

Fermilab

$\bar{p}$  NOTE #441

Debuncher Kicker Studies

12/23/85

Ralph Pasquinelli

## DEBUNCHER KICKER STUDIES

A measurement program to improve the match between Debuncher TWT's and kicker tanks was completed in December of 1985. Debuncher tanks, kicker brackets & TWT power splitting circuits were measured in a test set up in the MRRF building. All electrical connections are identical to the tunnel environment.

$S_{11}$  measurements show that matching over a broad band would be quite difficult due to the many wavelengths between the TWT & kicker termination resistors. Multistub tuners are capable of matching <sup>ALMOST</sup> any impedance to  $50 \Omega$  but only over a narrow band of frequencies. Figures 1 & 2 show best & worst case TWT load impedance for the Tank measured. The worst case system has a return loss of 11.7 dB using broadband noise techniques. In actual testing, the TWT's were

(2)

operated in excess of 140 watts for a period of 24 hours before proceeding to the next test. FIGURE 3

The last test performed was driving one kicker bracket with one TWT at a power level of 150 watts. After 72 hours of running there was no noticeable degradation in performance. This power level corresponds to approx 9 watts per terminating resistor. (They are rated at 10 WATTS) Kicker bracket temperature was  $53^{\circ}\text{C}$ , Kicker bracket resistances were 12.8-13  $\Omega$ . Figures 4 & 5 are before and after  $S_{11}$  measurements on the Kicker Bracket. S11.

(3)

## CONCLUSIONS

Kicker to TWT match is about as good as it will ever be and that's not too bad. Tube output power can easily be increased to 120 watts/TWT.

This level is approximately 3dB higher than the power levels during the Fall 1985  $\bar{p}$  run.

One major improvement will be the addition of water cooled heatsinks for the Hybrids mounted on the TWT. After a 24 hour running period @ 140 watts, the uncooled Hybrid temp was  $84^{\circ}\text{C}$  while the water cooled Hybrid remained @  $37^{\circ}\text{C}$ . Room temp for the test was  $22^{\circ}\text{C}$  & Water Temp  $25^{\circ}\text{C}$ .

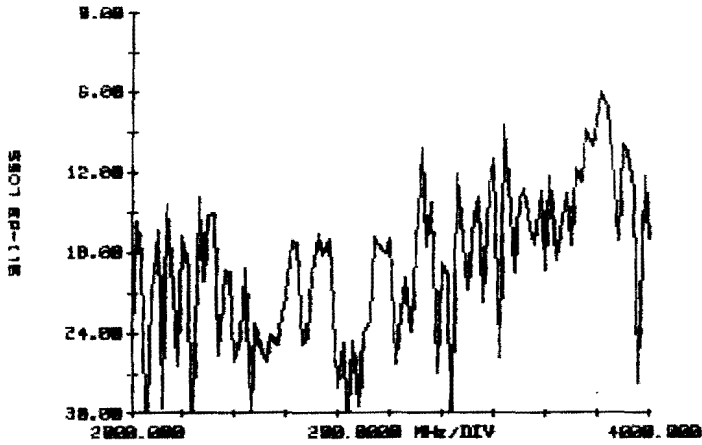
Tunnel temperatures during the  $\bar{p}$  run were typically  $38-40^{\circ}\text{C}$ . The max operating temp for the Hybrids is  $+85^{\circ}\text{C}$ . This temperature may easily have been exceeded in the tunnel which could explain the three Hybrid failures that occurred during the run.

