OSA ILLUSTRATIONS

OSA-95-OS-11-R

August 31, 1995

Summary

Optimization Systems Associates (OSA) was established in 1983 and was incorporated in 1986. Driven by the microwave/mm-wave industry's demand OSA has developed user-friendly, state-of-the-art software design tools for statistical parameter extraction, modeling of devices, yield-driven simulation, design and optimization of RF, high frequency, high speed, microwave and mm-wave circuits.

OSA is widely recognized for its visionary research on CAD techniques, as evidenced by our many publications. We have invested 80 years of cumulative CAD experience in our software, and it shows. Since 1983, OSA has been serving the microwave industry with state-of-the-art software solutions, providing one-of-a-kind innovations and impeccable after-sales support.

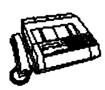
In 1988, OSA released its first product RoMPE™ - a PC based computer program for FET parameter extraction. In 1989, OSA announced a UNIX based software system HarPE™ for modeling and statistical modeling of active microwave devices and parameter extraction from DC, small-signal and large-signal measurement data. In 1991, OSA released OSA90/hope™: a new general purpose software system for optimization of high frequency and microwave circuits.

In 1992, OSA announced its ground-breaking product Empipe™: a smart interface between OSA90/hope™ and Sonnet Software's *em*™ for direct circuit design optimization with EM field-level simulation of microstrip structures. The unique capabilities of Empipe remain unchallenged by other software vendors.

In 1994, OSA announced the breakthrough concept of Space Mapping™ (SM). SM not only accelerates the speed of design optimization exploiting EM simulators but also makes it tractable. As a result, modeling of engineering devices, circuits and systems will reach a level of precision and computational efficiency previously undreamed of.

The distinctive features of OSA's software are exemplified in the publications of users of OSA's technology and in the publications of OSA authors over the years.

This report illustrates recent applications of OSA'S technology from the key figures of a number of selected publications which are listed in the references.



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Optimizing a Microstrip Bandpass Filter Using Electromagnetics

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Received February 16, 1995; revised April 20, 1995.

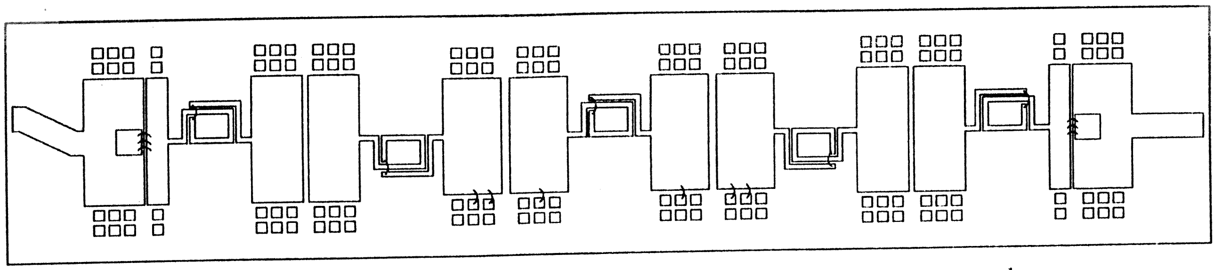

Figure 1. Top view of the printed bandpass filter. Parallel-plate capacitors are used across the outermost gaps to increase the coupling. The substrate size is 945 mil long by 190 mil wide, $\epsilon_r = 9.8$, and $h = 20$ mil.

