$\bar{p}$ Note 404

MICROWAVE RIDGED WAVEGUIDE BEAM PICKUPS

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October 15, 1984

This note is intended to summarize the striking results of an investigation of ridged waveguide beam pickups at Argonne.

The magnetic field from the beam couples to the waveguide and the energy is propagated by the $TE_{1,0}$ mode. The energy is extracted by an electric field stub into a transmission line.

To achieve a low frequency cutoff of 2.1 Ghz a standard waveguide must have an "a" or wide dimension of 3.4" and a "b" dimension of 1.7". The standard waveguide has only a half-octave bandwidth and its 3.4" width gives a rather broad transverse gain resolution.

Ridges in the waveguide cavity broaden the frequency band up to 3.6:1 as compared to 1.5:1 without ridges. The ridges increase the field path length so that smaller external dimensions give lower cut-off frequencies than with standard waveguides. Basically, the low and high frequencies use different areas of the waveguide but the ridge gap primarily determines the impedance. The frequency and phase response are quite flat, within 3 db and 10^{o} respectively for an octave bandwidth. Transverse spatial resolution for the ridged waveguides is better because of the smaller dimensions.

The compromise in using ridges is that the attenuation is larger than without ridges, greater than twice as large. With the short lengths and low power used for pickups, the increased attenuation is of little consequence.

The figures show the evaluation results as measured at the Argonne Beam Test Facility for several configurations. The results are so encouraging that a full-sized array of 2-4 Ghz waveguide pickups is being assembled.

The great advantage of ridged waveguide pickups is the construction simplicity. The output signal can be coupled from the gap, although the stub pickup gives slightly flatter response. Commercial components are being evaluated and it appears that they are well suited for the application.

With the development of a suitable insulating window, it is feasible that the waveguides can be placed outside the vacuum chamber.

With the information gained from Fig. 5, I am optimistic that a 4-8 GHZ band pickup can produce comparable results.

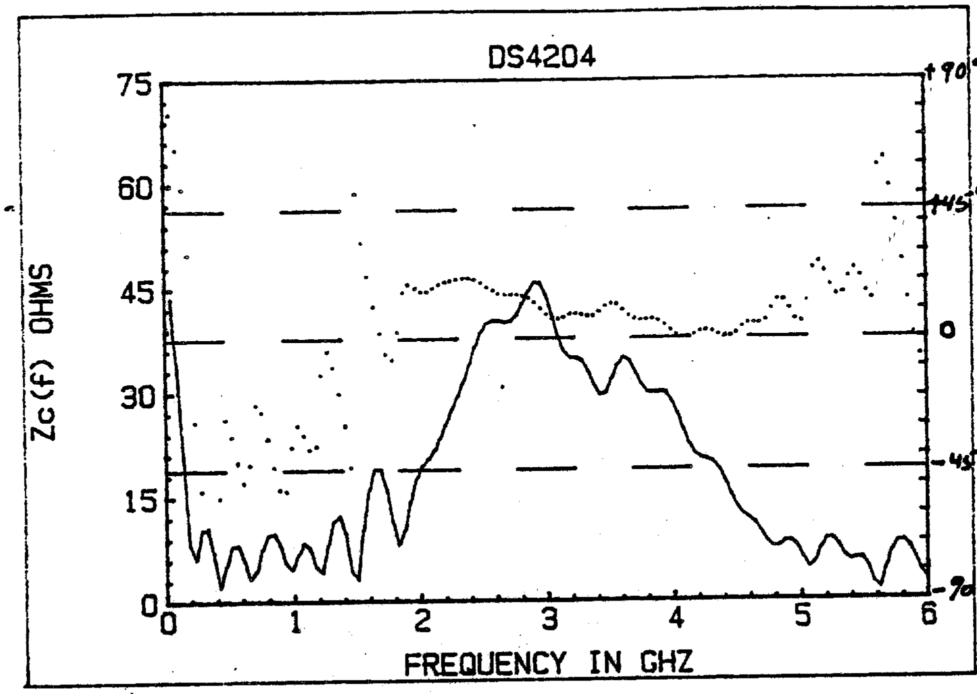

Fig. 1. Frequency and Phase Response of a Pair of 2-4 GHZ Ridged Waveguides. (One above and one below the beam line.) At X = 0

