DVD Part Number: CFP20V66-DVD; ISBN: 978-1-7281-4107-7

8:1 Radio Frequency High Power Combiner

Mrs. Neha N. Gharat
Electronics and Telecommunication Department of Engineering
Vidyavardhini's College Of Engineering *and Technology, vasai w*
Vasai, India
neha.gharat@vcet.edu.in

Mrs. Ekta V. Naik
Electronics and Telecommunication Department of Engineering
Vidyavardhini's College Of Engineering *and Technology, vasai w*
Vasai, India
ekta.naik@vcet.edu.in

Abstract— **Power combiner used to combine the power from various solid-state amplifiers. A power combiner is essential for applications that require a larger power source for their efficient operation. Since taking inputs from multiple solid-state amplifiers is a tedious job and limits its overall power throughput. This paper proposes a design for 8:1 RF combiner, operating at radio frequency, which combines the power received at its eight input ports in one-step. The design approach is Circuit level combining based on N-way combining structure and radial combining and is analyzed using S-parameters. The simulated results show that this approach of designing 8:1 way power combiner provides a high degree of isolation, low return loss and low reflection loss with 90% efficiency and unsurpassed simplicity in design to fabricate.**

Keywords—Radial transmission line, RF Combiner, Scattering Parameters

I. INTRODUCTION

The radiofrequency (RF) and microwave power combiner play a vital role in the solid-state RF amplifier. In present-day for any practical applications, instead of vacuum tubes, the transistor-based solid-state amplifier is used because of their advantage in mechanical robustness. However, the major drawback of these solid-state amplifiers for these kinds of applications is that they can only work at a specific low power level. This power level is not enough in machines or applications that require a large power source for operation. One way to address this is to create a network of solid-state amplifiers, which will be complex if the power level to be achieved a very high like 20kW. This is when RF combiners play a significant role in designing. As the name suggests, it is a passive microwave device used for combining RF signals, which are fed from various solid-state amplifier sources as shown in Fig. 1, and gives their combined power at its output port. An advantage of this method is that it keeps the solid-state amplifiers at the inputs isolated from each other [3]. Also, an RF power combiner can be designed using reactive splitters, 90-degree hybrids and 80-degree hybrids as well. The main aspect of any power combiner is its efficiency. If a regular corporate combiner is used with a loss of 1dB at each stage by the time it reaches stage three or four half of its power would be lost and there would be no power left to the combiner. Moreover, in any microwave system, reflection loss plays a major role in the overall performance loss [7]. The power combining is analogous to multiplexing technique, with even number of input ports, 2n +1 number of ports where n>2. If a 4:1 combiner is used, which is simple in its design but the reflected power is dispersed among the remaining ports thus disturbing the overall system itself. To reduce this effect and improve the overall performance number if inputs should be increased. Incase 16:1 combiner considered spacing between ports would lead to isolation loss. As a tradeoff, 8:1 approach is the ideal way out, providing proper isolation to all the ports and minimizing the reflected power distribution problem as well.

A. *Related Work*

A. Eroglu had proposed, a novel technique for the design of RF combiner [4]. He converted the distributed elements to equivalent lumped elements using different formulations. This circuit was then fabricated on a ceramic substrate. This was the first time such a model was designed for HF range. However, the losses in the substrate and conductor were not considered in the design. At the radio frequency range; losses become more prominent and cannot be ignored. Besides, the computation of values would get cumbersome as well as the fabrication of these components would be a complex process. Wilkinson had designed an 8:1 power divider using radial approach [7]. According to his studies, the radial approach is better of all for N-way combining. A resistive star (radial) network connected to the N ports provides the isolation. This circuit was not designed for higher frequencies since at high frequencies the resistors would dissipate a large amount of heat, which greatly reduces the overall performance for any practical power combiner. K.J. Russell had proposed various power combining configurations [6]. The tree structure, the chain structure and the n-way combining structures like cavity resonators. He had also mentioned about the work from Wilkinson's paper under a non-resonant combining structure,

978-1-7281-4108-4/20/$31.00 ©2020 IEEE

IEEE

Hindusthan Institute of Technology
Accredited with 'A' Grade by NAAC and Accredited by NBA

CERTIFICATE OF PRESENTATION

This is to certify that

Mrs. Neha N. Gharat

has successfully presented a paper entitled

8:1 RADIO FREQUENCY HIGH POWER COMBINER

in the **International Conference on Electronics and Sustainable Communication Systems (ICESCS 2020)**
organised by Hindusthan Institute of Technology, Coimbatore, Tamil Nadu, India
during 02-04, July 2020.

VIDYAVARDHINI'S COLLEGE OF ENGINEERING & TECHNOLOGY
EXTC Engg.

HEAD
Dept. of Electronics and Telecommunication Engg.,
Vidyavardhini's College of Engineering & Technology

SESSION CHAIR

CONFERENCE CHAIR
Dr. S. Kavitha

PRINCIPAL
Dr. C. Natarajan

484