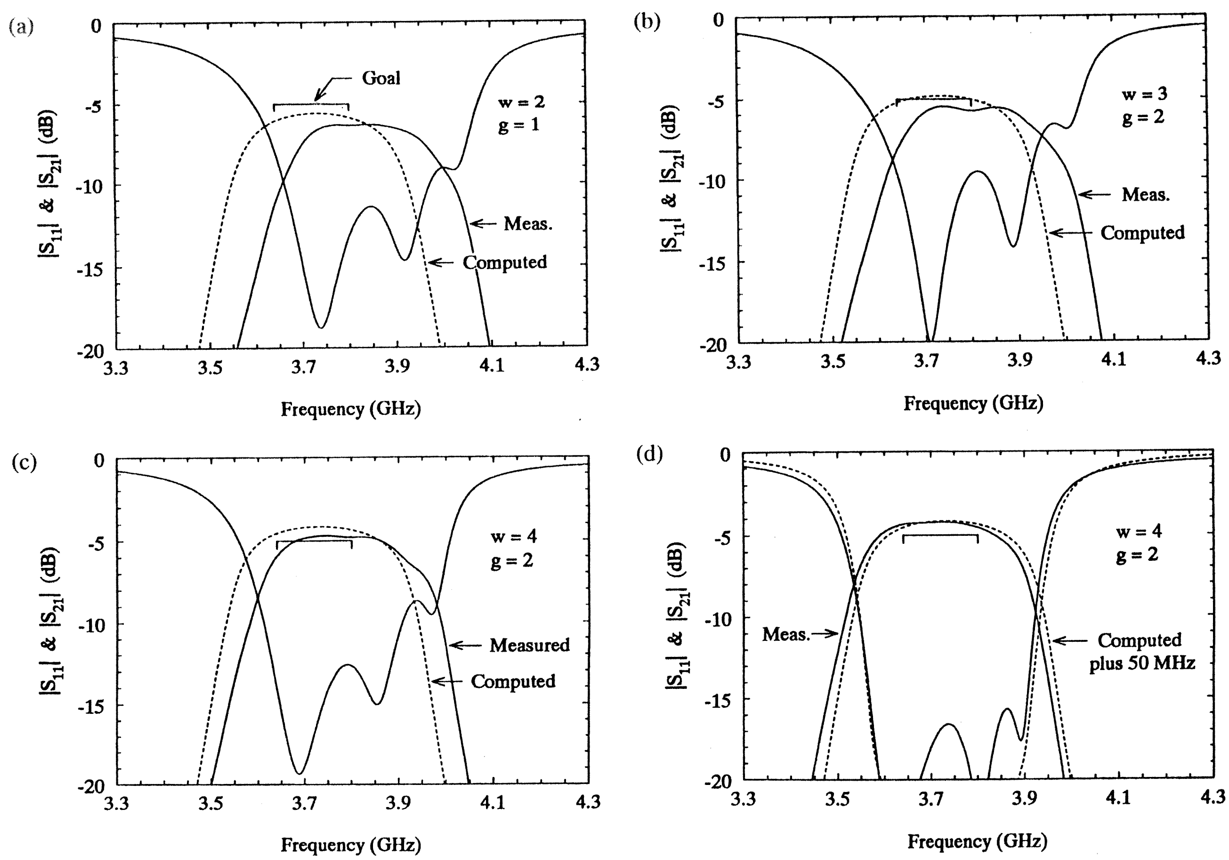

Figure 6. Experimental results from the four filter designs: (a) spirals with 2-mil lines and 1-mil gaps; (b) spirals with 3-mil lines and 2-mil gaps; (c) spirals with 4-mil lines and 2-mil gaps; and (d) same dimensions as (c) except Y-dimension of spirals increased by 0.9 mil.

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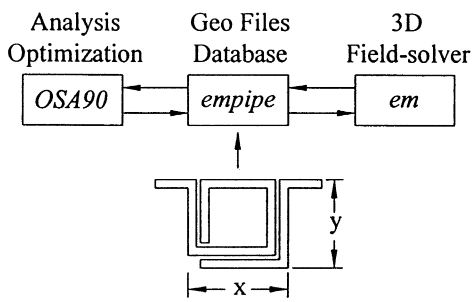
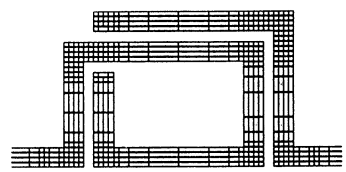
Optimizing Microstrip Filters Using Electromagnetics

Mr. Daniel G. Swanson, Jr.
Staff Scientist

The Optimization Process



Meshing the Spiral Inductor

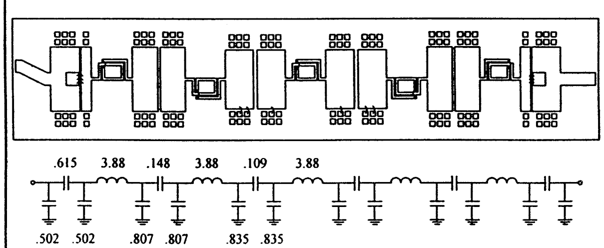


- ✓ Resolution in corners
- ✓ Cross-over region
- ✓ Convergence ?

width = 4 mils
gap = 2 mils

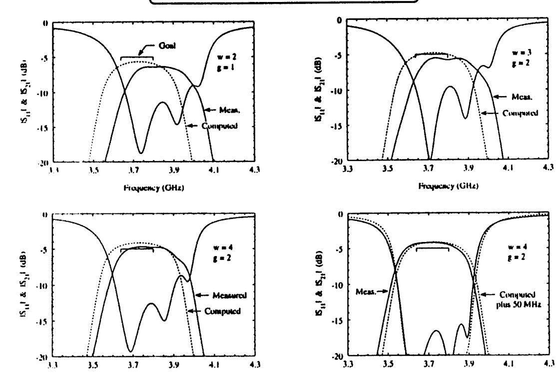
cell size = 1 mil
subsections = 976
4 min : 14 sec per freq

3.72 GHz Bandpass Filter



Units are pf and nH.

3.72 GHz Filter Results



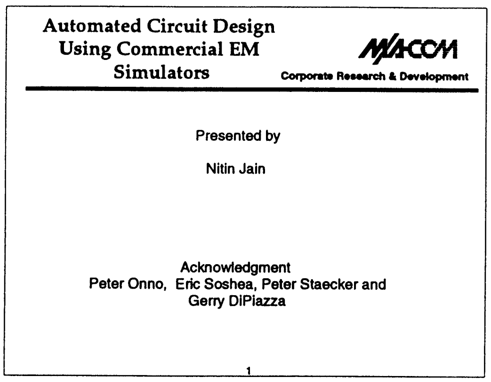
WORKSHOP ON AUTOMATED CIRCUIT DESIGN USING ELECTROMAGNETIC SIMULATORS
1995 IEEE MTT-S Int. Microwave Symposium, Orlando, FL, May 1995.

