

Multichip MMIC Package for X and Ka-bands

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ABSTRACT

A new multichip MMIC package for X and Ka-bands has been developed and tested. This package provides space for mounting upto five MMIC chips and has three RF and five DC feed-throughs. The RF feed-throughs are a mixed-modes, conductor backed coplanar waveguide design that minimizes reflections and insertion loss over a wide bandwidth. DC feed-throughs permit bias access for upto five chips and internal mounting of chip bypass capacitors. Prototype of the package have been built and tested using miniature coplanar probes and a test fixture. Test results indicate the package meets design goals to about 30 GHz and can be used to about 35 GHz. The package has been analyzed using a "Composite Model" approach in which individual elements are separately analyzed and modeled and then combined in a circuit simulator to provide a complete package model. This approach has provided quite good agreement with measured data.

ACKNOWLEDGMENTS

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Table 1 : *MMIC Packaging Specifications*

Frequency Range	1 - 35 GHz
Input/output	3 RF lines (50 ohms each)
DC bias/control lines	4-8
input/output Return Loss	>20 dB
Insertion Loss	< 1 dB
Port-to-Port Isolation	> 30 dB
MMIC Chip Dimensions	245 X 185 mils (mm)
Muti-Chip Package	3 - 5 chips
Hermeticity	1×10^{-8}
Operating Temp. Range	-30 to +85° C

Table II: *Requirements for Good Feed-Through Design*

Signal confinement	Negligible EM radiation Good isolation from other Signal paths
Electrical Transparency	Low signal reflection Low signal absorption
Bandwidth	operating BW of 1- 35GHz
Fabrication	Mechanically robust Dimensional & Material requirements - compatible with technology