START= 2000.0000 STOP= 4000.0000 STEP= 20.00000  
18 Dec 1985 09:04:26  
TUBE A: HYBRID TO 2 KICKER BRACKETS

20.00000

P20-H1-142

TUBE R: HYBRID TO 2 KICKER BRACKETS



TWT LOAD S11

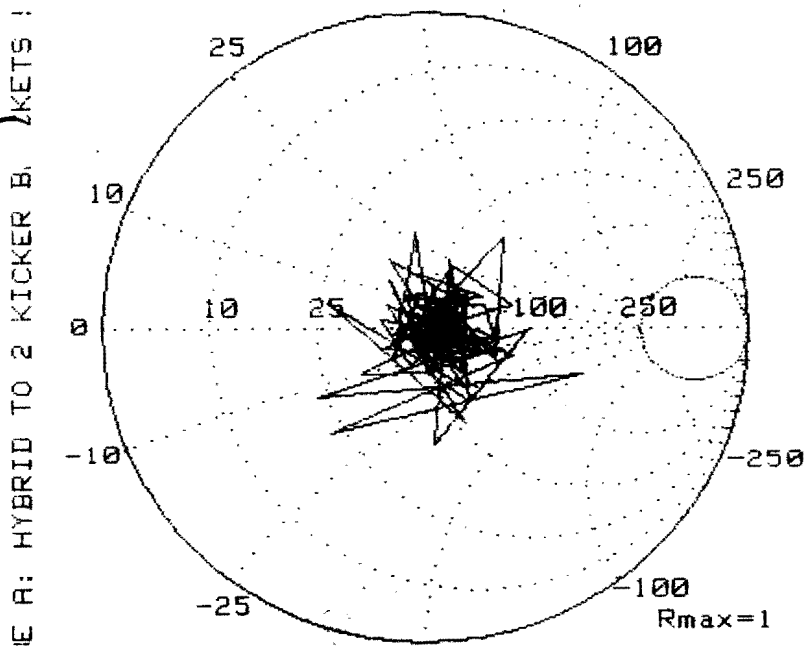


FIGURE 1

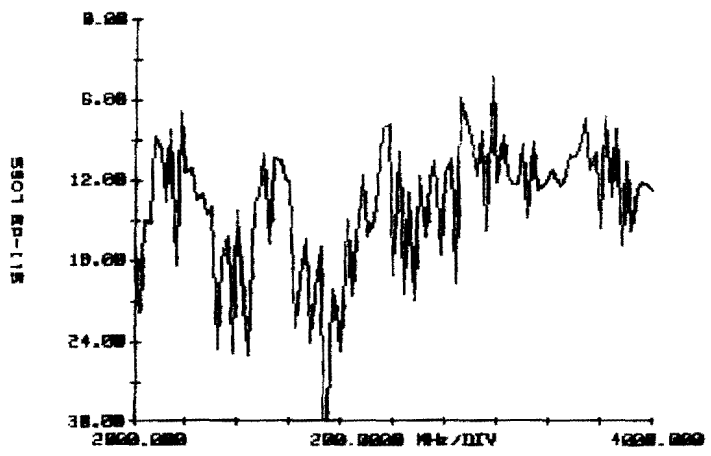
START= 2000.00000 STOP= 4000.00000 STEP= 20.00000