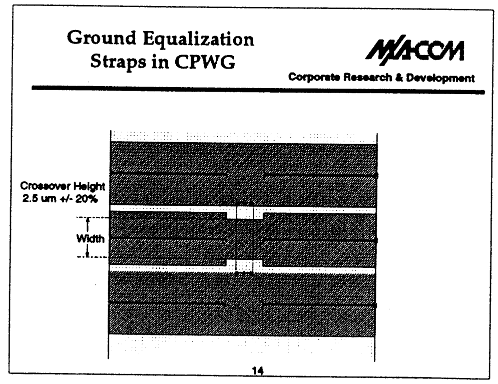
Automated Circuit Design Using Commercial EM Simulators

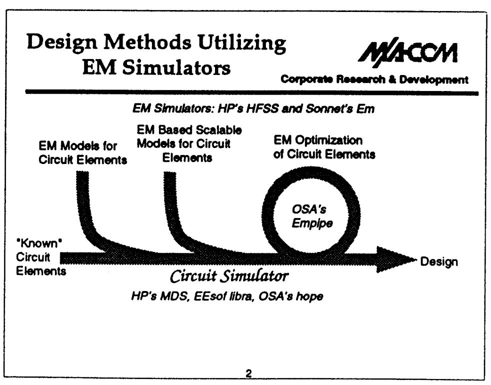
M/A-COM
Corporate Research & Development

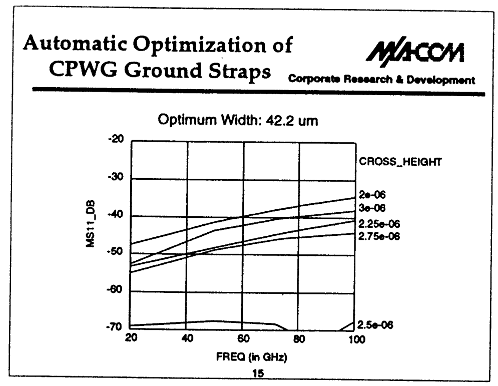
Presented by

Nitin Jain









WORKSHOP ON AUTOMATED CIRCUIT DESIGN USING ELECTROMAGNETIC SIMULATORS
1995 IEEE MTT-S Int. Microwave Symposium, Orlando, FL, May 1995.

Optimization of Microwave Structures using Time Domain TLM Electromagnetic Simulators

Wolfgang J.R. Hoefer

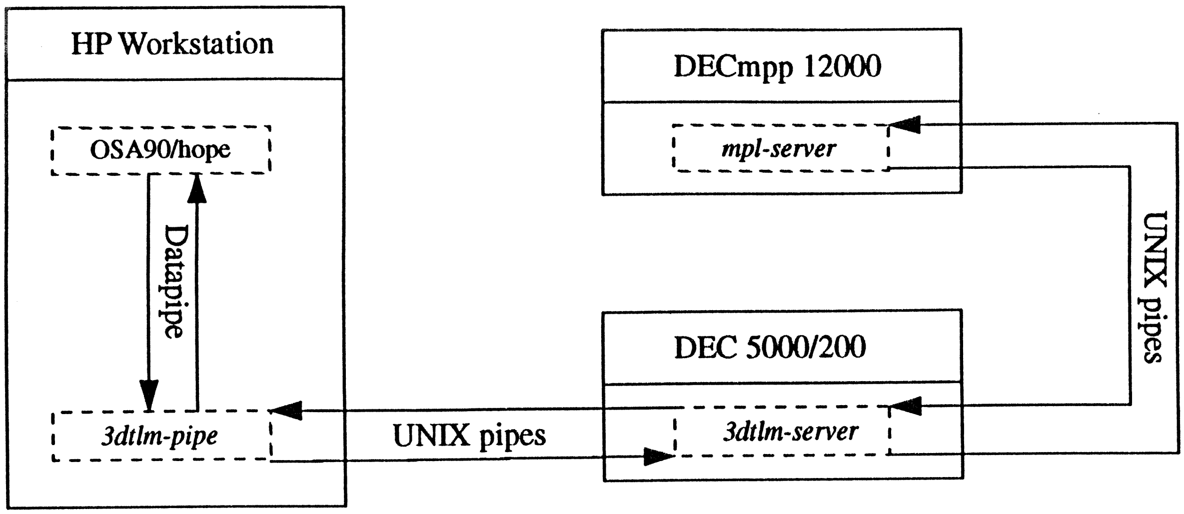
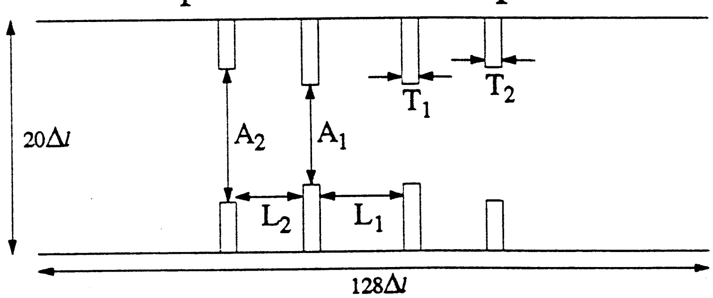


