

IN-33

91288

P. 6

A 1-W, 30-GHz, CPW Amplifier for ACTS Small Terminal Uplink

Susan R. Taub
National Aeronautics and Space Administration
Lewis Research Center
Cleveland, Ohio

and

Rainee N. Simons
Sverdrup Technology, Inc.
Lewis Research Center Group
Brook Park, Ohio

Prepared for the
Monolithic Microwave Integrated Circuit Space
and Ground Applications Symposium
cosponsored by the National Aeronautics and Space Administration
and the Jet Propulsion Laboratory
Pasadena, California, April 28-29, 1992



Post Coupler

A CPW-to-CPW post coupler is shown in figure 3. The CPW's share a common ground plane that has an aperture. The coupler is formed by a metal post which passes through the aperture and contacts the strip conductors of the CPW. A pair of wire located to the sides of the post, tie the CPW ground planes to a common potential. The S-parameters for the coupler are shown in figure 4. The coupler works only marginally at 30 GHz, but shows excellent characteristics at 7 GHz. Work is being done, including computer simulations to better understand the behavior of this coupler.

MMIC Chips

Two MMIC chips were used, a three-stage and a single-stage amplifier chip. The gain compression of the three-stage chip is shown in figure 5. A typical chip has a power output of 190 mW, gain of 23 dB, and efficiency of 30.2 percent. Typical characteristics for the single-stage chip are: power output of 710 mW, gain of 4.2 dB, and efficiency of 24 percent. In order to achieve the required 1 W of output power, the MMIC chips were cascaded. The cascading configuration is shown in figure 6.

MMIC Carrier

A novel package, which consist of a carrier and housing, was developed to mount the MMIC chips in the amplifier. The carrier with housing is shown in figure 7. The carrier has CPW interconnects and provides heat-sinking, tuning, and cascading capabilities. The housing provides electrical isolation, mechanical protection, and a feed-through for biasing. Figure 8 shows the measured insertion and return loss of the carrier with a 50- Ω microstrip line in place of the MMIC. After subtracting the losses due to the test fixture, the insertion loss of the carrier is about 1.0 dB and the return loss is better than 15 dB.

Conclusions

The paper presents two schemes for the assembly of a 1-W, 30-GHz MMIC amplifier for the ACTS small terminal. The characteristics of TI MMIC chips, the post coupler, and the carrier have been presented. Future work includes: characterizing the power divider/combiner, tuning the MMIC chips, and assembling the amplifier.

References

1. Saunier, P.; and Tserng, H.Q.: AlGaAs/InGaAs Heterostructures with Doped Channels for Discrete Devices and Monolithic Amplifiers. IEEE Trans. Electron Devices, vol. 36, Oct. 1989, pp. 2231-2235.
2. Simons, R.N.; and Taub, S.R.: A Flexible CPW Package for a 30-GHz MMIC Amplifier. Presented at the IEEE Topical Meeting on Electrical Performance of Electronic Packaging, Apr. 22-24, 1992, Tuscon, AZ. NASA TM-105630, 1992.

Power input	-25 dBm
Power output	1 W
Center frequency	29.634 GHz
Bandwidth	29.1-30 GHz
Input connector	2.4 mm OS-50
Output waveguide	WR 28

Table 1: Amplifier requirements.

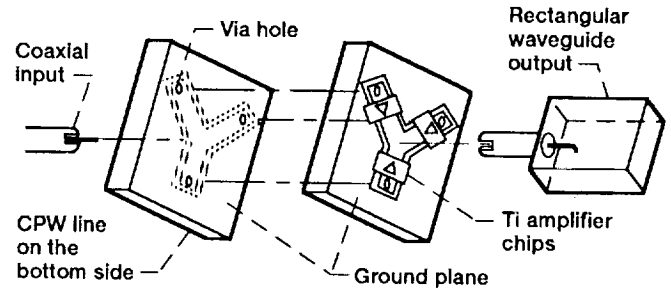
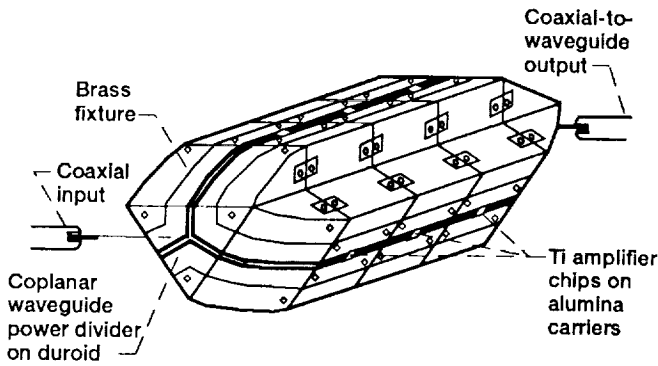


Figure 1.—Amplifier configuration.