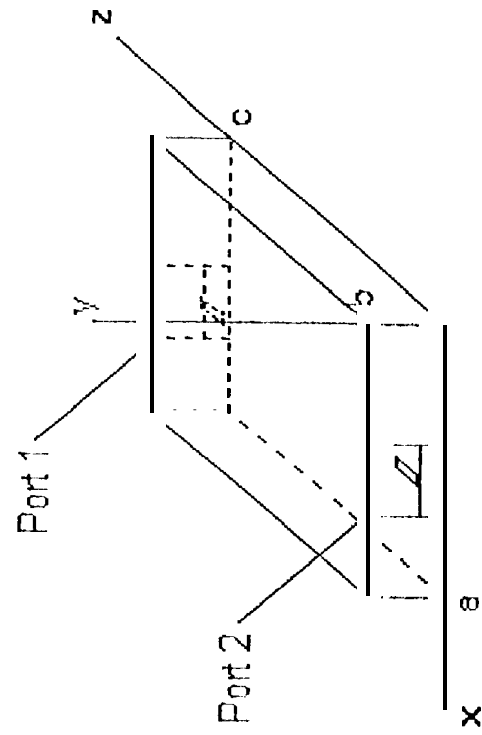


Fig.1a Geometry of the Cavity

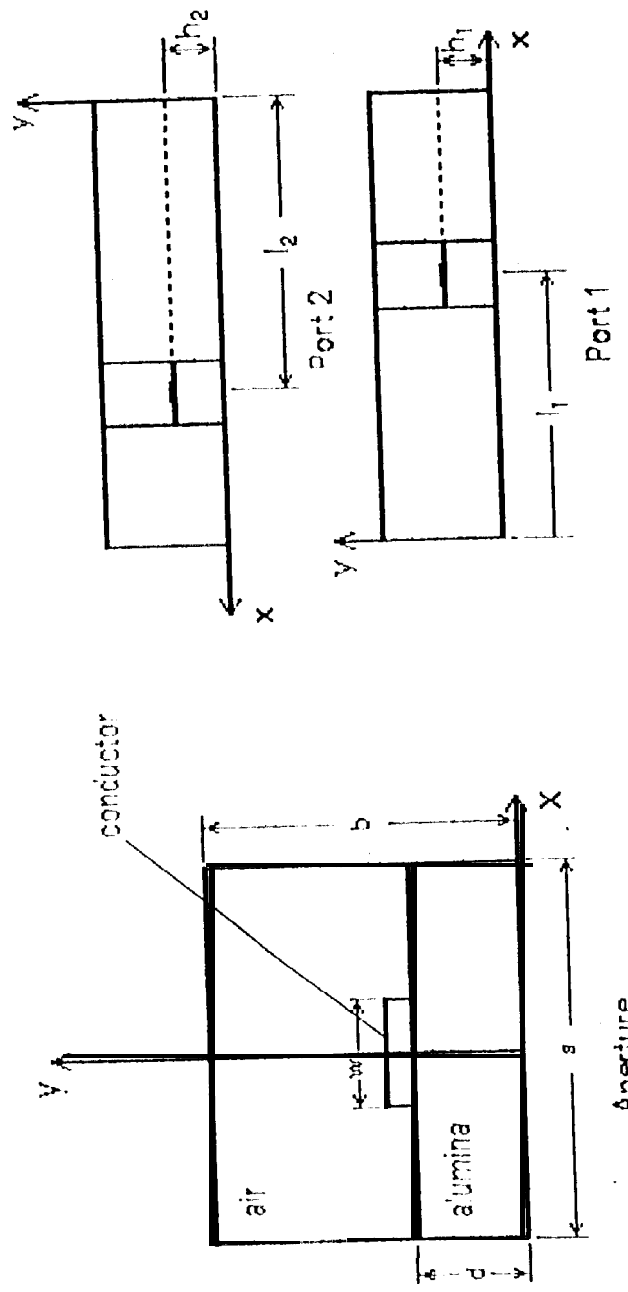


Fig.1b Geometry of Port Apertures

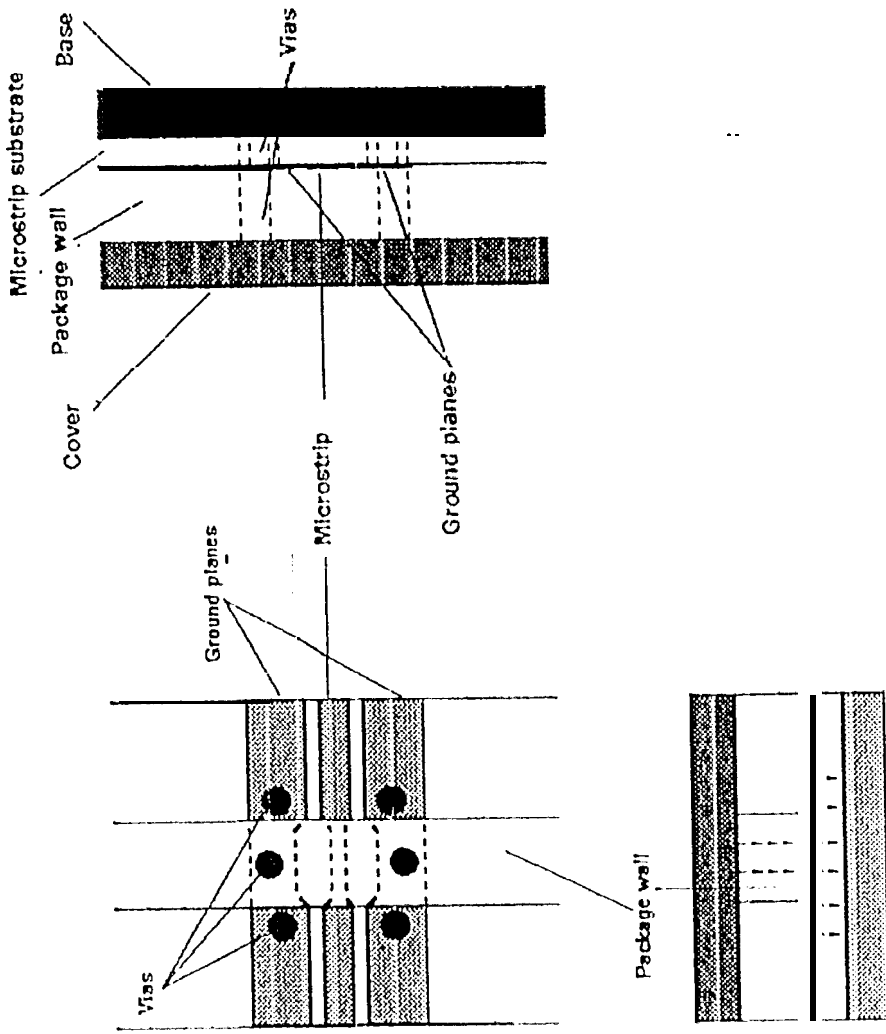
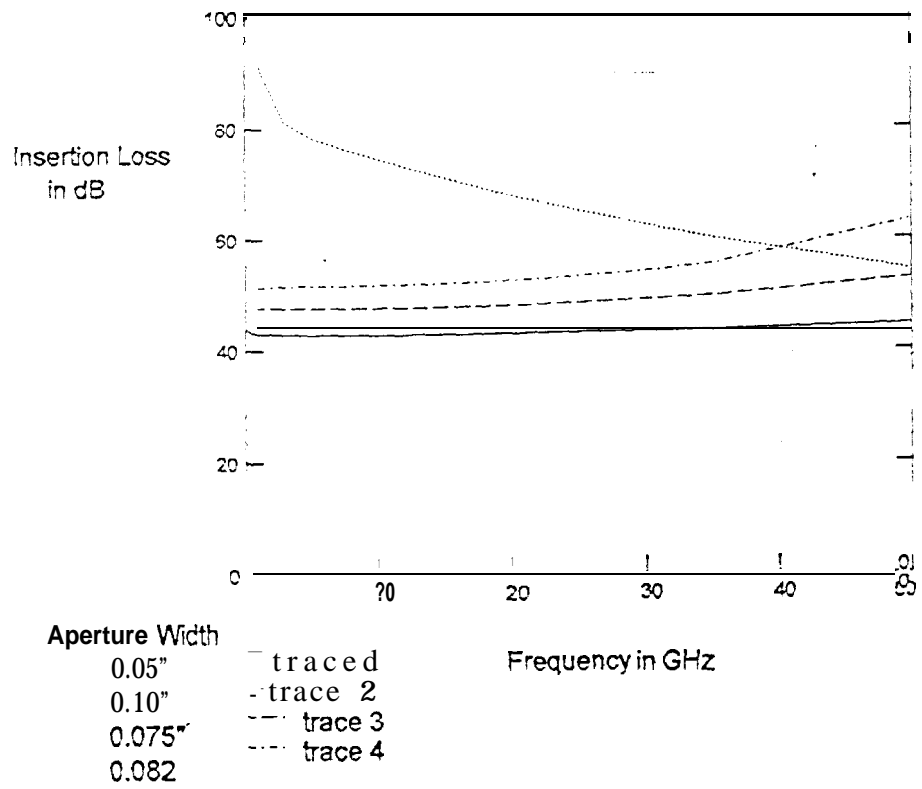