Figure 2 The interaction of OSA90/hope, *3dtlm-pipe*, *3dtlm-server* and *mpl-server.*

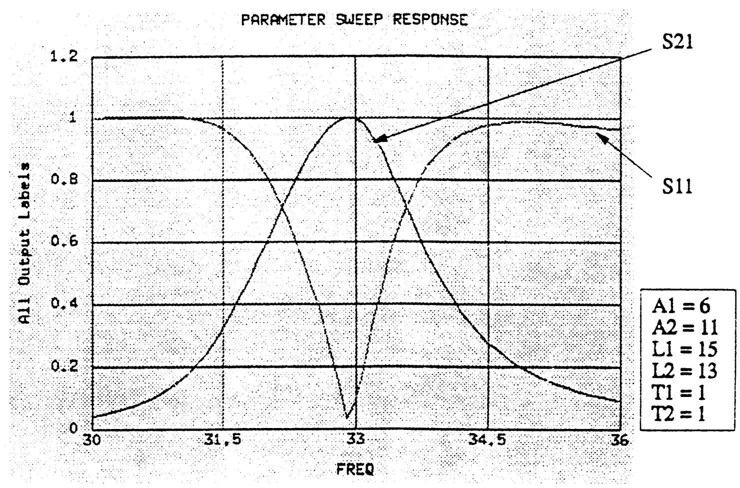
Optimization Example 1



A bandpass filter in the WR28 rectangular waveguide, $\Delta l = 0.3556$ mm. Using single precision floating operation, the mesh requires 50K of RAM. The optimization goal is:

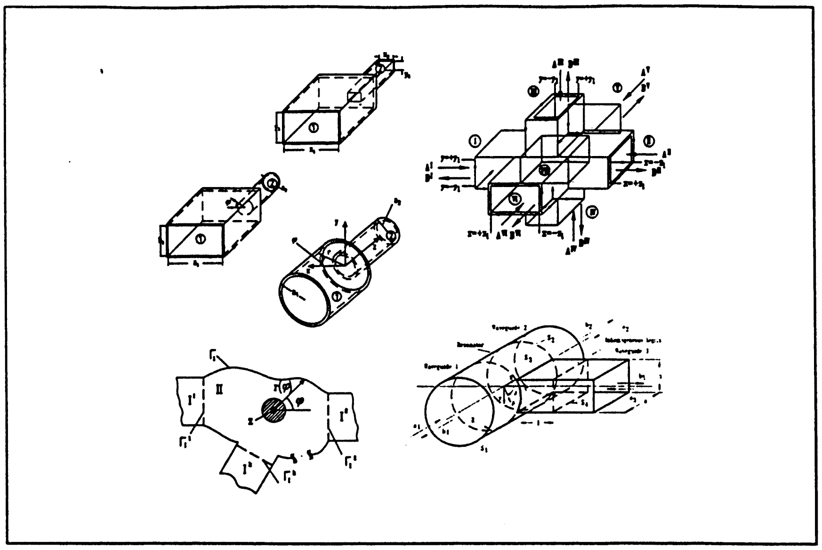
30.0 to 32.0 GHz step 0.1 GHz	S11=1	S21=0	weight=1
32.5 to 33.5 GHz step 0.1 GHz	S11=0	S21=1	weight=2
34.0 to 36.0 GHz step 0.1 GHz	S11=1	S21=0	weight=1

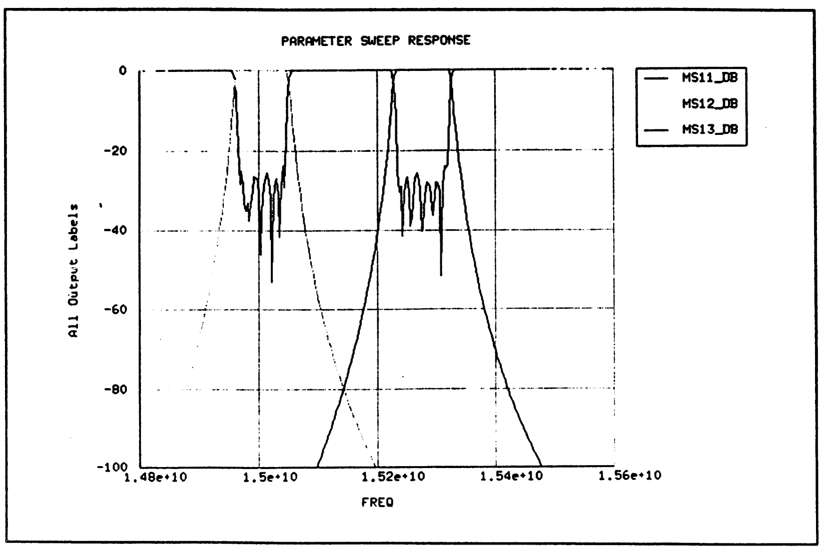
Optimized Result (180 Iterations)



EFFICIENT DESIGN OF RECTANGULAR AND CIRCULAR WAVEGUIDE COMPONENTS USING MODE-MATCHING SIMULATORS IN COMMON CIRCUIT CAD TOOLS

F. Arndt, Th. Sieverding, U. Papziner, T. Wolf





WORKSHOP ON AUTOMATED CIRCUIT DESIGN USING ELECTROMAGNETIC SIMULATORS
1995 IEEE MTT-S Int. Microwave Symposium, Orlando, FL, May 1995.