(a) Alternate amplifier configuration.

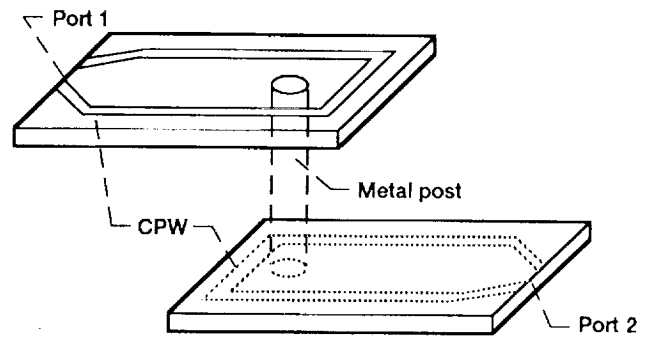
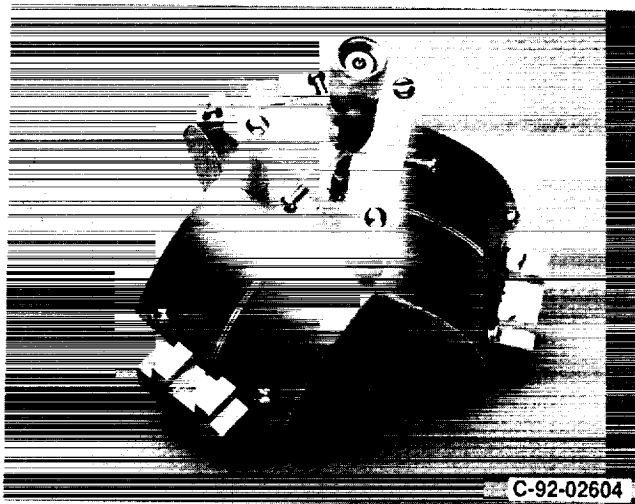
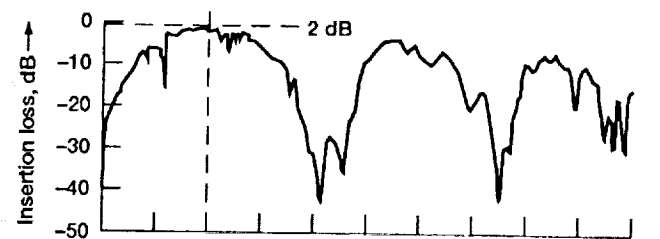


Figure 3.—CPW-to-CPW post coupler.

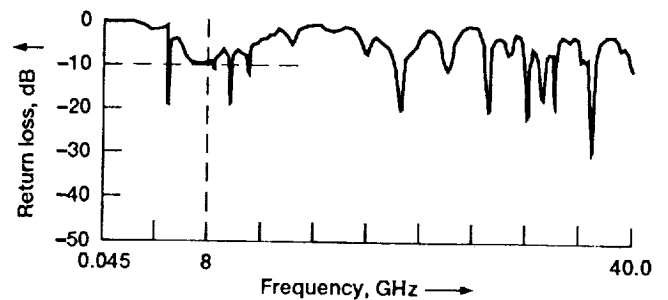


(b) Coax-to-CPW in-phase three-way radial nonplanar power divider/combiner.

Figure 2.



(a)



(b)

Figure 4.—Post coupler S-parameters.

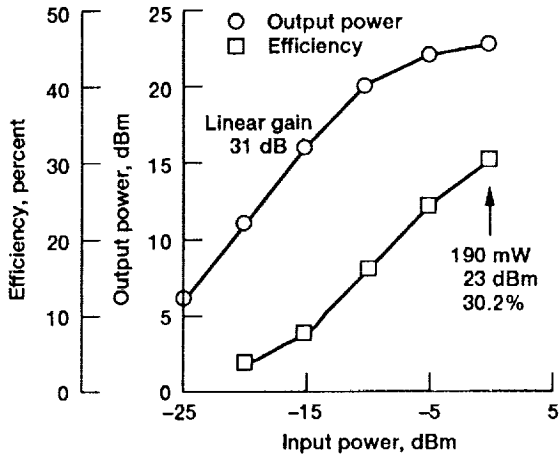


Figure 5.—Gain compression diagram of three-stage amplifier.

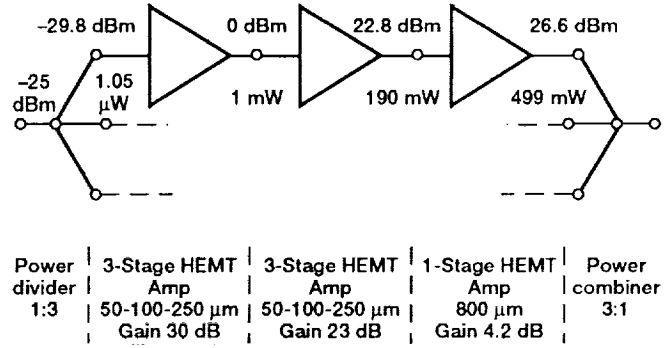


Figure 6.—MMIC combination scheme.

