

Table of Contents

List of Symbols	
List of Figures	
List of Tables	
1.0 Introduction	1
2.0 Microwave Fundamentals	14
2.1 Microwave/Material Interaction	14
2.2 Polarization	15
2.2.1 Electronic Polarization	16
2.2.2 Ionic Polarization	17
2.2.3 Molecular Polarization	17
2.2.4 Interfacial Polarization	17
2.3 Relative Permittivity	18
2.4 Plane & TEM Waves	20
2.4.1 Gaussian Beams	22
2.5 Lossless/Low Loss models	22
2.6 Conduction Losses & Skin Depth	24
3.0 Transmission Line Theory	26
3.1 TEM Waveguides	26
3.1.1 Telegrapher's Equations	27
3.1.2 Characteristic Impedance	28
3.2 Measurable Quantities	28
3.2.1 Load Conditions	29

4.0 Modeled Results	34
4.1 Shorted T-line	34
4.2 Lossless Condition	36
4.3 Low Loss Condition	41
5.0 Experimental Apparatus	48
5.1 Horn Antennas	49
5.2 Microwave Lens	49
5.2.1 Lens Design	49
5.3 Network Analysis	52
5.3.1 Scattering Parameters	43
5.3.2 Reciprocity	55
5.3.3 Network Analyzer	55
5.3.4 Calibration	56
6.0 Experimental Data & Results	59
6.1 X-band Measurements	60
6.1.1 Alumina Samples	61
6.1.2 MSZ Samples	69
6.2 Ku-band Measurements	76
6.2.1 Alumina Samples	77
6.2.2 MSZ Samples	84
7.0 Discussion	93
8.0 Conclusions	98