An improved P-HEMT large-signal model for medium-power Ka-band amplifiers

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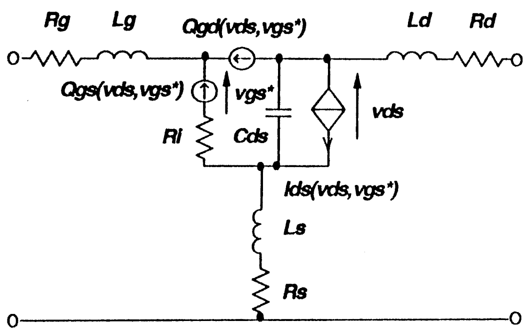

Figure 1: Structure of large-signal HEMT model.

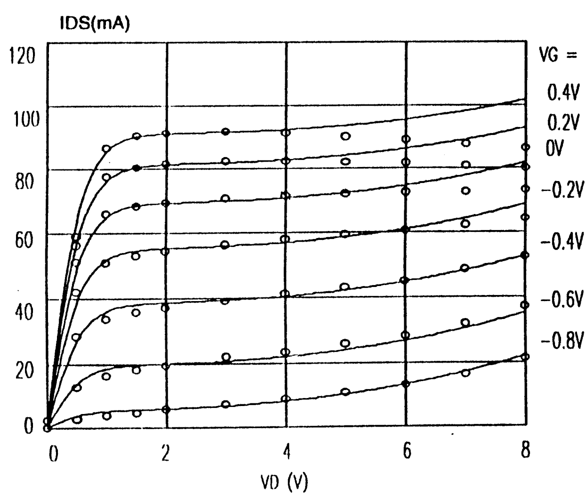

Figure 2: Measured and simulated DC curves of P-HEMT2 device.

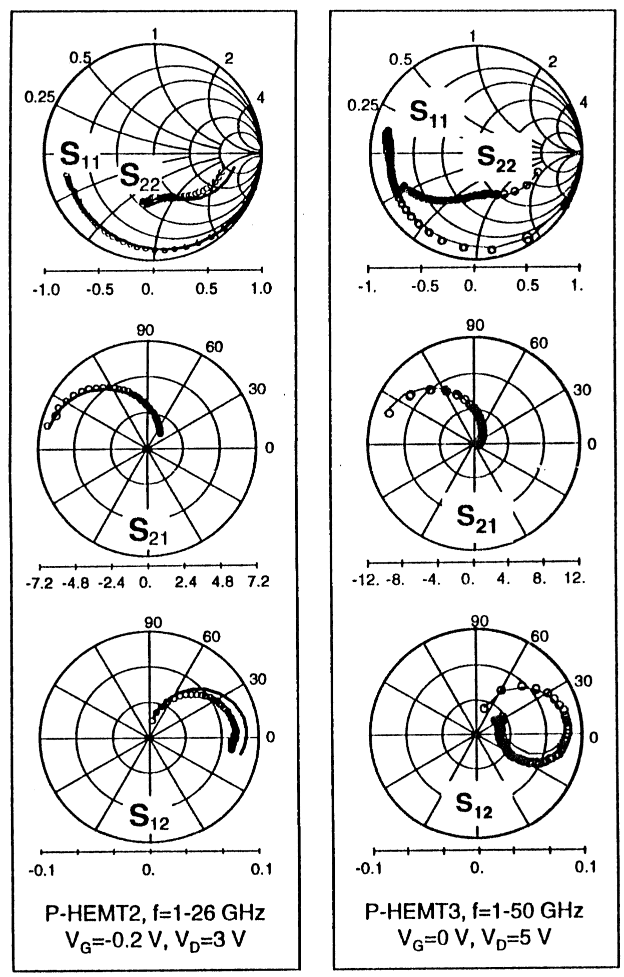

Figure 3: Examples of measured and simulated scattering parameters of P-HEMT2 and P-HEMT3 devices.

Proc. European Gallium Arsenide Applications Symposium
Turin, Italy, 1994, pp. 423-426

Non-linear CAD benchmark

For the latest in our series of CAD reviews, a challenging bipolar amplifier circuit was supplied to the major rf CAD vendors. An original concern that the results might all prove to be identical proved far from reality. OSA, Hewlett Packard, Eesof and Compact Software took up the challenge and supplied the simulation results here.

