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New Modified Gysel Power Divider and Leakage Cancellation Circuit for Wireless Applcations

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Abstract— In this paper, a new modified system for equal power division is implemented with the help of rectangular micro strip patch antenna, Gysel power divider and leakage cancellation circuit. Today's world power division plays an important role in wireless application areas such as base stations, antenna arrays, hand held devices etc., Here micro strip patch antenna is implemented with FR4 as a substrate material due to its benefits such as low loss and low fabrication cost while the ground material is aluminium due to its conductivity. For a good system, the return loss should be highly desirable and insertion loss should be low. Our proposed system is designed with a combination of micro strip patch antenna, leakage cancellation circuit and Gysel power divider produces equal power division with low loss such as insertion loss is measured as -39.291dB, return loss as -16.11dB and leakage cancellation as 6dB which was designed and simulated in Agilent Advanced Design System software (2009).

Keywords: ***Advanced Design System software (2009) (ADS), Gysel Power Divider (GPD), Leakage Cancellation Circuit (LCC), Wilkinson Power Divider (WPD), Return Loss (RL), Insertion Loss (IL)***

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I. INTRODUCTION

In today's world, wireless applications plays a major role especially in wireless communication systems. For this application there is a need of equal power division between the base station and the user with low loss and high signal strength. So, in this paper, we have introduced a new modified system for equal power division using GPD with low loss (in dB), LCC[10] circuit where as the presence of rectangular micro strip patch antenna [6] provides the input to the system. Section 1.1 deals about GPD where as section 1.2 says about LCC and section 1.3 deals about rectangular micro strip patch antenna. Section II deals about the implementation part while section III tells about simulation results and discussion. Section IV and V implies about conclusion and references respectively. 1.1 GPD In general, power dividers are also called as power splitters, when used in reverse acts as the power combiner. It plays a vital role in various RF and communication applications [1,2]. The areas of applications are TV analyzer, hand-held spectrum analyzer, antenna arrays, and

microwave applications, WLAN such as 802.11b, 802.11g, and 802.11n over a frequency range of 2.4GHz band. It is a passive device[4] which is used in the field of radio technology which requires power to be distributed among different paths. Power dividers are used especially for antenna array systems that utilize power-splitting network, such as a corporate or parallel feed system. The desirable properties of a power divider are low insertion loss, low isolation loss, high isolation between output ports and high return loss. The additional deseriable property of a power divider is wider bandwidth leading to number of sections and is helpful for N-way power division [1,2]. As opposed to WPD[3], GPD is used to successfully combine and divide RF power above 10 kilowatt level for each input[5]. This design has characteristics such as low insertion loss, high isolation between output ports, matched conditions at all ports, external high power load resistors and monitoring capabilities for imbalances at the input ports. GPD[4] has not only the advantage of high power-handling capability [12] but also monitoring capability for imbalance at the output ports. In the above aspects it outperforms the WPD[3].

II. LCC

The main advantage of this circuit is to improve the isolation between transmitter and receiver.

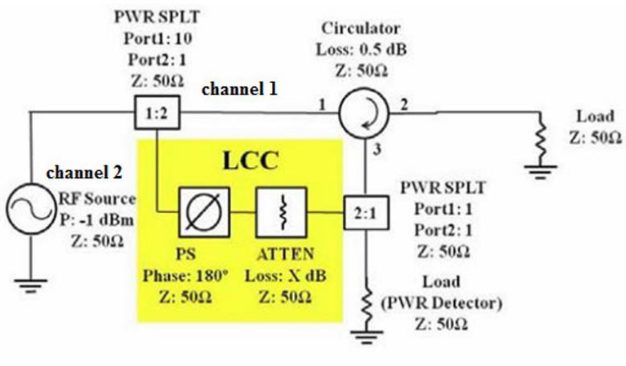


Figure 1: General representation of LCC[10]

From the above figure, LCC can be indicated by an attenuator and phase shifter[10]. While splitting the incoming power using power splitter, some amount of incoming power is circulated where as the other part of incoming power is given to LCC and the output is the cancellation signal (C) designed to cancel leakage signal (L) from the circulator. The cancellation improvement in dB is given below,

From the above description, LCC is comprised of both phase shifter and attenuator[10]. But generally there is some difficulties to match both the phase and amplitude of the leakage to achieve R=0. When the signals from two channels are being added, the total voltage becomes V = V1 + V2 = 1 + α (2) Where channel 1 is used as a reference (V1=1) and α and Φ are the relative amplitude and phase of channel 2 to the reference. Thus, the amplitude imbalance is simply α and the phase imbalance is Φ. V2 represents the cancellation voltage C. The main aim of the cancellation branch is to cancel the leakage L and mismatch M which implies only the desired signal S [10].

