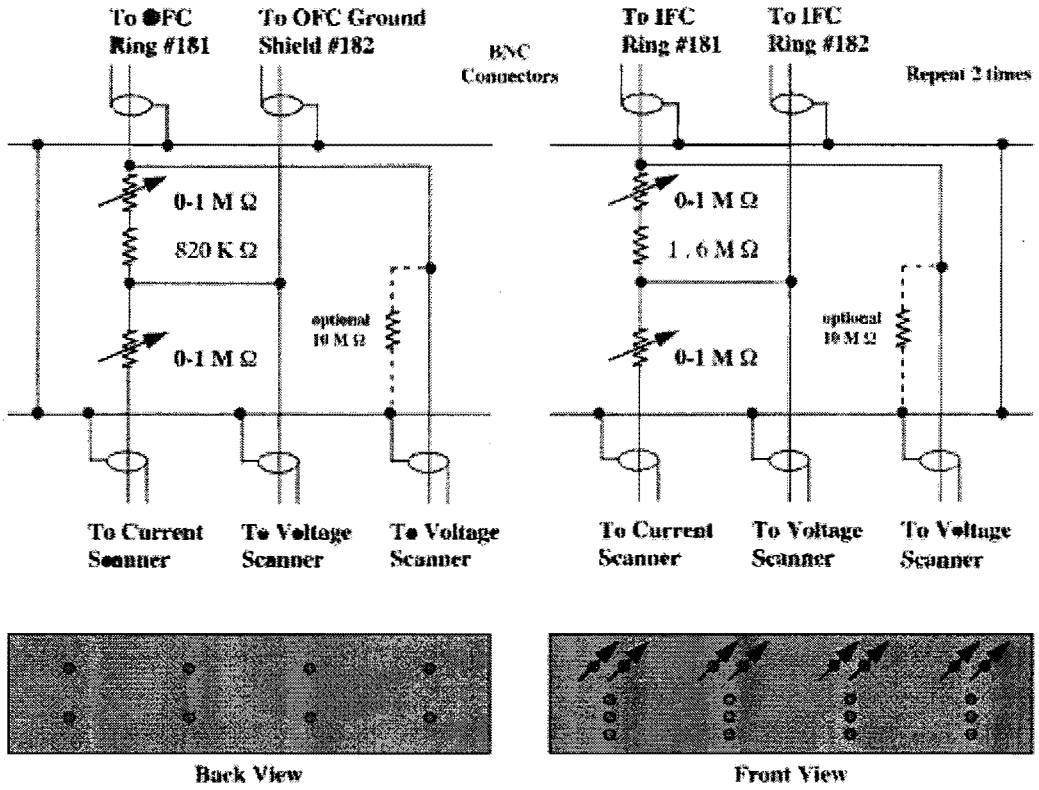
The TPC field cage defines a uniform electric field between the central membrane and the gating grid near the pad plane. The terminus of the field region is the gating grid (and not the anode wires, ground wires, or pad plane) because we are not interested in drifting electrons inside the anode sector. Either we are trying to regulate the drift with the gate or we are trying to drift and amplify the signal near the anode wires. These actions require electric fields bigger than the drift field. However, the TPC field cage extends beyond the gating grid in the region outside the anode sector and we do want the uniform field to continue in this region to prevent distortions of the tracks at the sector boundary. Resistors 181 and 182 set the voltage on the last two field cage rings and they must be tuned to achieve this goal.



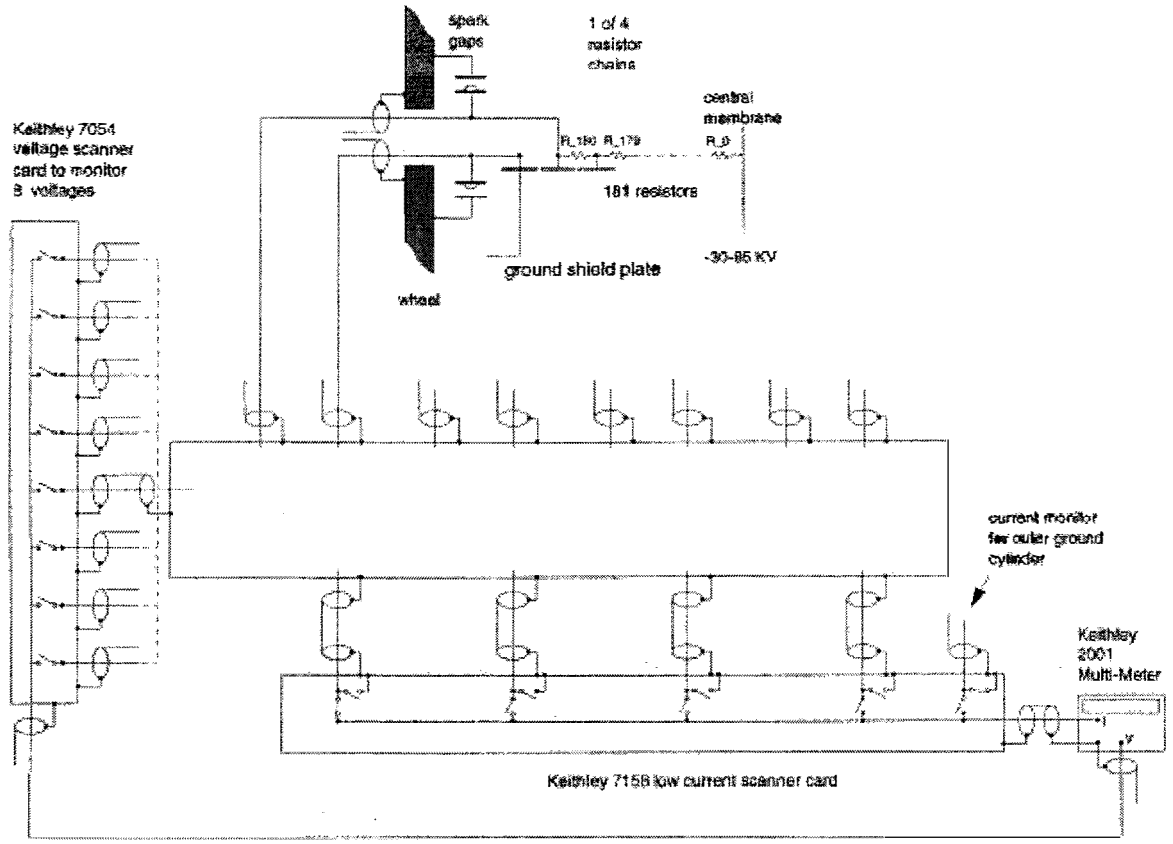
The resistor chains are different for the outer field cage and the inner field cage. The outer field cage has a "ground shield" attached to ring 182 and the shield is lined up with the "ground wires" in the anode sector. This prevents the shield from being located at the center of the ring and requires us to set the ring at the correct voltage for the ground shield rather than its own natural setting. Accomplishing this requires tuning both resistors.

