ABSTRACT

The design of GaAs HEMT and HBT Bessel-type transimpedance amplifiers

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The need of the everyday user to transfer large amounts of data is driving the need for larger data transfer capacity. Optical communication networks can satisfy this need. To be economically viable, optical transceivers must be integrated onto chips at low cost, using relatively cheap semiconductor processes. The optical preamplifier (transimpedance amplifier) receives optical information and converts it to a useful electrical form. It must operate at high speed, contribute little distortion to the input signal, and add little electrical noise to the incoming signal. This thesis investigates the design techniques in the literature, and proposes new architectures. Two high performance preamplifiers are designed, one using GaAs HEMTs, and the other using GaAs HBTs, each with different circuit techniques. The HEMT preamplifier has a transimpedance gain of 1.4 kÃ¢Â„Â¦, the highest in the literature for 10 Gb/s operation, along with a low input referred noise current of about 15 pA/Hz1/2 at a bandwidth of 6.3 GHz. The HBT preamplifier also has a transimpedance gain of 1.5 kÃ¢Â„Â¦, with a low input referred noise current of about 7 pA/Hz1/2. Both have clear, open eye-diagrams with a 10 Gb/s bit stream input, and are suitable for integration on a chip. The HEMT preamplifier was implemented as a common-gate, common-source amplifier cascade with a darlington output driver for a 50 Ã¢Â„Â¦ load. The HBT preamplifier was implemented as common-emitter darlington amplifier with shunt peaking, and a simple emitter degenerated output driver for a 50 Ã¢Â„Â¦ load. Both implementations exceeded the bandwidth, transimpedance gain and noise performance typically expected of the transistor technologies used. It is shown that the transimpedance limit can be circumvented by the use of novel architectures and shunt peaking.