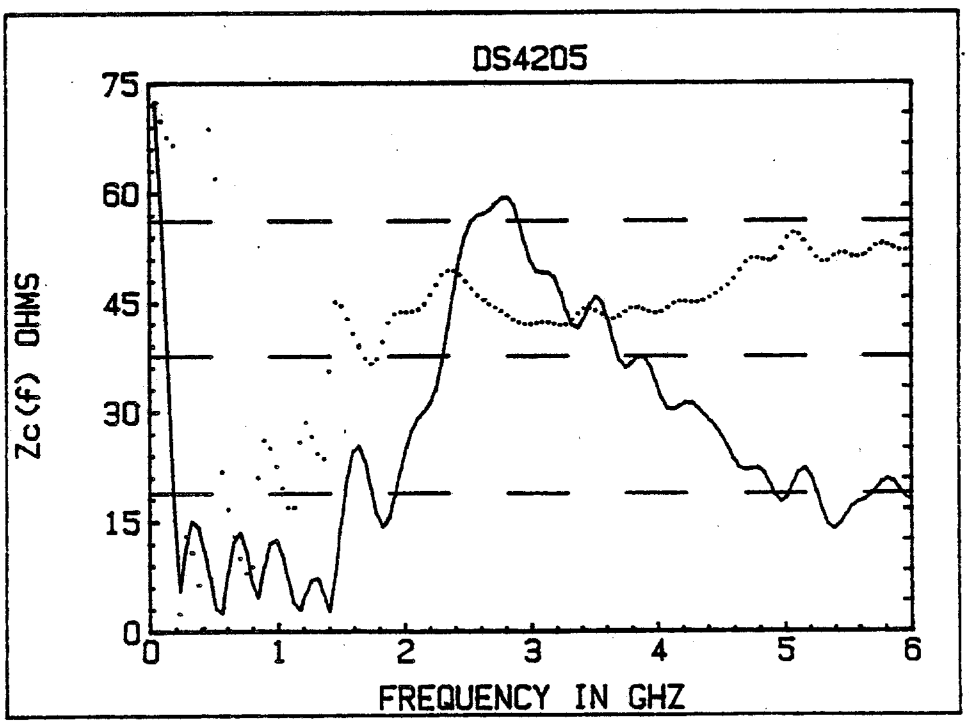

Fig. 2. Two pairs of the same as in Fig. 1. Outputs combined to give one signal.

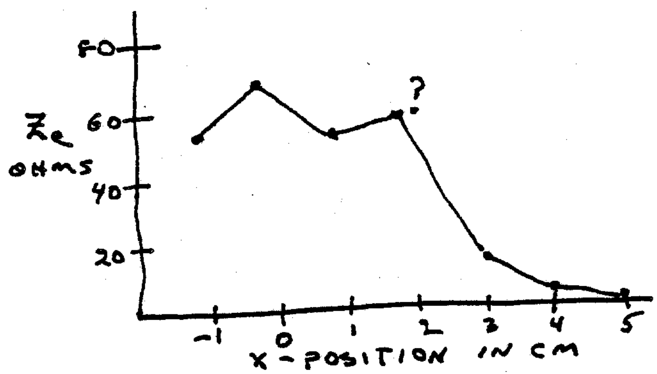

Fig. 3. 2-4 GHZ Pickup Sum Mode. Two pair combined.

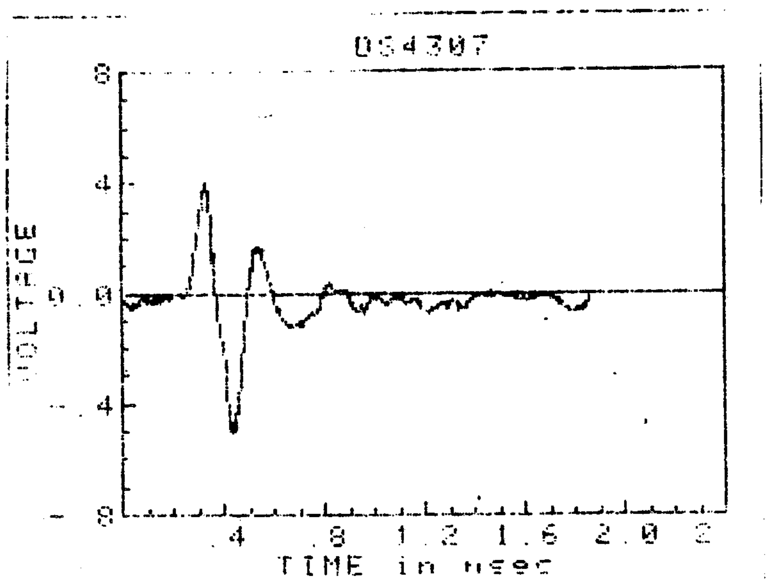

Fig. 4. Time Domain Signal of Small (1.25" x 0.6") Ridged Waveguide Pickup. (One each above and below beam.)

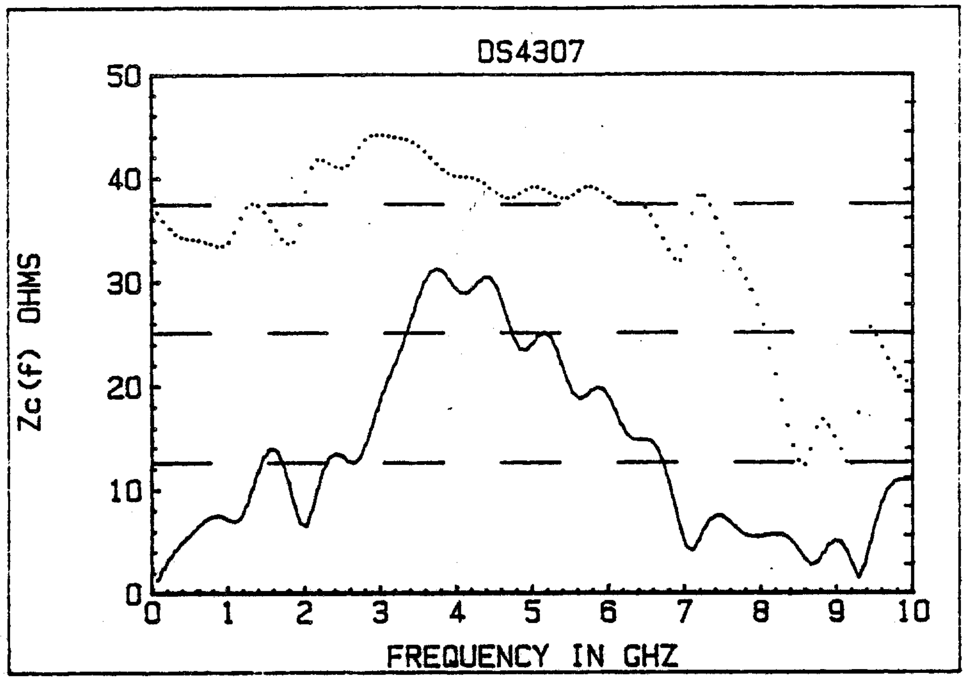

Fig. 5. FFT of Waveform in Fig. 4. Looks like a good 3-6 GHZ Pickup.