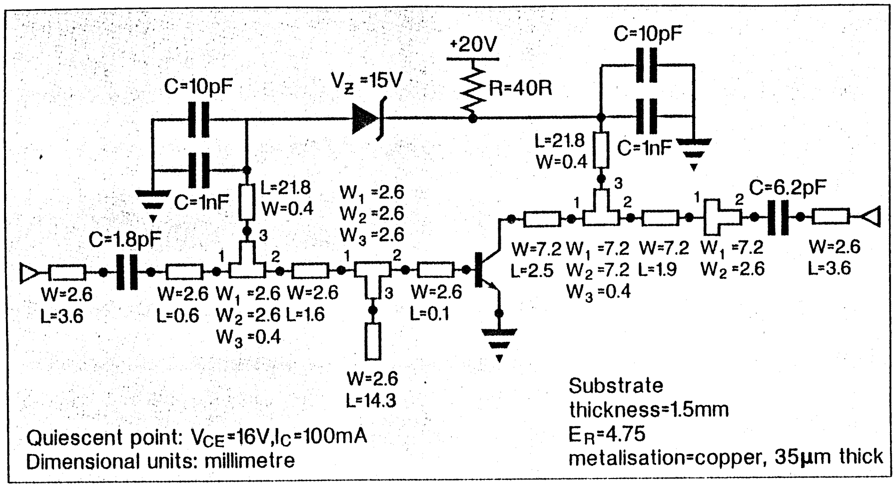

Figure 1: The power amplifier circuit, as supplied to the CAD vendors.

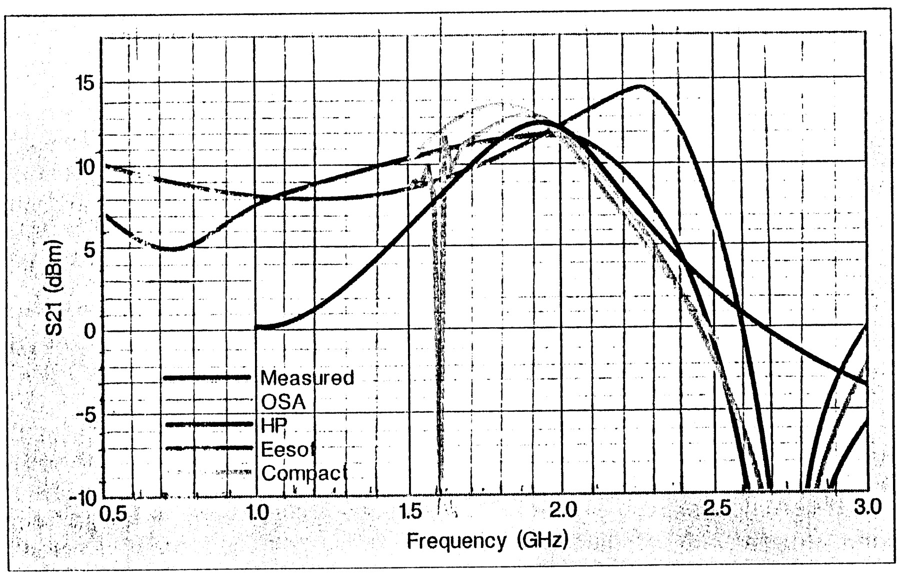

Figure 3 (above left): The linear simulation results for small signal gain, compared with the results measured at University College Dublin.

Microwave Engineering Europe, November 1993, pp. 11-15

CAD Review: the 7GHz doubler circuit

For our latest CAD benchmark, a doubler circuit was supplied to commercial vendors of non-linear microwave CAD. The results are presented here for simulators from Compact Software, Hewlett Packard and Optimization Systems Associates.

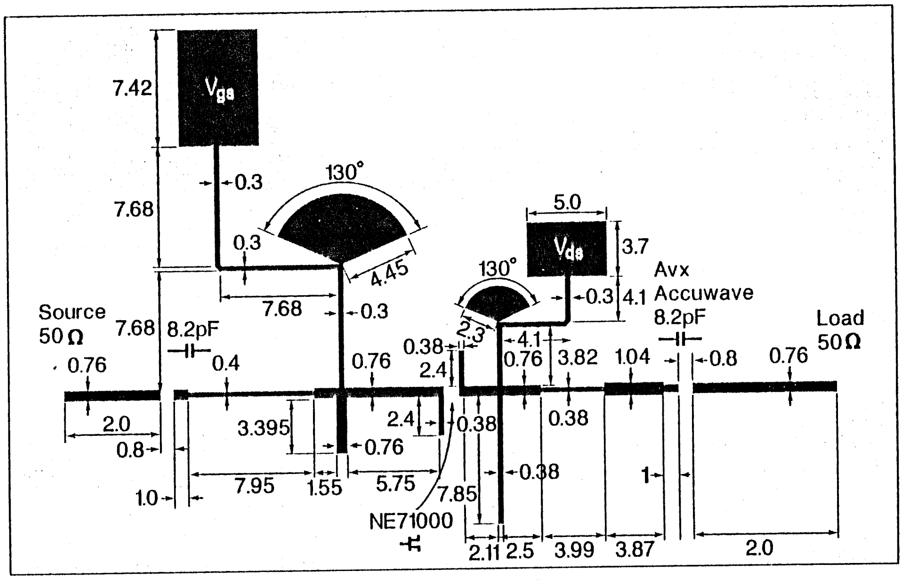

Figure 1: Circuit layout for the 7GHz doubler.