18 Dec 1985 09:08:23

TUBE B: HYBRID TO 2 KICKER BRACKETS D20-H1-3&4

Hot Hybrid

TUBE B: HYBRID TO 2 KICKER BRACKETS D20-H1-3&4



TWT LOAD S11

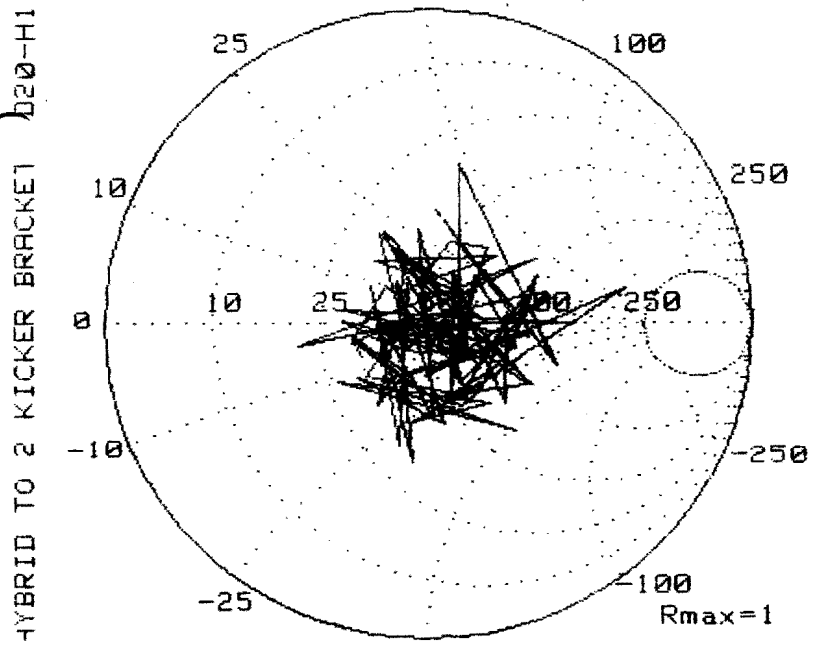
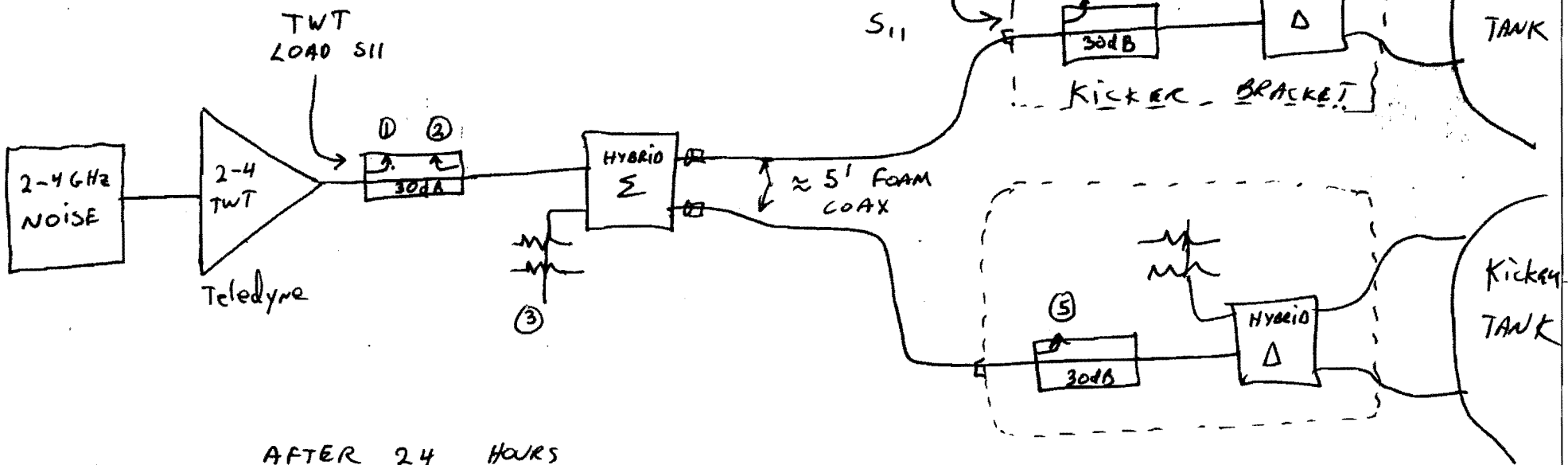


FIGURE 2

TWT to Resistor time  $\approx 10\text{NS}$



AFTER 24 HOURS  
POWER LEVELS (WATTS)