Fig. 2 Geometry of Prototype Feed-Through



Probe current distribution: frequency-dependent

Fig.3 Frequency Dependence of Cavity Insertion Loss

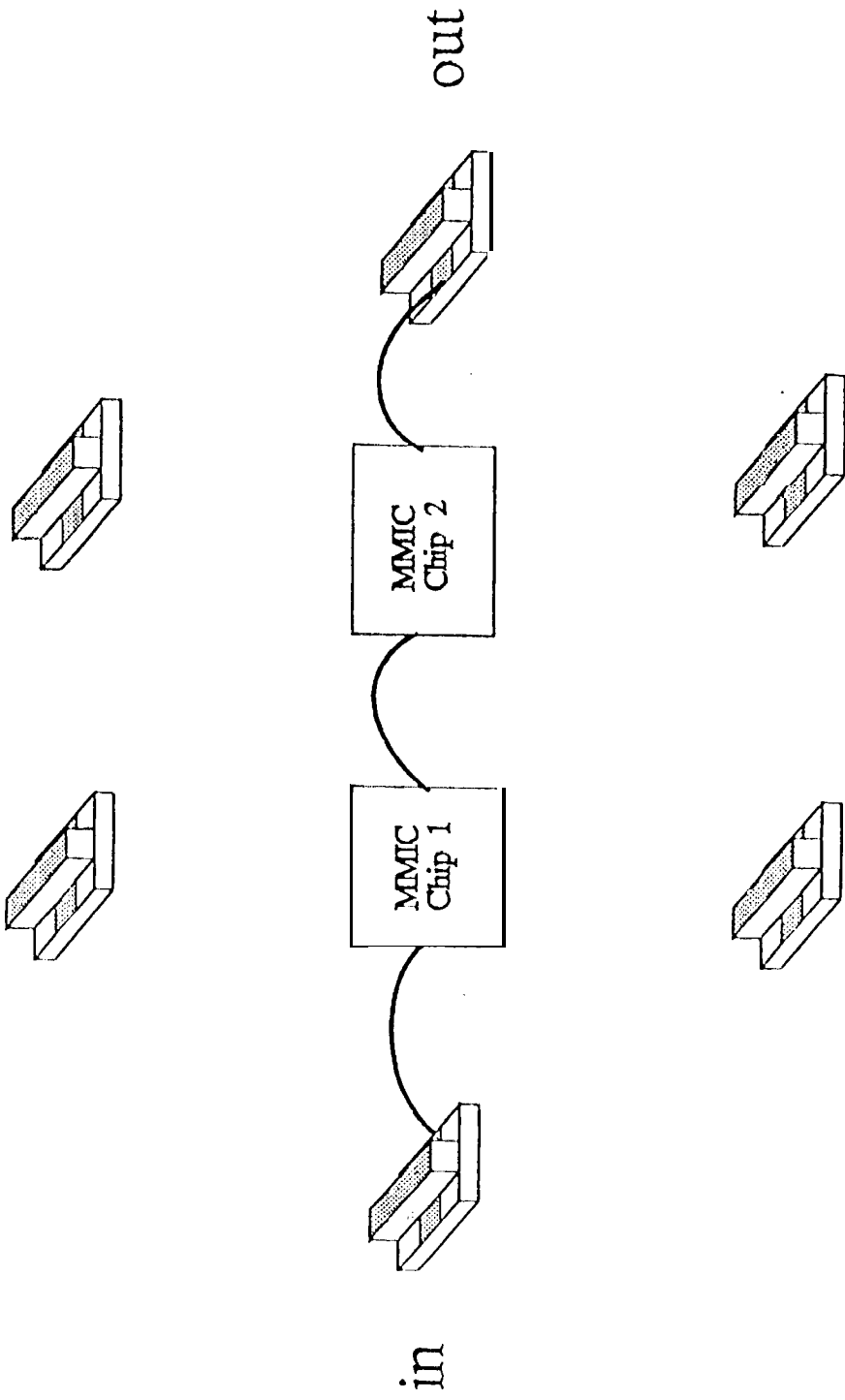


Fig. 4a Composite Model - Level 1

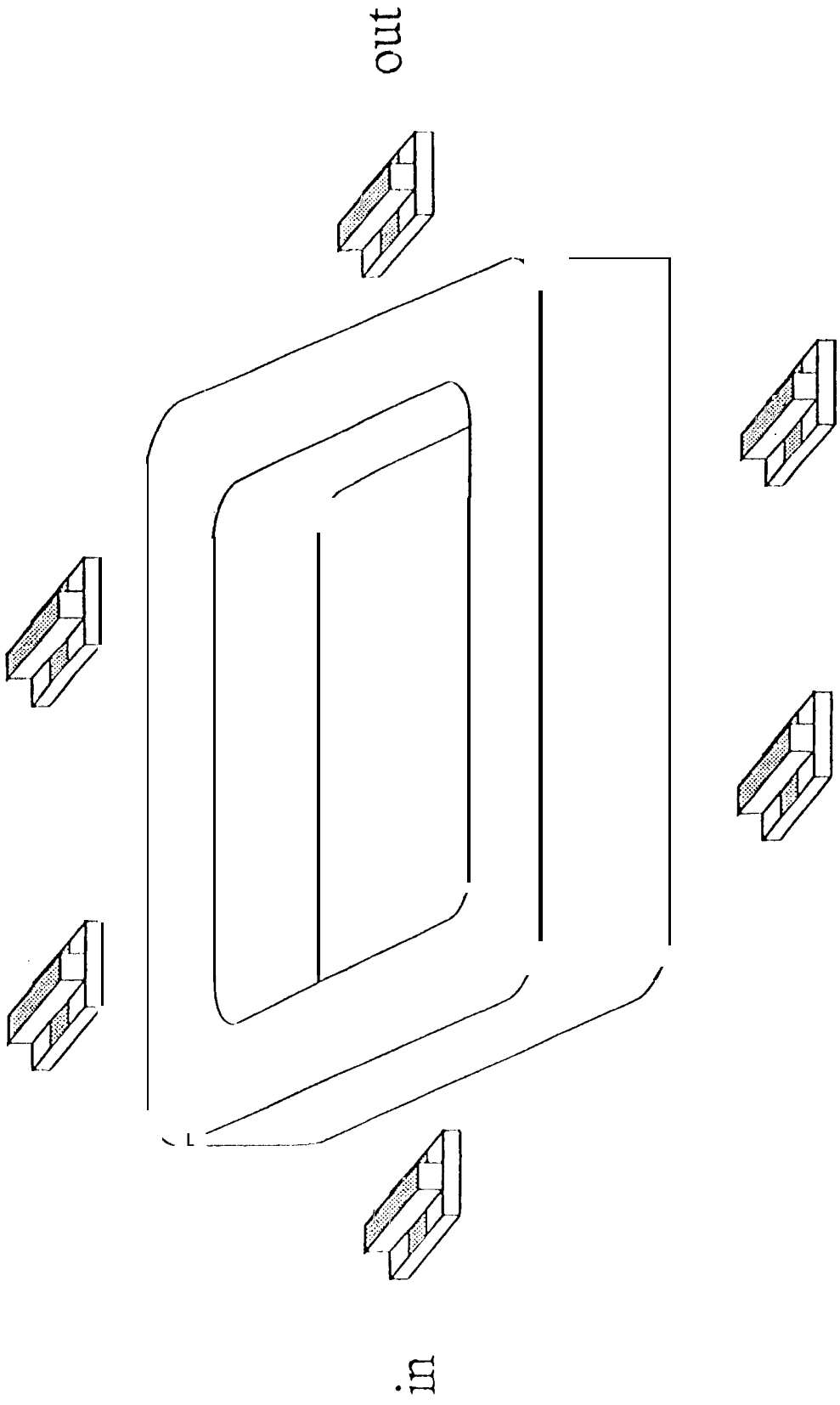
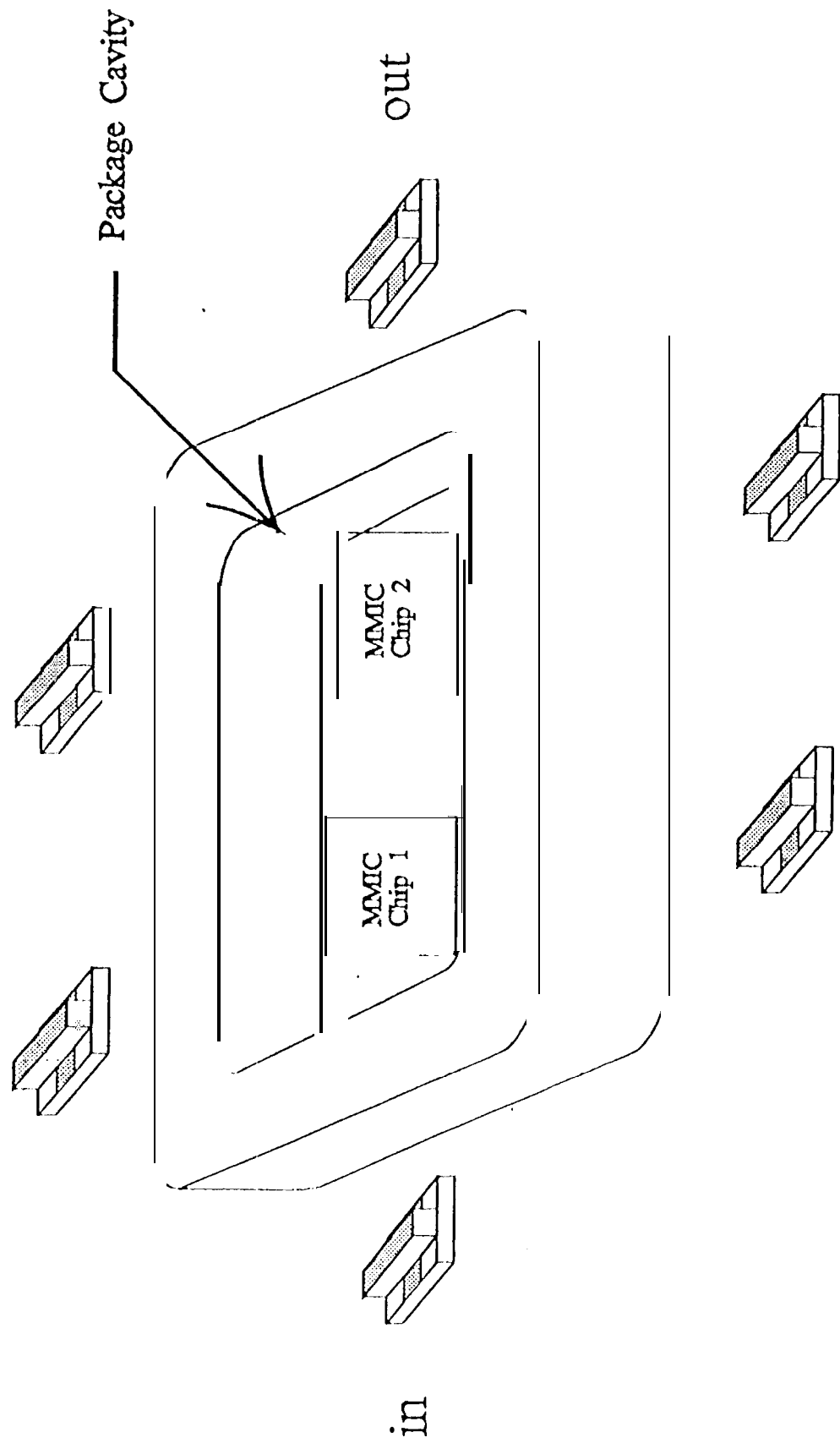