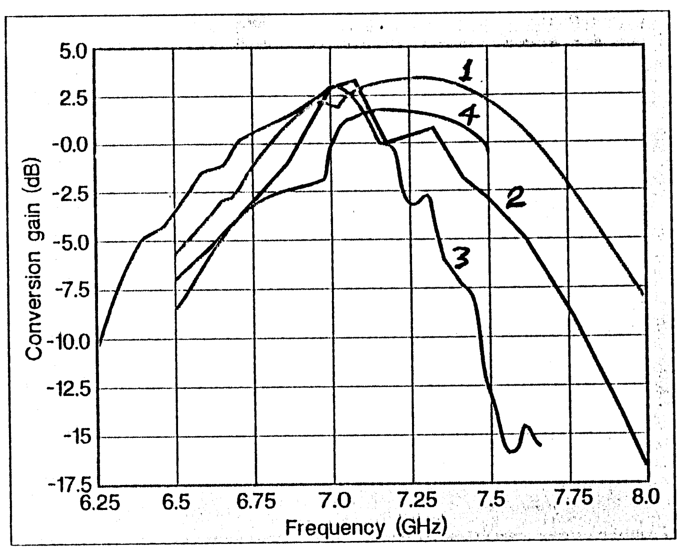

Figure 3: Conversion gain results plotted against frequency.

Key:

1	Compact	+ Fundamental (7GHz)
2	OSA	× 2nd harmonic
3	Measured	○ 3rd harmonic
4	HP MDS	● 4th harmonic

Microwave Engineering Europe, May 1994, pp. 43-53

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N. Jain, "Automated circuit design using commercial EM simulators," *IEEE Int. Microwave Symp., Workshop on Automated Circuit Design Using Electromagnetic Simulators* (Orlando, FL), May 1995.

W.J.R. Hoefer, "Optimization of microwave structures using time domain TLM electromagnetic simulators," *IEEE Int. Microwave Symp., Workshop on Automated Circuit Design Using Electromagnetic Simulators* (Orlando, FL), May 1995.

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M. Pirola, G. Ghione, J.M. Dortu and J. Müller, "An improved P-HEMT large-signal model for medium-power Ka-band amplifier," *Proc. European Gallium Arsenide Applications Symposium* (Turin, Italy), 1994, pp. 423-426.

"Non-linear CAD benchmark," *Microwave Engineering Europe*, November 1993, pp. 11-15.

"CAD review: the 7GHz doubler circuit," *Microwave Engineering Europe*, May 1994, pp. 43-53.

Microwave Circuit Design Utilizing Efficient Use of Electromagnetic Modeling of Circuit Elements

Nitin Jain

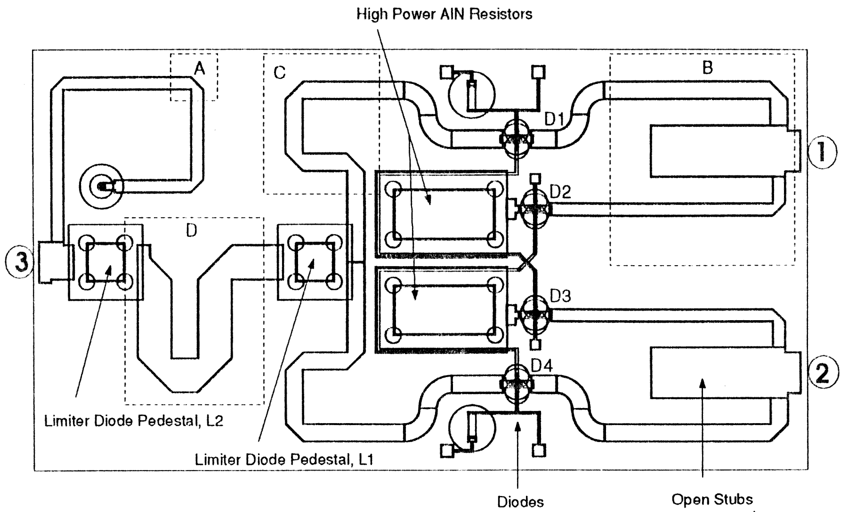

Figure 1. Switch-limiter layout in HMIC. The dotted region represents geometries that were simulate in the SONNET's EM.

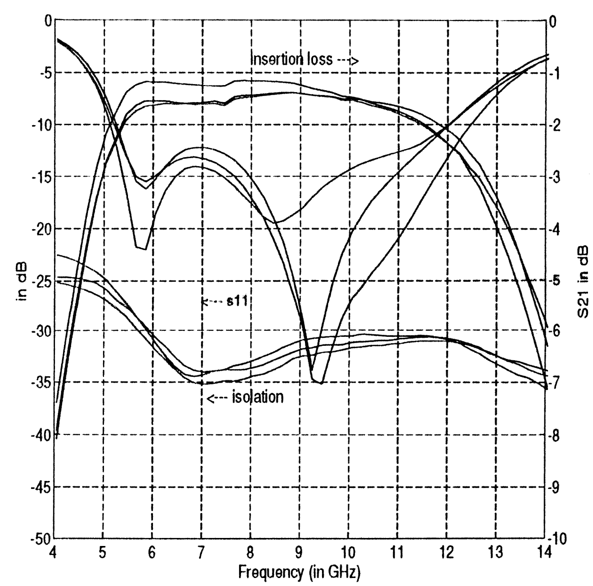

Figure 4. Measured S-parameter for a switch-limiter with no tweaking.

