Design of an Ideal Rat Race Coupler(RRC):

- **Block Diagram of RRC:**

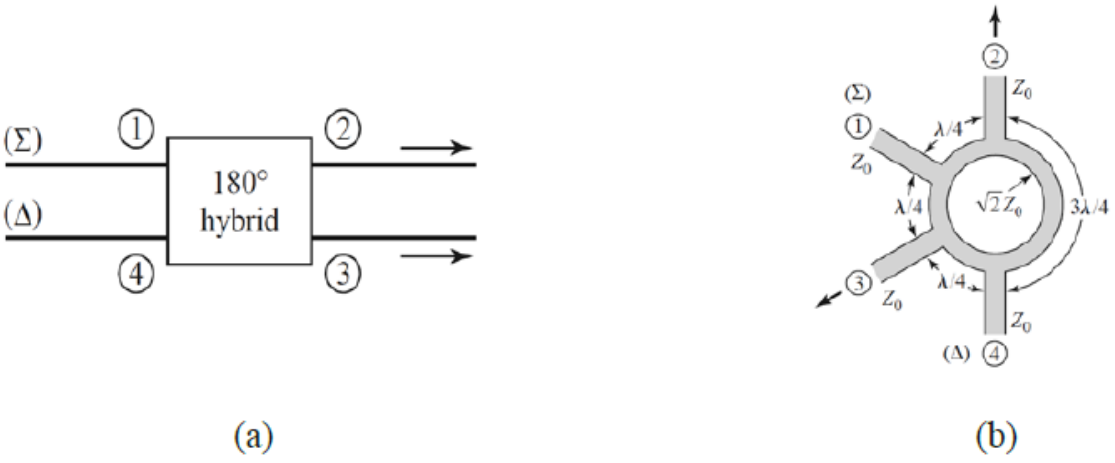

Fig. 1. (a) Symbol of 180 degree hybrid junction and (b) a ring hybrid or rat-race in microstrip line form.

- **Schematic of RRC network**

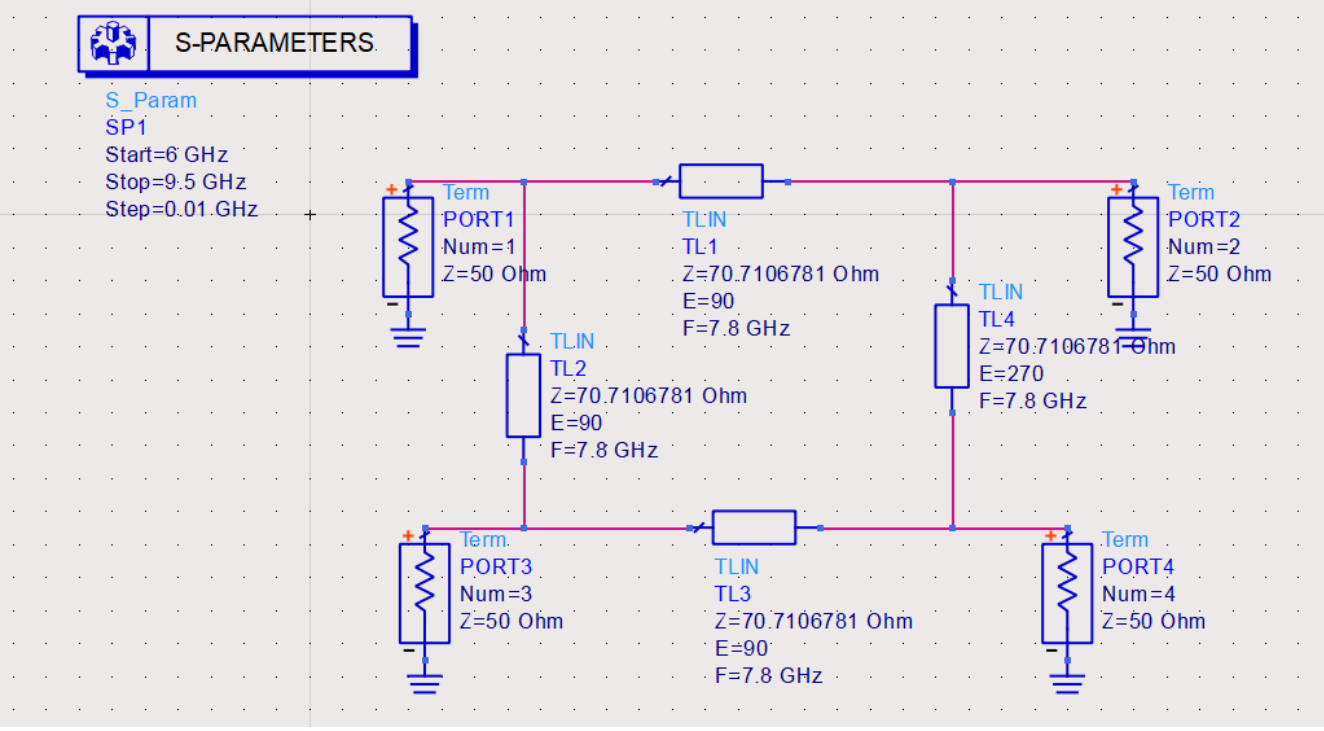

Fig 2. Schematic of Ideal RRC Network

➢ Design Criteria:

- Frequency of Operation: 7.8 GHz
- Ideal Transmission Lines are used.