Fig. 4b Composi e Model Level 2



Feedthroughs coupled to wall modes
 and feedthroughs coupled to cavity modes

Fig. 4c Composite Model - Level 3

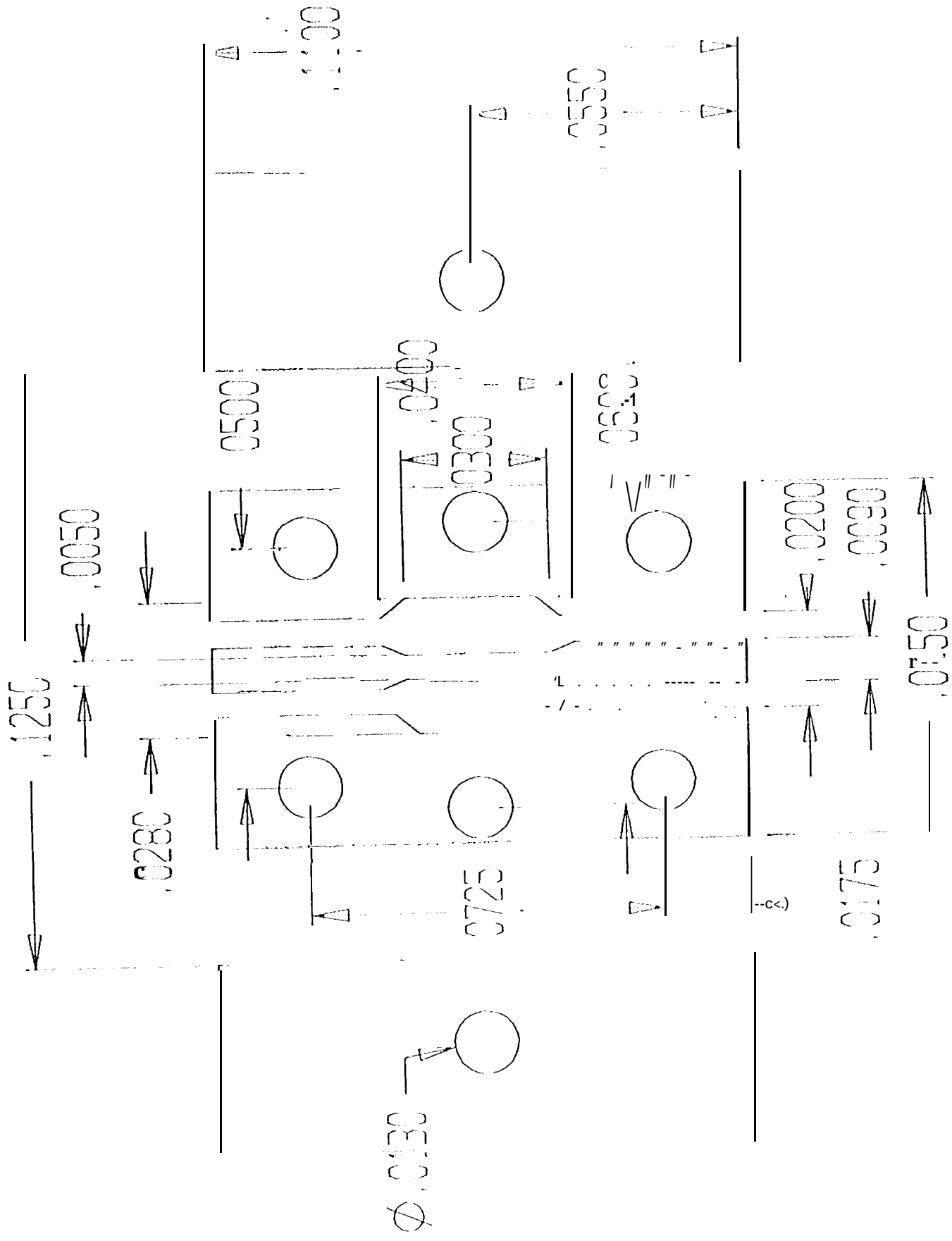


Fig. 5 Design of the RF Feed-Through Structure for MMIC Package

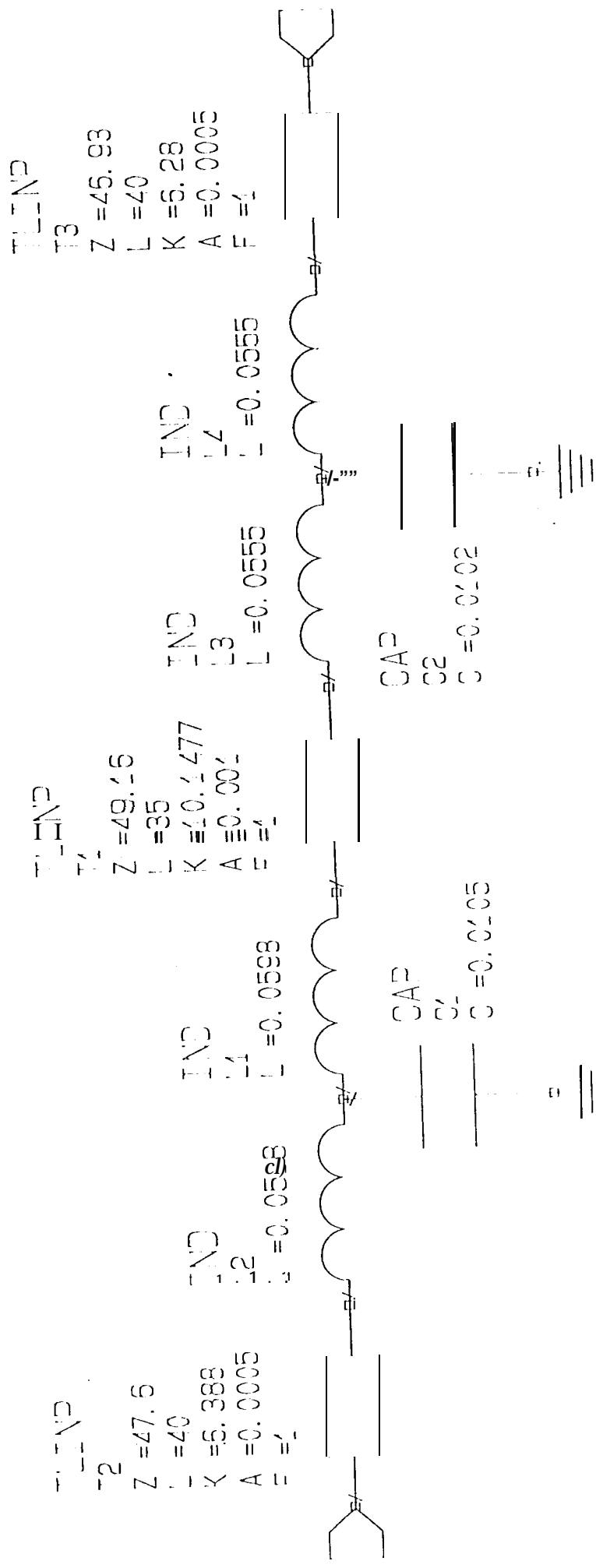
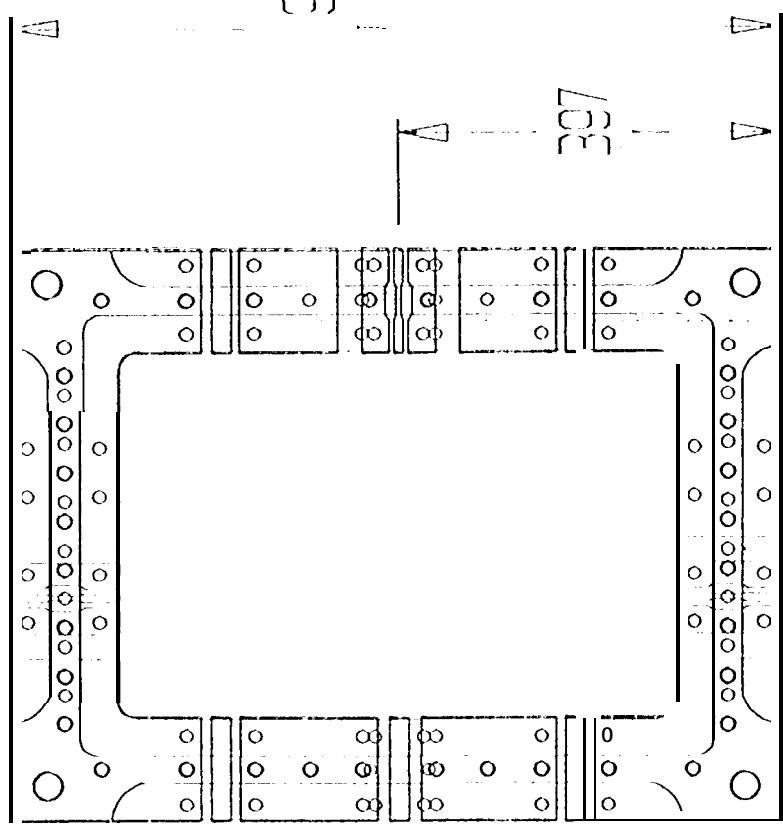
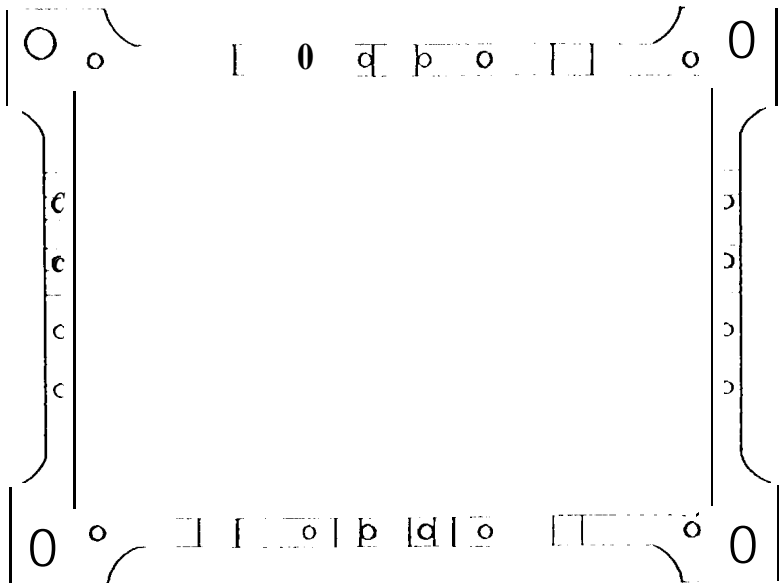