1995 MICROWAVES AND RF CONFERENCE AND EXHIBITION
London, UK, October 1995

First Pass CAD of Microstrip Filters Cuts Development Time

Daniel G. Swanson, Jr.

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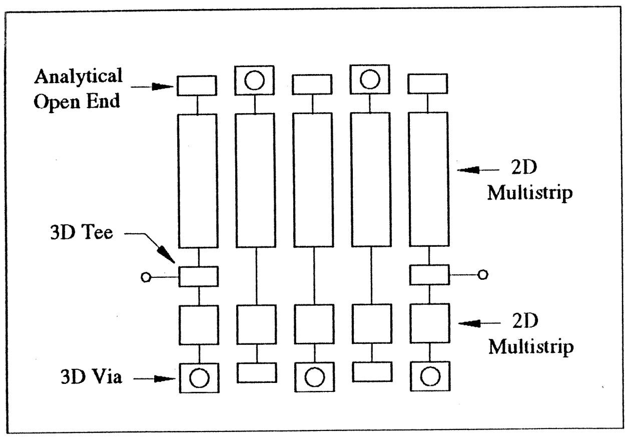

Fig. 3. A 2D cross-section-solver models the multiple coupled lines. The via and tee-junction models come from a 3D field-solver. Open-ends and short lengths of microstrip line are standard analytical models.

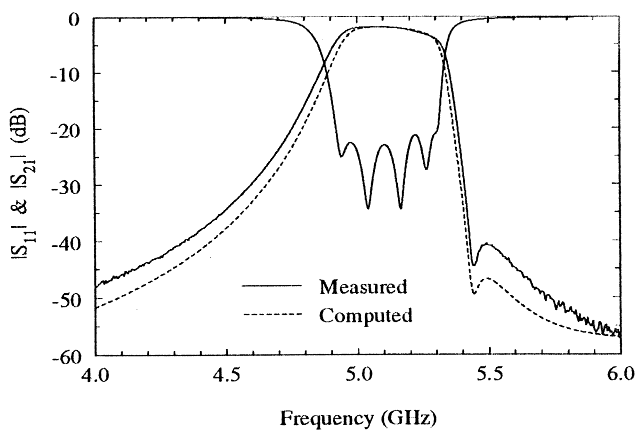

Fig. 4. A typical result for an interdigital filter at lower microwave frequencies. The transmission zero in the upper stopband is caused by non-adjacent couplings between strips. The f_0 error is less than 1% and the bandwidth error is about 9%.

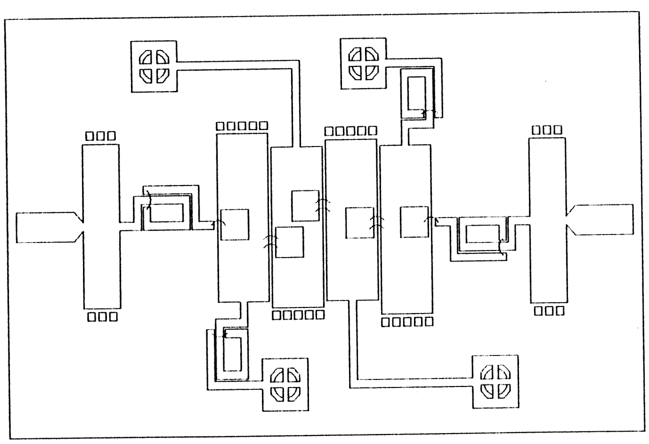

Fig. 10. The layout for the pseudo-lumped 1.5 to 5.5 GHz bandpass filter. This topology includes both series and shunt resonators. Four subnetworks are optimized of the field-solver: the series inductor, the shunt inductor, the single shunt patch, and the group of four shunt patches in the center of the filter. The substrate is 15 mil thick alumina, 350 mil long by 205 mil wide.

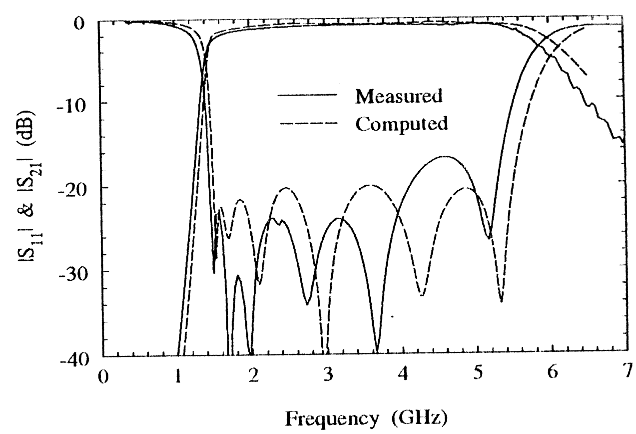

Fig. 11. The measured and modeled responses for the pseudo-lumped bandpass filter. The f_0 error is 50 MHz or 1.4% and the bandwidth error is 130 MHz or 3%.

1995 MICROWAVES AND RF CONFERENCE AND EXHIBITION
London, UK, October 1995

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