The inner field cage does not have a "ground shield" and resistor 181 is just one more step in the resistor chain. It keeps its normal value of 2 M ohms while resistor 182 is trimmed to bring the field to ground potential. Ring 182 is not necessarily set to an integral multiple of ring-to-ring voltage steps above true ground because the gating grid, which determines the overall drift field, is set independently and its value is determined by the transparency of the grid and other external factors. (See the next page).

So in order to easily adjust resistors 181 and 182, they have been removed from the TPC and installed in an external rack.



The resistor chain terminates in a scanning current meter so we can monitor the currents running down each chain. This is a useful diagnostic for helping to find short circuits in the voltage divider system. A scanning voltmeter also monitors the voltage on ring 181 and 182 to ensure that they are set properly.



To determine the setting on the variable resistors, let:

$Z_{gg} - Z_{cm}$ = the distance between the gating grid and the central membrane
$V_{gg} - V_{cm}$ = voltage on the gating grid minus the voltage on the central membrane

The drift field is then simply:

(1) $E_{drift} = (V_{gg} - V_{cm}) / (Z_{gg} - Z_{cm})$

The field cage is built of rings with equal spacing between the rings. This is true for all ring-to-ring gaps except for the gap between the central membrane and the first ring. It is slightly wider. In order to keep a uniform field gradient at the central membrane, the first resistor (R_0) must be slightly larger to represent the wider gap.

(2) $R_0 = Z_{01} * (R_1 / Z_{12})$

As long as R_0 is chosen this way, the voltage and resistances are well defined functions of Z in the region between the gating grid and the central membrane.

(3) $R(Z) = (Z - Z_{cm}) * (R_1 / Z_{12})$
(4) $V(Z) = E_{drift} * (Z - Z_{cm}) + V_{cm}$

Extending these equations to zero voltage will tell us the total resistance in the chain. Thus,

(5) $R_T = (V_{cm} / E_{drift}) * (R_1 / Z_{12})$

This is enough information to calculate the settings on the variable resistors R_{181} and R_{182}. There are several known quantities:

E_{drift} = 146.5 V/cm for P10 gas, chosen to be over the peak in the velocity curve (eg. see previous page)
V_{gg} = -125 V chosen to make the grid 100% transparent, see next page
R_1 = 2 M Ohms
Z_{gg} = 208.7 cm
Z_{cm} = 0.0 cm
Z_{01} = 1.225 cm
Z_{12} = 1.15 cm
Z_{gs} = 209.3 cm

From (1) V_{cm} = -30,700 Volts
From (2) R_0 = 2.130 M Ohms
From (5) R_T = 364.440 M Ohms

Since there are 180 identical resistors in the chain plus R_0, R_{181}, and R_{182} this means that

$R_{181} + R_{182} = R_T - R_0 - 180 * 2 \text{ M Ohms} = 2.310 \text{ M Ohms}$

In the special case of the inner field cage where there is no ground shield

R_{181} = 2 M Ohms
R_{182} = 310 K Ohms

R_T is the same for the outer field cage but it is split differently between R_{181} and R_{182} because the ground shield is partway between the center of rings 181 and 182 and we want to bias ring 182 so that the ground shield is at the correct voltage rather than the ring. We can easily calculate these values using equations (3) and (4).

$R_{gs} = (Z_{gs} - Z_{cm}) * (R_1 / Z_{12}) = 364.000$ M Ohms
$V_{gs} = E_{drift} * (Z_{gs} - Z_{cm}) + V_{cm} = -37.5$ Volts

R_{gs} is the total resistance between the central membrane and the ground shield and to make better sense of this number we should subract off the fixed resistor values. Thus in the special case of the outer field cage

$R_{181} = R_{gs} - R_0 - 180 * 2 \text{ M Ohms} = 1.870 \text{ M Ohms}$
$R_{182} = R_T - R_0 - 180 * 2 \text{ M Ohms} - R_{181} = 440 \text{ K Ohms}$

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