GCPW-to-WR Transition with Integrated Planar Bias Tee for Quasi-Hermetic E-Band Radio-over-Fiber Wireless Transmitter

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1. Radio-over-Fiber Technology

- Potentially able to provide multi-gigabit data rates, allowing “fiber-like” wireless connectivity [1] for
  - Expansion of existing mobile networks (backhauling and last-mile coverage).
  - Indoor applications.
  - World-wide allocated bands (71-76 GHz and 81-86 GHz).
- Necessary development of new devices, specifically designed for analog applications.
- A photonic transmitter converts the optical input into an electrical signal by means of a photodiode (PD) and transmits the radio-frequency (RF) power through an opportune antenna:
  - Optimum adapted bandwidth.
  - Rectangular waveguide (WR) output (loss and high power handling capability, used for antenna feed, resonators, filters and amplifiers).

2. Photonic Transmitter with WR output

- Novel integration concept [2]:
  - “Double-slot coupling” approach.
  - Quasi-hermeticity.
  - Commercial photodiode with built-in bias tee.
  - Error-free (BER<10⁻⁶) 1.025 Gb/s NRZ-OOK wireless data transmission over 2.5 m wireless distance [3].
  - Maximum power penalty of 1.2 dB in the 71-76 GHz band.

3. GCPW-to-WR Transition with Integrated Bias Tee

- Biasing of the photodiode via the integrated bias tee: more efficient use of the chip area.
- No mechanical modification of the rectangular waveguide.
- Excellent simulated RF performance.
- Low loss, planar design.
- Quasi-hermetic packaging possible.

4. Conclusion

- We presented a new grounded-coplanar-waveguide-to-rectangular-waveguide transition featuring an integrated and fully planar bias tee.
- Tailored for E-Band RoF photonic transmitters operating in the 71-76 GHz range.
- The integrated bias tee does not require any additional manufacturing step and allows for using photodiodes without built-in bias network.
- Full-wave electromagnetic field simulations show that the transition has an insertion loss of only 2 dB and a return loss at the grounded coplanar waveguide input of at least 25 dB; the RF-to-DC isolation of the bias tee is larger than 34 dB.

References


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