Fig. 6 3D Quasi-static Model of the RF Feed-Through Structure



232

60

397

Fig. 7 Layout of the MMIC Package and Package wall

□ DB[S11]
MODEL

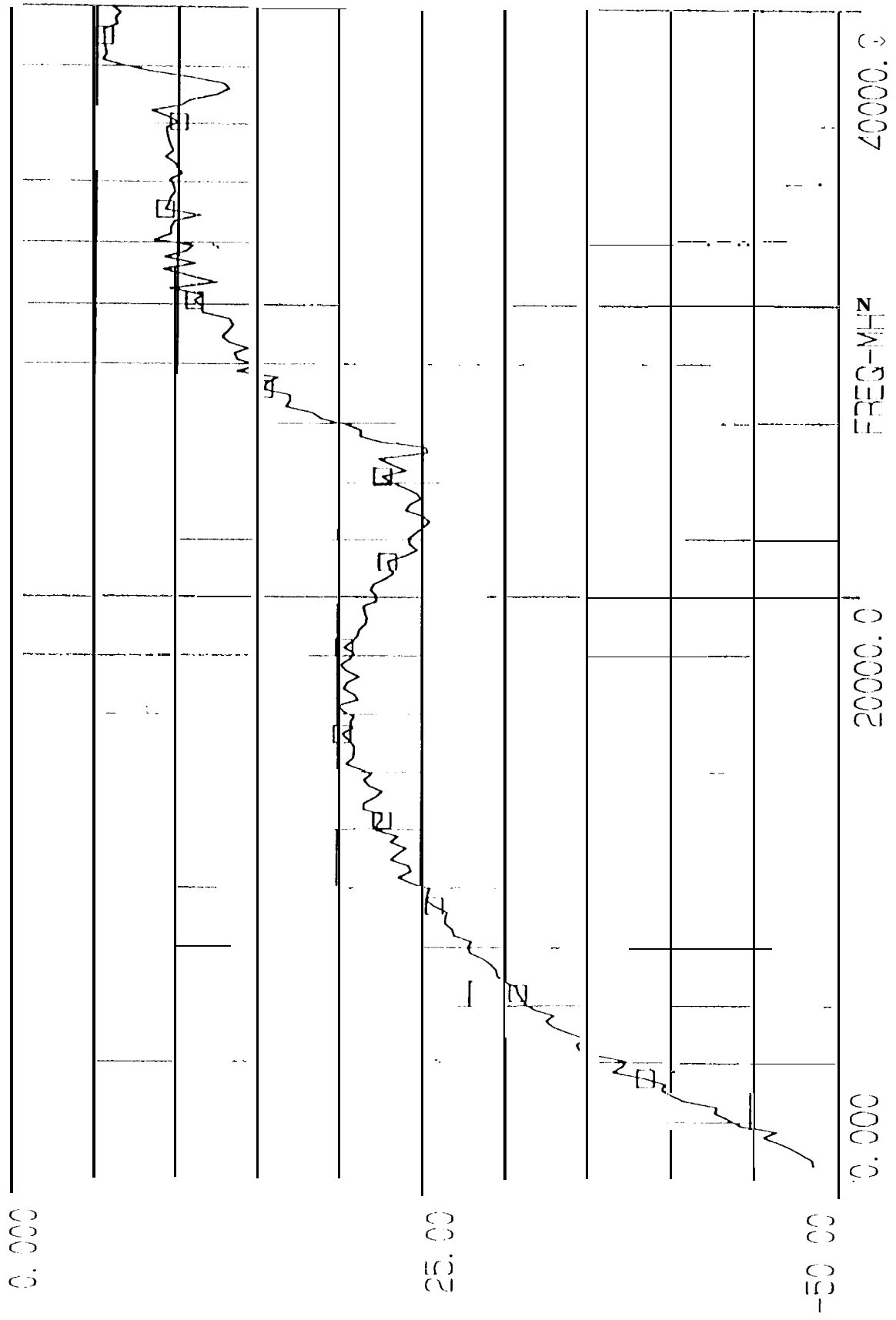


Fig. 8 Return Loss for RF Feed-Through A

03.821
VREF

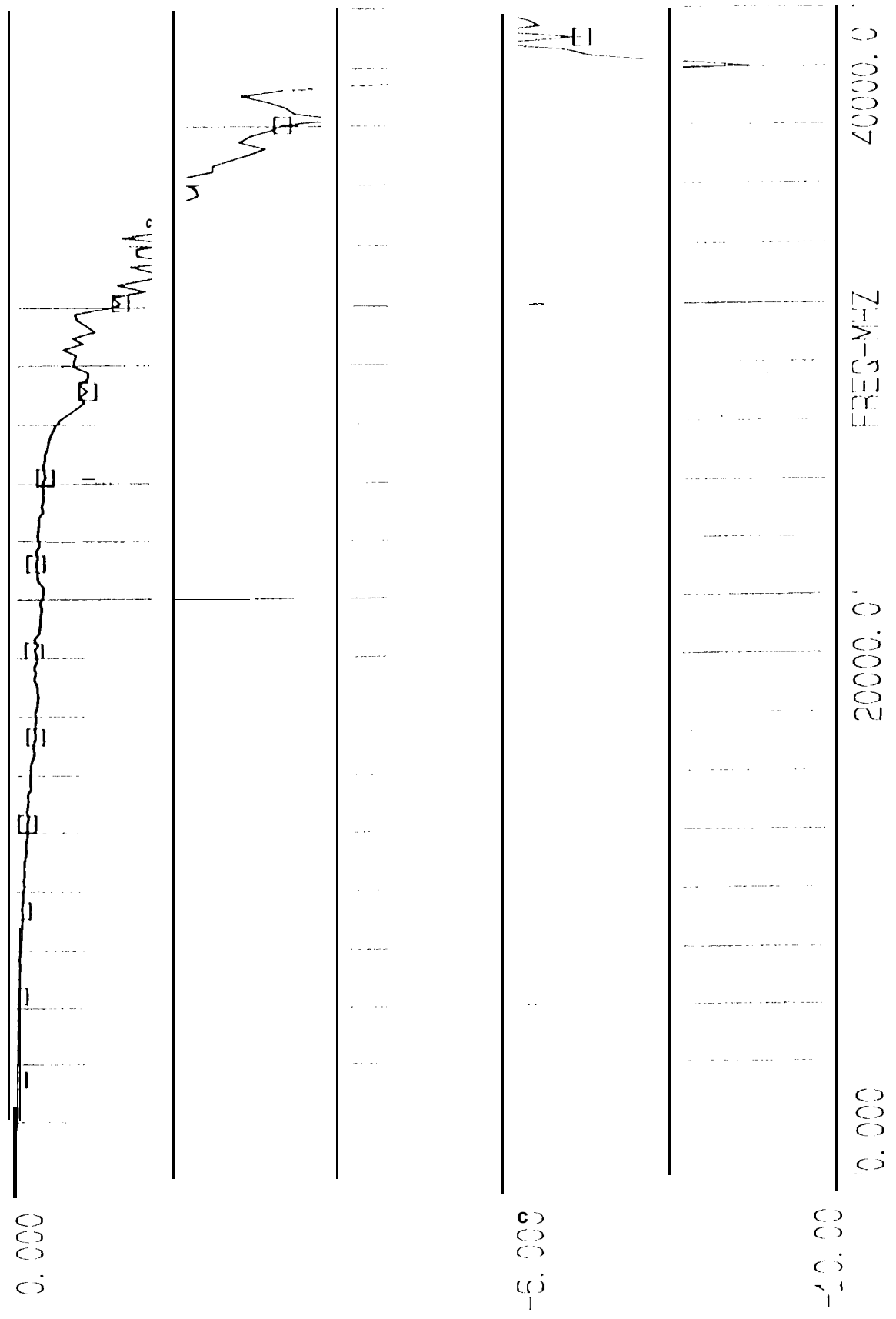
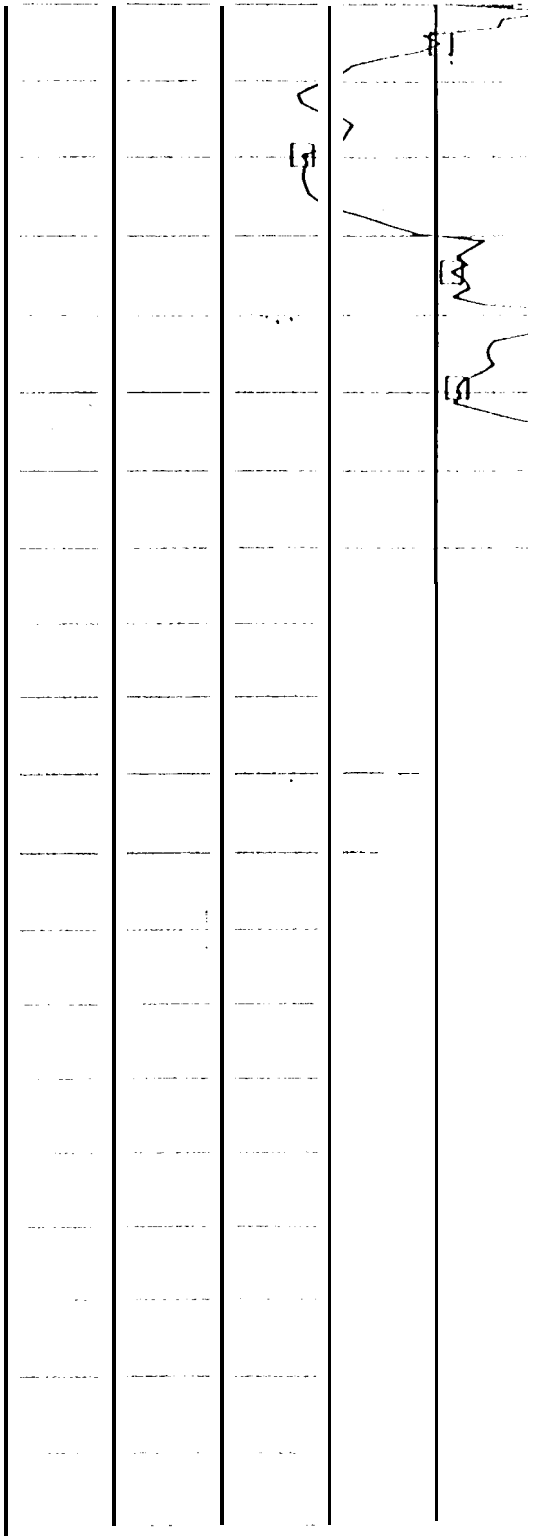