TEST POINT	TUBE A BEST $\Sigma$ HYBRID	TUBE B WORST $\Sigma$ HYBRID
①	143	162
②	7	11
③	4	8
④	56	81
⑤	65	53

ALL  
KICKER  
TANK  
DC  
RESISTANCES  
12.8 to 13 $\Omega$

$$S_{11A} = \left| 10 \log \frac{7}{143} \right| = 13\text{dB}$$

$$S_{11B} = \left| 10 \log \frac{11}{162} \right| = 11.7\text{dB}$$

HYBRID  
TEMP  $37^\circ\text{C}$   
24 hours WATER

$84^\circ\text{C}$

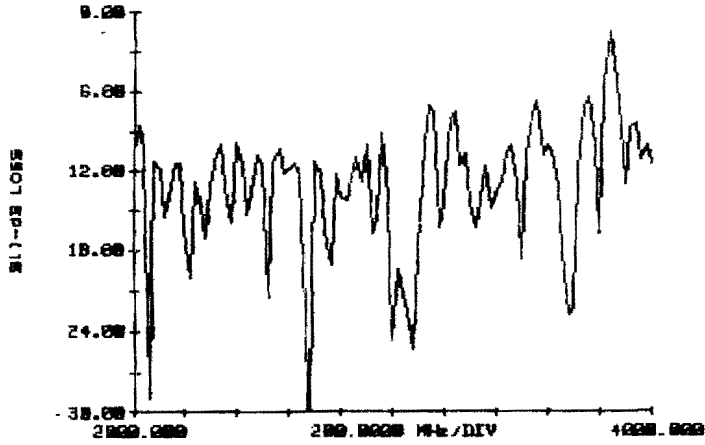
FIGURE 3

START= 2000.0000 STOP= 4000.0000 STEP= 20.0000

18 Dec 1985 09:18:10

TUBE B: KICKER BRACKET D20-H1-3