➢ Results:

- **Magnitude Plot of S11 Parameter**

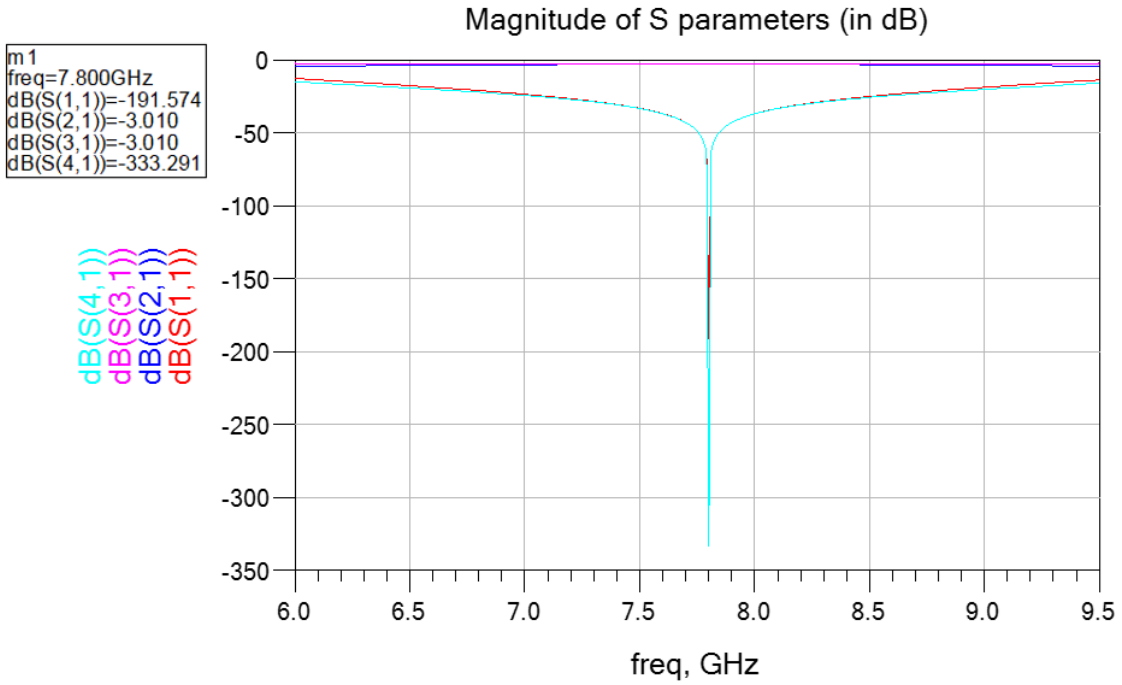

Fig.2. Magnitude Plot of S11 Parameters

➢ Calculations

- In order to find the effective bandwidth of the branch line coupler we have to determine the following bandwidths:

- $|S_{11}| < -20$ dB
- $|S_{41}| < -20$ dB
- $|S_{21}| \pm |S_{31}|$, $|S_{34}| \pm |S_{24}| < 0.5$ dB
- $\angle S_{31} - \angle S_{21} < 0° \pm 5°$
- $\angle S_{34} - \angle S_{24} < 180° \pm 5°$

Conclusion

- An ideal rat race coupler using ADS and its characteristics are studied through Fig.2
- An essential feature of directional couplers is that they only couple power flowing in one direction. Power supplied to port 1 is coupled to port 3 (the coupled port), while the remainder of the input power is delivered to port 2 (the through port). In an ideal directional coupler, no power is delivered to port 4 (the isolated port).
- These are clearly seen in Fig.2. The reflection curve remains below -30 dB indicating good matching at the resonant frequency 7.8 GHz.
- The isolation curve is also below -30 dB indicating good isolation between port 1 and port 4.
- The transmission coefficients are nearly at -3.01 dB, which indicates that almost half of the power is being coupled to port 3 and the remaining half is being delivered to port 2.
- Ideally the transmission through the coupler is supposed to be at -3 dB at both the ports 2 and 3 as the power transmitted through coupler should be equally divided in the two ports of the coupler