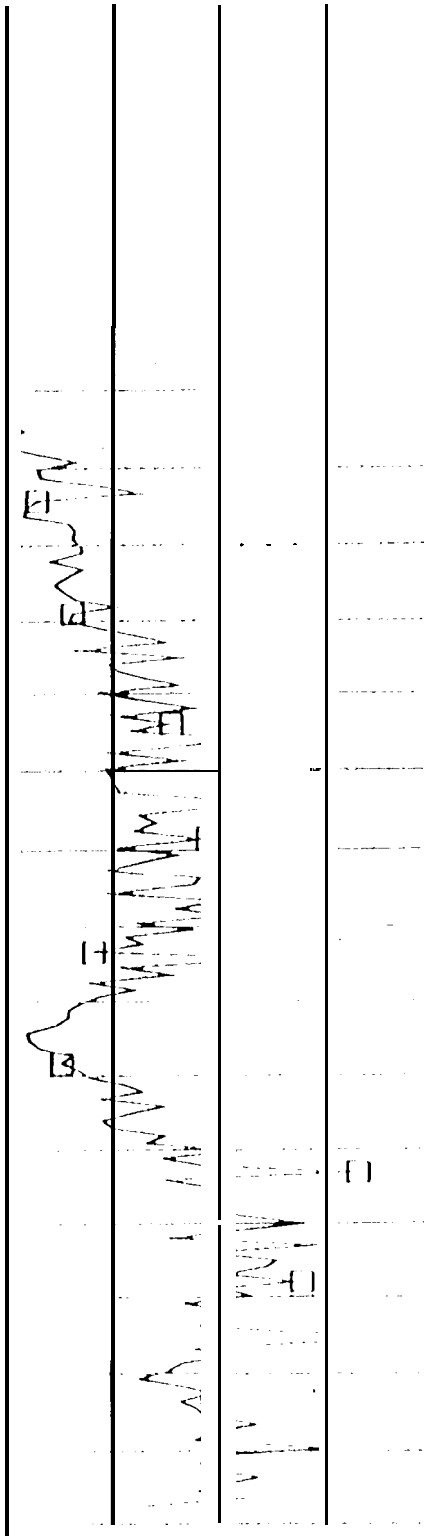
Fig. 9 Insertion Loss for RF Feed-Through A