TUBE B: KICKER BRACKET D20-H1-3 AFTER 120 WATTS



KICKER BRACKET S<sub>11</sub>  
BEFORE 150 WATT  
TEST

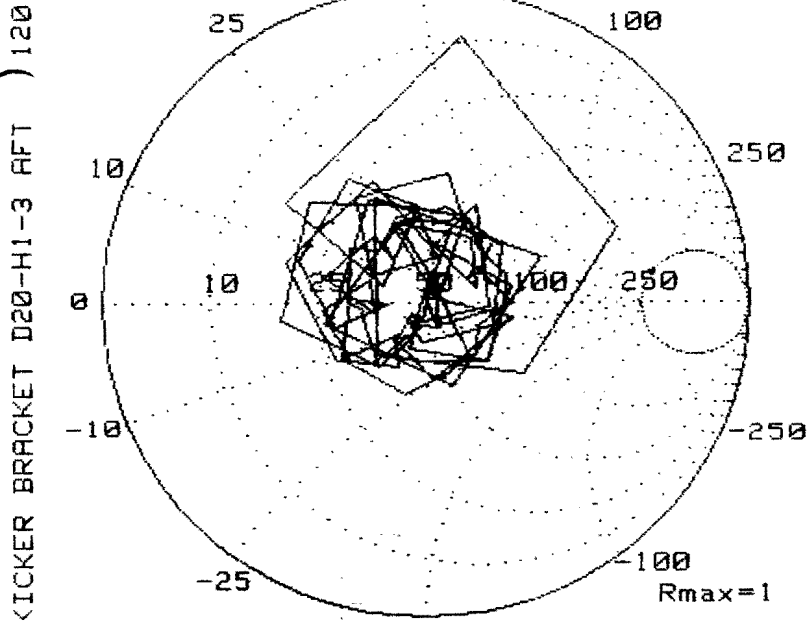


FIGURE 4

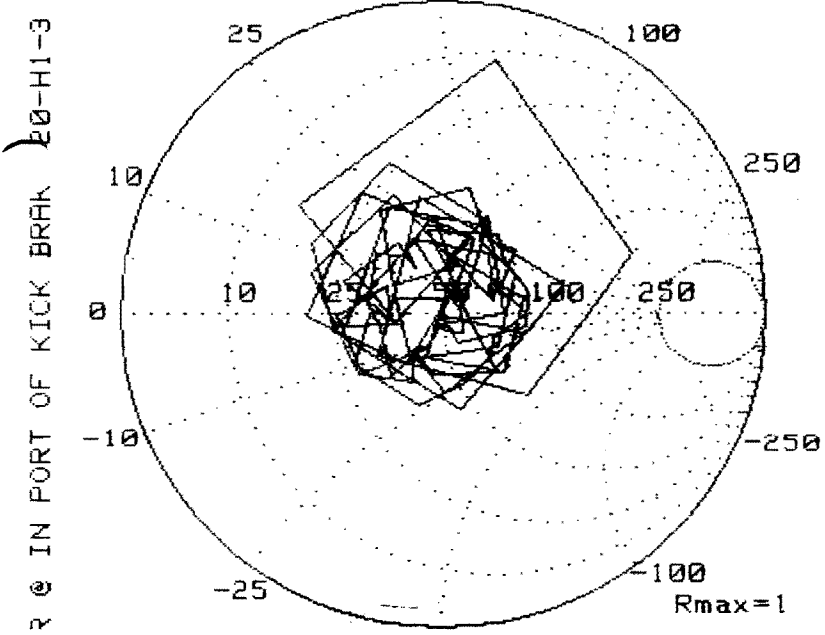
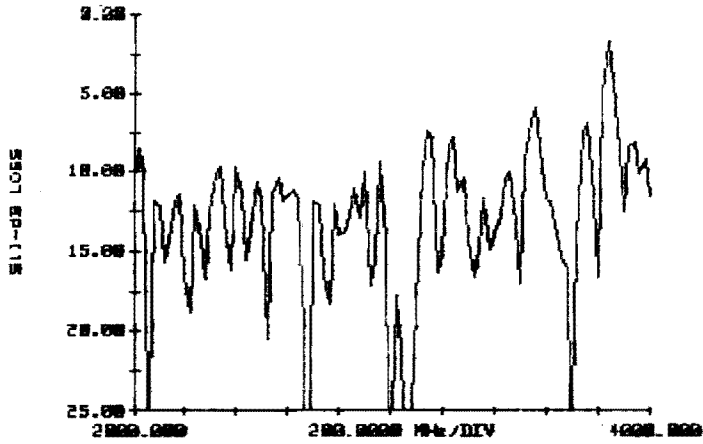


START= 2000.0000 STOP= 4000.0000 STEP= 20.0000

23 Dec 1985 13:42:42

VSWR @ IN PORT OF KICK BRAK D20-H1-3

VSWR @ IN PORT OF KICK BRAK D20-H1-3



KICKER BRACKET S11  
AFTER 150 WATTS  
for 72 hours

VSWR @ IN PORT OF KICK BRAK D20-H1-3

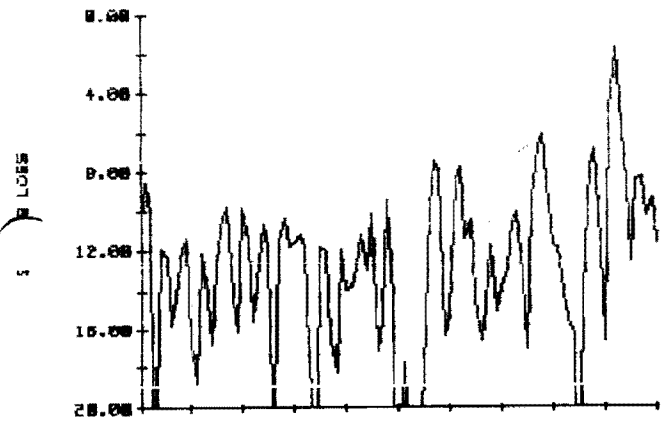


FIGURE 5