Debuncher Kicker Studies
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DEBUNCHER KICER STUDIES

A measurement program to improve the match between Debuncher TWTr'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 MJKF building. All electrical connections are identical to the tunnel environment.

S11 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 any impedance to 50 ohms 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
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°C, kicker bracket resistances were 12.8 \( \Omega \) and 13 \( \Omega \).

Figures 4 & 5 are before and after S11 measurements on the kicker bracket.
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 3 dB higher than the power levels during the Fall 1985 run.

One major improvement will be the addition of water cooled heat sink for the Hybrids mounted on the TWT. After a 24 hour running period @ 140 watts, the uncooled Hybrid temp was 84°C while the water cooled Hybrid remained @ 37°C. Room temp for the test was 22°C & Water Temp 25°C. Tunnel temperatures during the 1 run were typically 38-40°C. The max operating temp for the Hybrids is 85°C. This temperature may readily have been exceeded in the tunnel which could explain the three Hybrid failures that occurred during the run.
START= 2000.00000 STOP= 4000.00000 STEP= 20.00000

18 Dec 1985 09:04:26
TUBE A: HYBRID TO 2 KICKER BRACKETS

TWT LOAD S11

FIGURE 1
18 Dec 1985  09:08:23
TUBE B: HYBRID TO 2 KICKER BRACKETS D20-H1-3&4

TWT LOAD $1_1$

FIGURE 2
TWT to Resistor Time ~ 10NS

AFTER 24 HOURS
POWER LEVELS (WATTS)

<table>
<thead>
<tr>
<th>TEST POINT</th>
<th>TUBE A</th>
<th>TUBE B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BEST @ HYBRID</td>
<td>WORST @ HYBRID</td>
</tr>
<tr>
<td>1</td>
<td>143</td>
<td>162</td>
</tr>
<tr>
<td>2</td>
<td>7</td>
<td>11</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>8</td>
</tr>
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<td>4</td>
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<td>81</td>
</tr>
<tr>
<td>5</td>
<td>65</td>
<td>53</td>
</tr>
</tbody>
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\[
S_{11a} = 10 \log \frac{7}{143} = -3 \text{dB}
\]

\[
S_{11b} = 10 \log \frac{11}{162} = 11.7 \text{dB}
\]

**FIGURE 3**

Hybrid Temp for 24 hours:
- Water: 37°C
- Water: 84°C

All Kicker Tank DC Resistances: 12.8 Ω to 132 Ω
KICKER BRACKET S11
BEFORE 150WATT TEST

FIGURE 4
VSWR @ IN PORT OF KICK BRAK D20-H1-3

Kicker Bracket S11

After 150 watts
for 72 hours

Figure 5