DB[S21]
MODEL

0.000



-50.00



-100.0

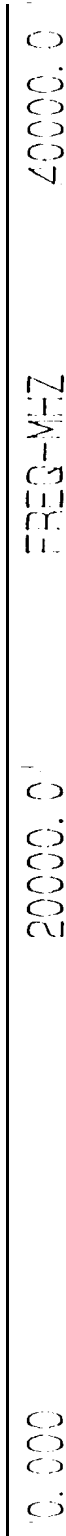


Fig. 10 Isolation between RF Feed-Throughs A & B - no lid

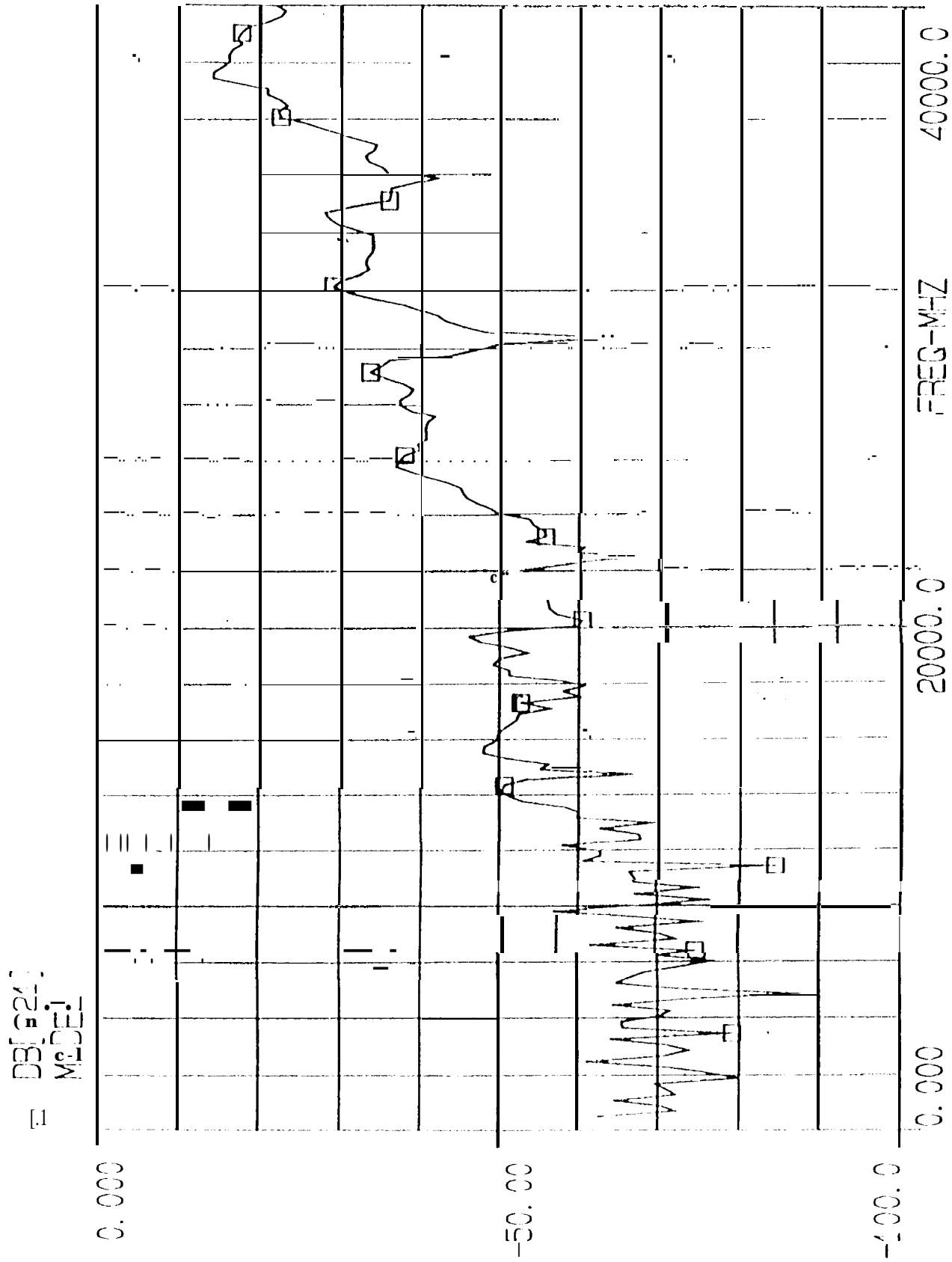


Fig. 11 Isolation Between RF Feed-Throughs A & B - with lid

DB(S)A
MODE

