Debuncher Kicker Studies

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DEBUNCHER KICKER STUDIES

A measurement program to improve the match between Debuncher TWI's and kicker tanks was completed in December of 1985. Debuncher tanks, kicker brackets & TWI power splitting circuits were measured in a test set up in the MKRF 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 TWI & 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 TWI 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 TWI'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 13.8 13.2. 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 test 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 test were typically 38-40°C. The max operating temp for the Hybrids is 85°C. This temperature may easily have been exceeded in the tunnel which could explain the three Hybrid failures that occurred during the run.
TUBE A: HYBRID TO 2 KICKER BRACKETS

TWT LOAD $S_{11}$

FIGURE 1
TUBE B: HYBRID TO 2 KICKER BRACKETS D20-H1-3&4

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

TWT LOAD S11

FIGURE 2
**Figure 3**

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**TWT to Resistor Transition**

<table>
<thead>
<tr>
<th>Test Point</th>
<th>Tube A Best $\varepsilon$ Hybrid</th>
<th>Tube A Worst $\varepsilon$ Hybrid</th>
</tr>
</thead>
<tbody>
<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>
<tr>
<td>4</td>
<td>56</td>
<td>81</td>
</tr>
<tr>
<td>5</td>
<td>65</td>
<td>53</td>
</tr>
</tbody>
</table>

**Power Levels (Watts)**

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

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

**Notes:**
- Hybrid temperatures: 37°C, 84°C
- Water bath
TUBE B: KICKER BRACKET D20-H1-3 AFTER 120 WATTS

KICKER BRACKET SII
BEFORE 150 WATT TEST

FIGURE 4
START = 2000.000000  STOP = 4000.000000  STEP = 20.000000
23 Dec 1985  13:42:42
VSWR @ IN PORT OF KICK BRAK D20-H1-3

KICKER BRACKET S11
AFTER 150WATTS
for 72 hours

FIGURE 5