This report is a document of recent measurement results of permittivity/permeability/loss tangent of the several microwave absorbers. The technique used in these measurements has been described before (P-bar note 555). The samples filled a section of a waveguide (WR159). The length of the waveguide is 0.752 inch. The positions of the samples were controlled carefully to ensure accuracy. S21 and S11 parameters were simultaneously measured. The permittivity, permeability and loss tangent were deduced from S parameters.

Measured samples are listed in table 1.

**Table 1. List of Measured Samples**

<table>
<thead>
<tr>
<th>Sample</th>
<th>Description</th>
<th>Manufacture</th>
<th>Thickness (inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ferrite-50</td>
<td>NiZn ferrite, ceramic-like</td>
<td>Trans-Tech, Inc.</td>
<td>0.038</td>
</tr>
<tr>
<td>TT2-111R</td>
<td>NiZn ferrite, ceramic-like</td>
<td>Trans-Tech, Inc.</td>
<td>0.038</td>
</tr>
<tr>
<td>AlN-40%SiC</td>
<td>AlN and SiC, hot pressed,</td>
<td>Ceradyne, Inc.</td>
<td>0.048</td>
</tr>
<tr>
<td>SiC</td>
<td>CN-163, hot pressed</td>
<td>Norton, Inc.</td>
<td>0.095</td>
</tr>
<tr>
<td>MF190</td>
<td>Iron powder and epoxy</td>
<td>Emerson&amp;Cuming, Inc.</td>
<td>0.060</td>
</tr>
<tr>
<td>Plastic Glass</td>
<td>Plastic Glass</td>
<td></td>
<td>0.115</td>
</tr>
</tbody>
</table>

Results of Ferrite-50 are shown in Figure 1 - 4.
Results of TT2-111R are shown in Figure 5 - 8.
Results of AlN-40%SiC are shown in Figure 9 - 12.
Results of SiC (two samples) are shown in Figure 13 - 20.
Results of MF190 are shown in Figure 21-24.
Results of Plastic Glass are shown in Figure 25-28.
Results of Air are shown in Figure 29-32.

Plastic Glass and Air are used to check possible systematic error and what kind of accuracy can be expected. The results of air (Figure 30 and 32) show that the accuracy for loss tangent data may be 0.005 (+/-). Figure 27 and 31 show that there was a systematic error on permeability data: about 2-3 % lower at low frequency end. The data of MF190 are checked with the data supplied by the manufacture. They are in relatively good agreement.

Magnetic loss tangent of TT2-111R and Ferrite-50 at lower frequency seem to be erroneous. This is due to very small value of real part of permeability plus the
aforementioned systematic error. The imaginary part of the permeability actually are reasonable. Since the magnetic loss tangent was deduced from real and imaginary part of permeability, it should not be a problem as long as imaginary part of permeability are reasonable.
Figure 1. Permittivity of Ferrite-50

Figure 2. Dielectric Loss of Ferrite-50
Figure 3. Permeability of Ferrite-50

Figure 4. Magnetic Loss Tangent of Ferrite-50
Figure 5. Permittivity of TT2-111R

Figure 6. Dielectric Loss Tangent of TT2-111R
Figure 7 Permeability of TT2-111R

Figure 8 Magnetic Loss Tangent of TT2-111R
Figure 9. Permittivity of AlN-40%SiC

Figure 10. Dielectric Loss Tangent of AlN-40%SiC
Figure 11. Permeability of AlN-40%SiC

Figure 12. Magnetic Loss Tangent of AlN-40%SiC
Figure 13. Permittivity of SiC (Sample 1)

Figure 14. Dielectric Loss Tangent of SiC (Sample 1)
Figure 15. Permeability of SiC (Sample 1)

Figure 16. Magnetic Loss Tangent of SiC (Sample 1)
Figure 17. Permittivity of SiC (Sample 2)

Figure 18. Dielectric Loss Tangent of SiC (Sample 2)
Figure 19. Permeability of SiC (Sample 2)

Figure 20. Magnetic Loss Tangent of SiC (Sample 2)
Figure 21. Permittivity of MF190

Figure 22. Dielectric Loss Tangent of MF190
Figure 23. Permeability of MF190

Figure 24. Magnetic Loss Tangent of MF190
Figure 25. Permittivity of Plastic Glass

Figure 26. Dielectric Loss Tangent of Plastic Glass
Figure 27. Permeability of Plastic Glass

Figure 28. Magnetic Loss of Plastic Glass
Figure 29. Permittivity of Air

Figure 30. Dielectric Loss Tangent of Air
Figure 31 Permeability of Air

Figure 32 Magnetic Loss Tangent of Air