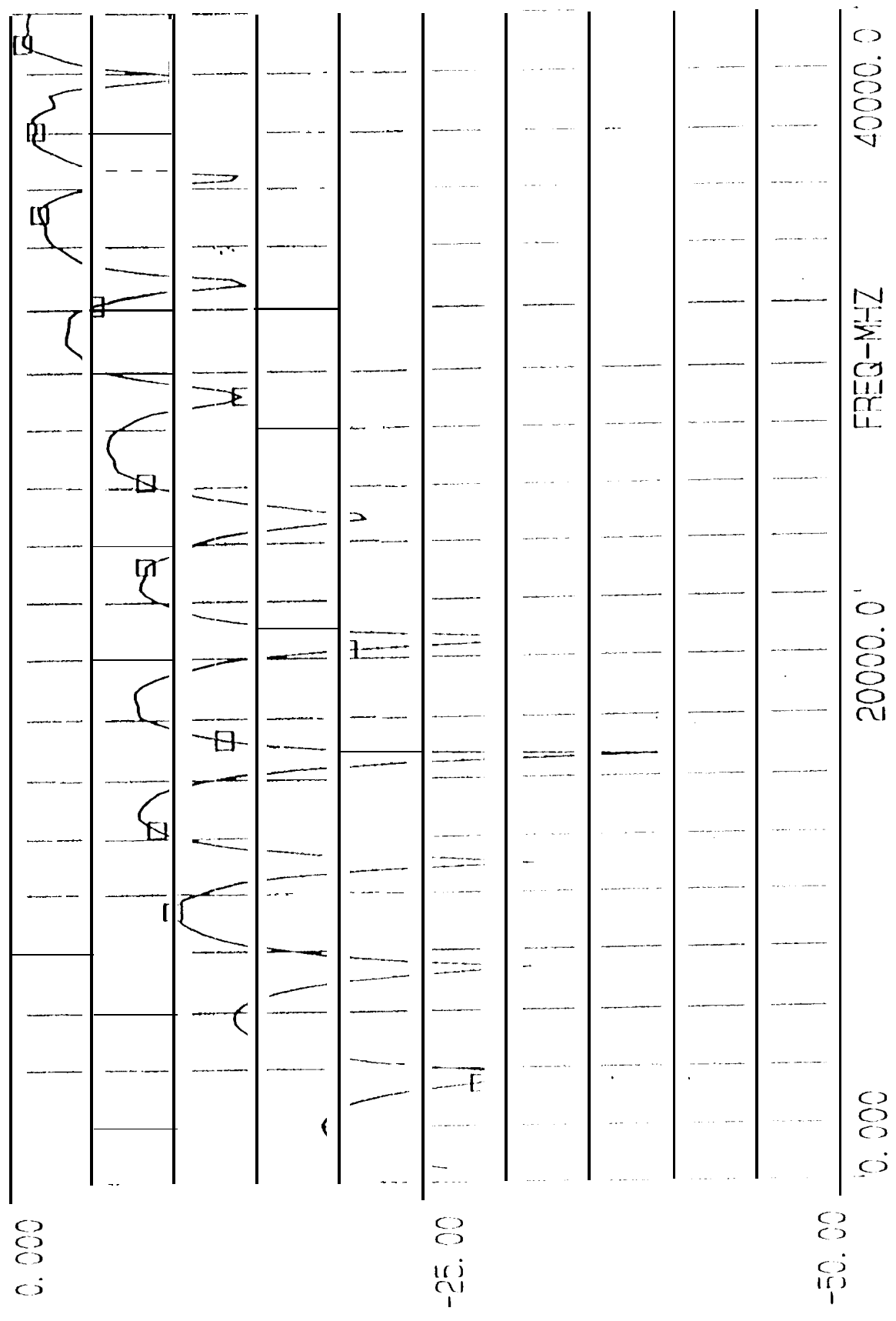


Fig. 12 Return Loss with Thick Film Through Line between RF Feed-Throughs A & B - no lid

DB[S21]
MAG

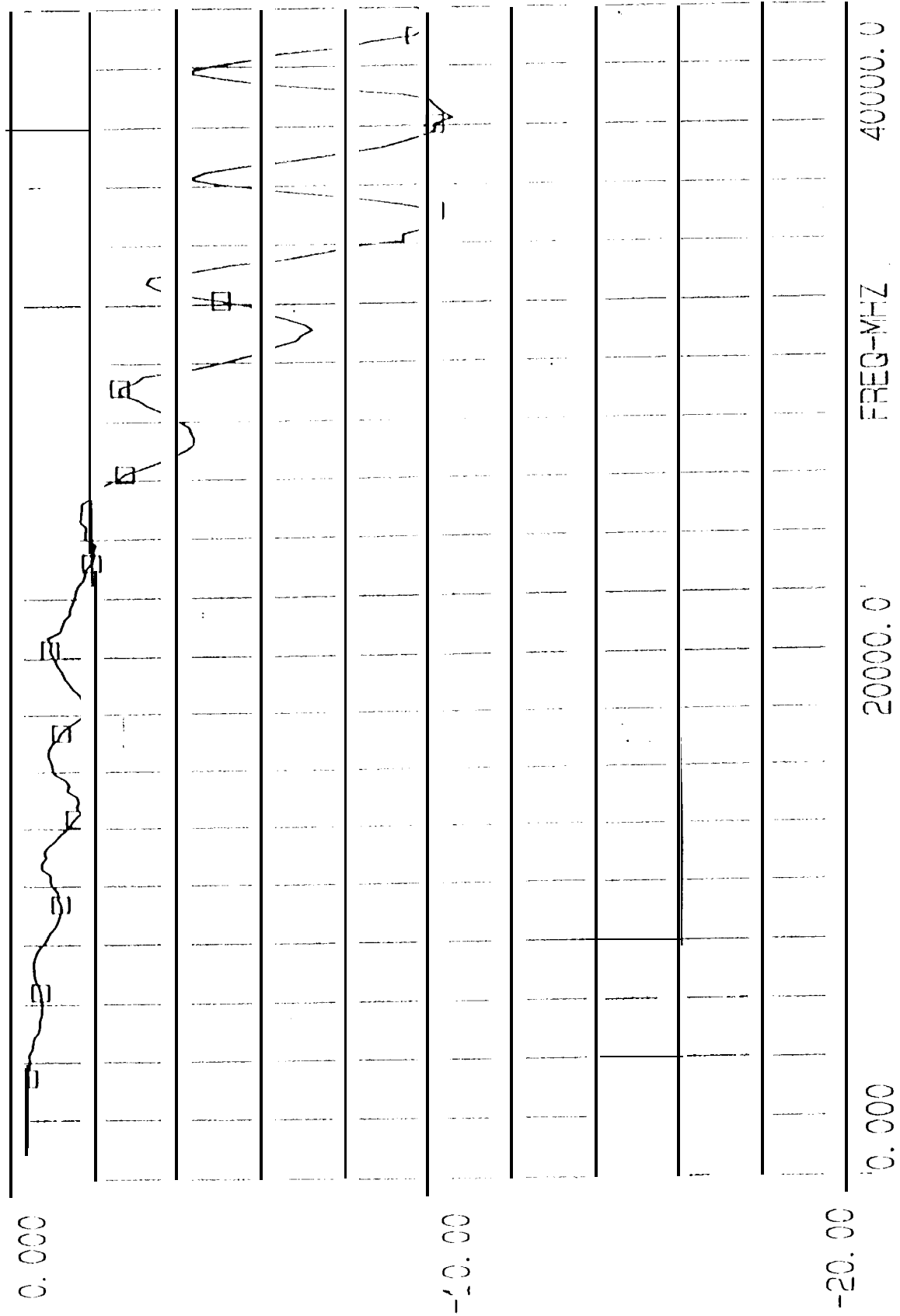


Fig. 13 Insertion Loss with Thick Film Through Line between RF Feed-Throughs A & B - no lid