1.3 Rectangular Microstrip Patch Antenna There are many types of antenna with each one has their own characteristics[6]. But here we used a micro strip patch antenna which radiates primarily because of the fringing fields between the patch edge and the ground plane. Due to its low profile structure it became popular one to use in wireless applications, satellite applications and military applications.

It realizes the good antenna parameters such as high efficiency, low dielectric constant, small size and good radiation pattern. We implement micro strip patch antenna in our system due to its advantages such as light weight, low volume, supports both linear as well as circular polarization, capable of dual and triple frequency operations and low fabrication cost[6].

III. PROPOSED SYSTEM MODEL

From the above section, GPD leads to equal power division with high power handling capabilities. In the existing system, GPD has been used as a combiner rather than divider in TV applications because of its high isolation between the ports. But in our system, we implement such a GPD with LCC[6] and micro strip patch antenna. Here the system receive the power source from the micro strip patch antenna and then the leakage cancellation circuit cancels the leakage and give the source to power divider to provide equal power division which can be applicable to TV applications, broad cast applications and base stations. RF input Micro Strip Patch Antenn a LCC circuit GYSEL POWER DIVIDE R Output Figure3: Block diagram of proposed system

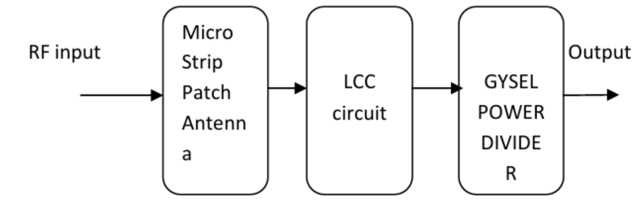


Figure3: Block diagram of proposed system

Figure 4 shows the implementation of rectangular micro strip patch antenna in Agilent ADS software with a size of 38x27mm. It has FR4 as a substrate material and aluminium as a conducting material in ground over a operating frequency range of 3GHz. We have chosen the substrate material as FR4 since it has low loss and easy to fabricate. The impedance matching is high due to the placement of feeding line on the left edge of the patch. Since rectangular patch is easy to design and have a good polarization characteristic, the antenna parameters such as return loss is highly desirable and insertion loss is minimum. Thus our system has high efficiency.

IV. RELATED WORKS

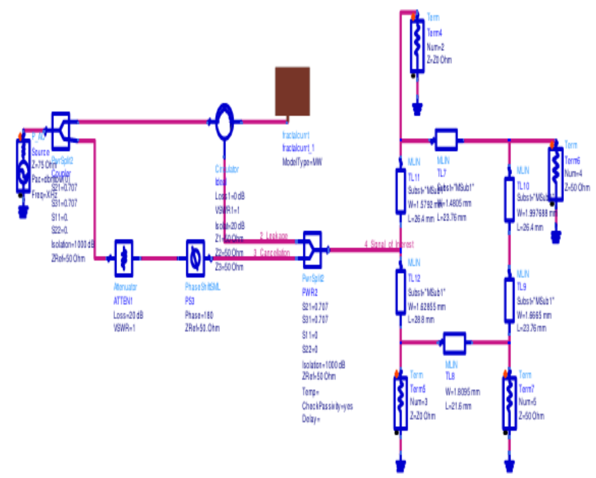


Figure 5: Implementation of proposed system in ADS software

source to the system and circulator is used to transmit a microwave or radio frequency signal entering any port is transmitted to the next port in rotation (only). This system is operated over a frequency range of 3GHz with 1.5GHz as a center frequency. The simulation result of this system is shown below.

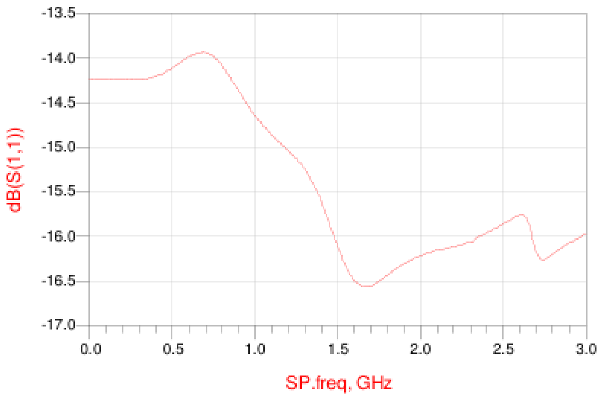
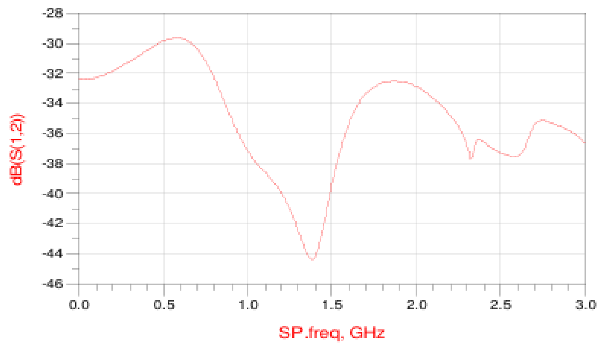


Figure 6: Return loss of the system



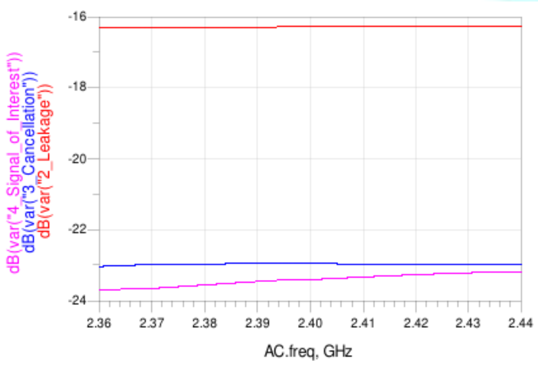


Figure 8: Leakage cancellation of the system

In comparator circuits to reduce power consumption the Power gating technique is proposed. In this technique, circuit operates in sleep mode by switching off the current in circuit. Power gating has the benefit that is it measures current (Idd) in the quiescent state. In this paper the different architectures of double tail comparator is presented. The proposed comparator is designed by using power gating technique. Using this technique power and delay is reduced.

V. BACKGROUND OF STUDY

The circuit diagram of the single tail comparator shown in Fig 3. The single tail comparator circuit operation is given below. When CLK=0 the circuit works in reset phase so the Mtail NMOS transistor is in off position and the reset transistors M7 and M8 PMOS transistors are in on position now the output at OUTN and OUTP will be VDD. When CLK= VDD , Mtail NMOS transistor is in ON position and M7 and M8 PMOS transistors are in OFF position now the OUTN and OUTP urrent to keep the differential amplifiers in weak condition so a large current required enabling fast regeneration in the circuit.

VI. METHODOLOGY

This structure has the power consumption 20.49 nW and circuit delay is 38.83 ps. Circuit diagram of the conventional double tail comparator shown in Fig 4. This structure has low static power consumption and operates at lower supply voltages compare to the single tail comparator. The working of this comparator is given below.

When CLK=0 the to discharge with different charging rates. Due to these

ending on the input voltages INN and INP. When INP voltage>INN voltage, M1 NMOS transistor provides less current than M2 NMOS transistor due to this current fn discharges faster than fp. The disadvantage of this structure is static power consumption whenever the current drawn from VDD to ground through input and Mtail1 transistor. To overcome static power consumption in proposed double tail comparator two NMOS transistors MSW1 and MSW2 used below the input transistor

VII. CONCLUSION

Thus we conclude that a new modified system for equal power division is designed successfully and the parameters such as RL, IL and leakage cancellation get minimized of about -16.11dB, 39.291 dB and 6dB respectively which operate over an operating frequency range of 3GHz with 1.5GHz as a center frequency and it is suitable for base stations and antenna arrays. The system is designed using ADS software (2009).

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