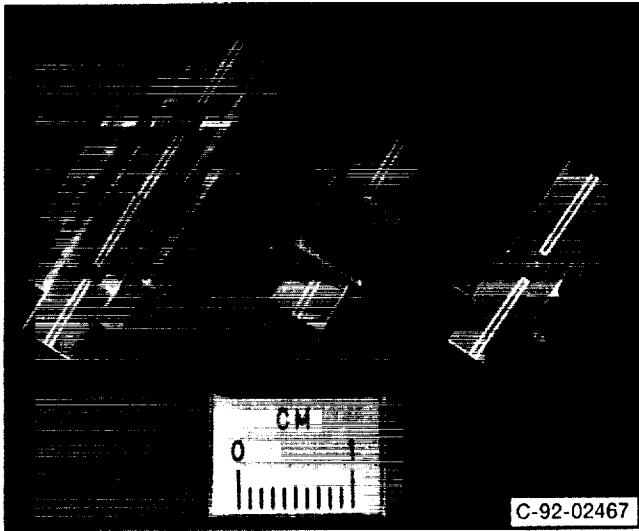


Figure 7.—Carrier with housing.

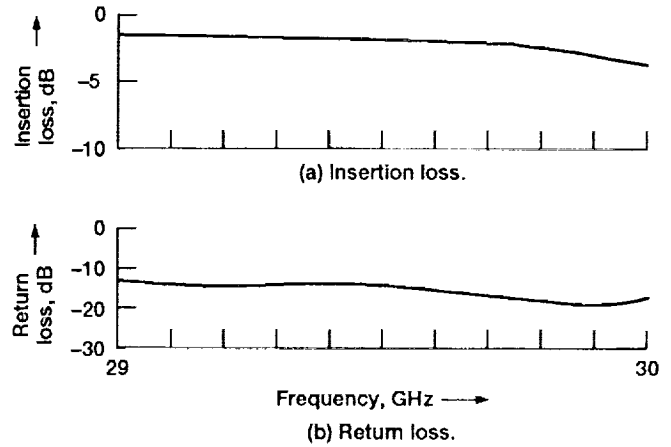


Figure 8.—Measured insertion loss and return loss of the carrier.

ORIGINAL PAGE
BLACK AND WHITE PHOTOGRAPH



REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE 1992	3. REPORT TYPE AND DATES COVERED Technical Memorandum	
4. TITLE AND SUBTITLE A 1-W, 30-GHz, CPW Amplifier for ACTS Small Terminal Uplink			5. FUNDING NUMBERS WU-506-72-1E	
6. AUTHOR(S) Susan R. Taub and Rainee N. Simons				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) National Aeronautics and Space Administration Lewis Research Center Cleveland, Ohio 44135-3191			8. PERFORMING ORGANIZATION REPORT NUMBER E-7037	
9. SPONSORING/MONITORING AGENCY NAMES(S) AND ADDRESS(ES) National Aeronautics and Space Administration Washington, D.C. 20546-0001			10. SPONSORING/MONITORING AGENCY REPORT NUMBER NASA TM-105671	
11. SUPPLEMENTARY NOTES Prepared for the Monolithic Microwave Integrated Circuit Space and Ground Applications Symposium cosponsored by the National Aeronautics and Space Administration and the Jet Propulsion Laboratory, Pasadena, California, April 28-29, 1992. Susan R. Taub, NASA Lewis Research Center; Rainee N. Simons, Sverdrup Technology, Inc., Lewis Research Center Group, 2001 Aerospace Parkway, Brook Park, Ohio 44142 (work funded under contract NAS3-25266). Responsible person, Susan R. Taub, (216) 433-6571.				
12a. DISTRIBUTION/AVAILABILITY STATEMENT Unclassified - Unlimited Subject Category 33			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) This paper describes the progress to date of the development of a 1-W, 30-GHz, coplanar waveguide (CPW) amplifier for the Advanced Communication Technology Satellite (ACTS) Small Terminal Uplink. The amplifier is based on Texas Instruments' monolithic microwave integrated circuit (MMIC) amplifiers; a three-stage, low-power amplifier and a single-stage, high-power amplifier. The amplifiers have a power output of 190 mW and 0.710 W, gain of 23 and 4.2 dB, and efficiencies of 30.2 and 24 percent for the three-stage and one-stage amplifiers, respectively. The chips are to be combined via a CPW power divider/combiner circuit to yield the desired 1 W of output power.				
14. SUBJECT TERMS Amplifier; Monolithic microwave integrated circuit			15. NUMBER OF PAGES 6	
			16. PRICE CODE A02	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT	