A NEW MODIFIED SYSTEM FOR EQUAL POWER DIVISION WITH LCC 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)

1. INRODUCTION

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

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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].

1.2 LCC

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

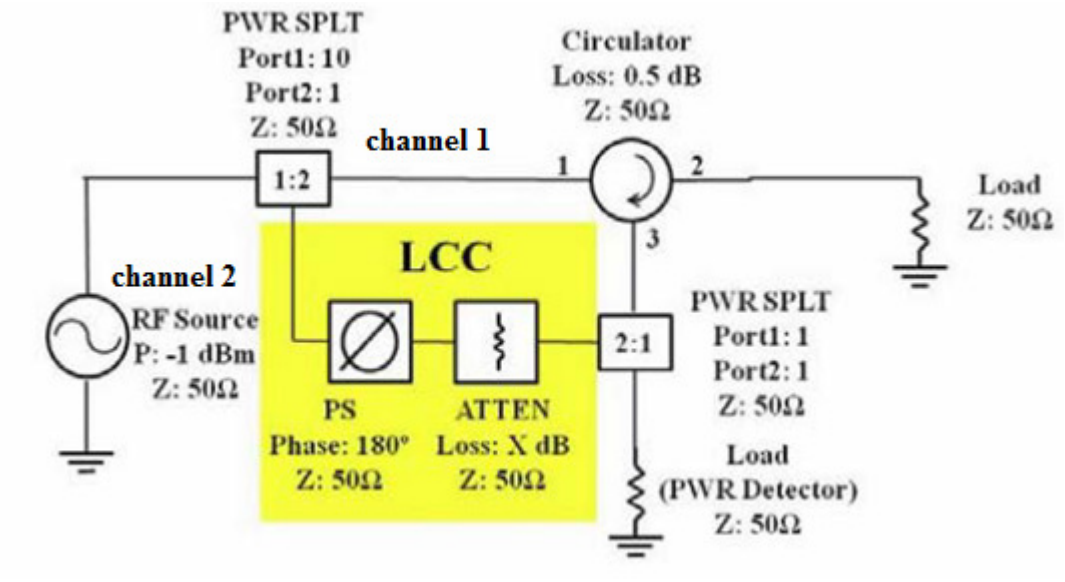

Figure 1: General representation of LCC[10]

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,

$$CI = 10\log\left(\frac{R}{L+M}\right) = 10\log\left(1-\frac{C}{L+M}\right) \quad (1)$$

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

$$V = V_1 + V_2 = 1 + \alpha e^{i\Phi} \quad (2)$$

Where channel 1 is used as a reference (V_1=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. V_2 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].

2. 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.

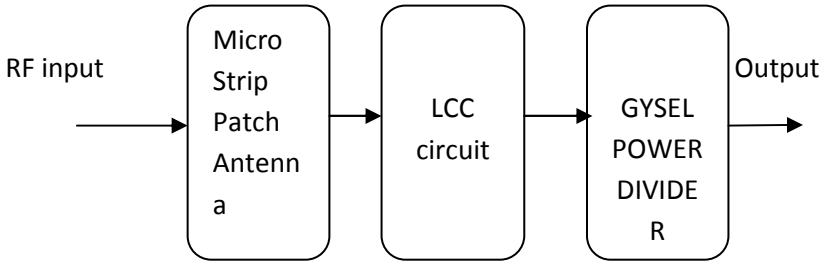

Figure3: Block diagram of proposed system

Figure 4: Implementation of micro strip patch antenna in ADS

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.

3. APPLICATIONS

Some of the applications of power dividers are TV analyzer, hand-held application, military application, satellite application, antenna arrays, base stations, ratio measurement, wireless applications such as WiMAX, WLAN, Wi-Fi etc.,

4. SIMULATION RESULTS

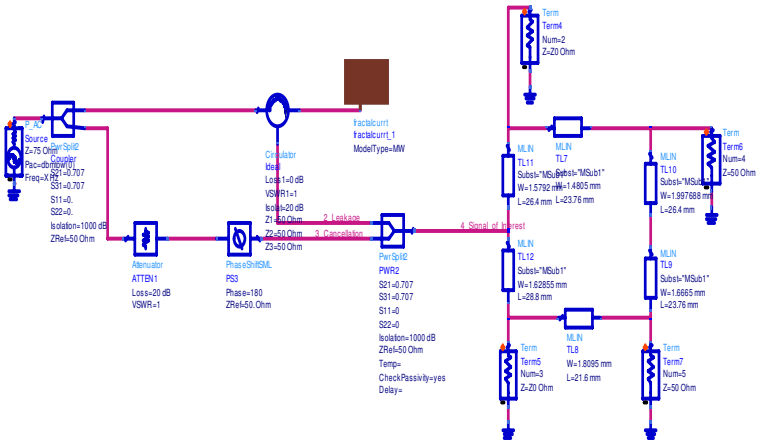

Figure 5: Implementation of proposed system in ADS software

Above figure shows the system implementation in ADS software with the help of RF and microwave tools. The power splitter is used to split the power where as antenna is used to give

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.

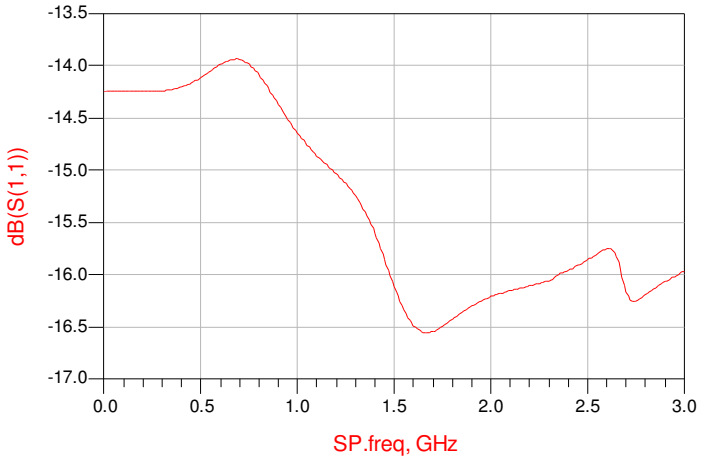

Figure 6: Return loss of the system

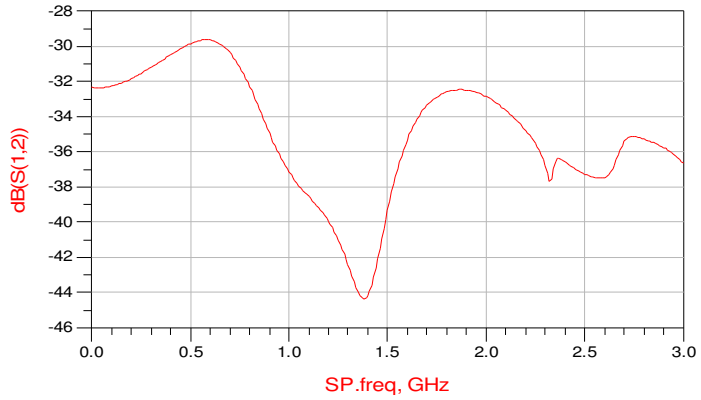

Figure 7: Insertion loss of the system

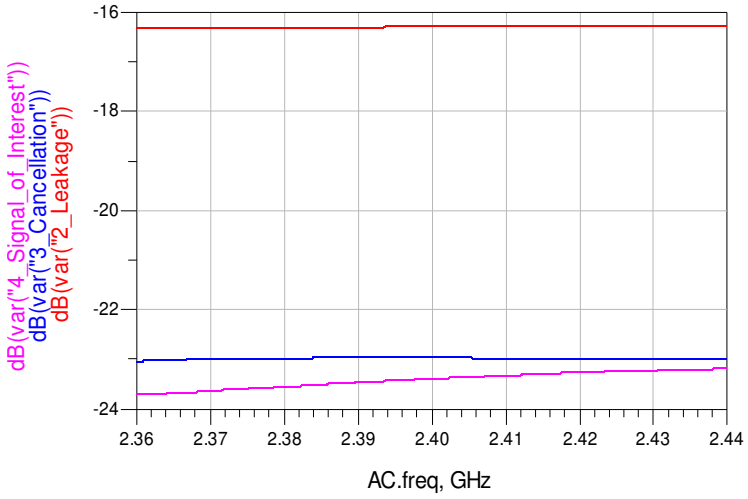

Figure 8: Leakage cancellation of the system

Thus, the system is designed and simulated in good manner with ADS software and the simulation parameters[1,8,9] such as IL, RL and leakage cancellation is analyzed. Figure 6 shows the RL of system which is highly desirable of about -16.11dB. Figure 7 shows the IL of system which is about -39.291dB. In the system, leakage cancellation is more important to cancel the leakage signal to improve the efficiency of the system. Figure 8 shows the leakage cancellation of the system which is about 6dB. That is, the leakage signal gets cancelled of about 6dB.

5. 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).

6. REFERENCES

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