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Review Paper of Low Reflection Noise Amplifier for Modern Application

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Abstract— Recently, the rising the demand of Low Noise Amplifier (LNA) products for the high data rate communication system. LNA transistors are used in applications where a high gain and noise rejection is needed. Recently Low Noise Amplifier (LNA) products have been reported high gain and good bandwidth for modern application. In modern communication Low Noise Amplifier (LNA) products is versatile used in low noise amplifier, distributed amplifier, broadband mixer, power amplifier and active balunes. Today technology required high speed transmission efficiency with less power consumption and less circuitry to used, Low Noise Amplifier (LNA) products satisfy all parameters so that review and future advancement required. In these papers designing, application, issues and recent trends of Low Noise Amplifier(LNA) products is reviewed; we have surveyed almost all the Possible Work Done in Low Noise Amplifier(LNA) products in Past Decades.

Keywords—Ultra-wideband (UWB), Hetero junction bipolar transistor (HBT), high electron-mobility transistor (HEMT), MOS Varactor, Narrow energy material.

I. INTRODUCTION

In the last decade silicon transistors suffered from low values of current gain, and large variations of current gain in similar manner transistor. Today technology wanted transistors with larger current gain with stability in operation so negative feedback could be employed, at the sacrifice of gain of system, to stabilize overall circuit performance against variations in operating conditions and transistor characteristics. . In the last decade silicon transistors suffered from low values of current gain, and large variations of current gain in similar manner transistor. Today technology wanted transistors with larger current gain with stability in operation so negative feedback could be employed, at the sacrifice of gain of system, to Stabilize overall circuit performance against variations in operating conditions and transistor characteristics. Low Noise Amplifier (LNA) is a best solution to provide large current gain with large stability. In the past decade LNA reported high loading capacity with high input impedance and low out resistance. Reported unit voltage gain with high current gain and voltage gain. LNA is versatile used due to all above features. For high-speed data Communications is increasing day by day. A few multi gigabits/second transceivers have been reported for advanced semiconductor technologies is a best solution to provide large current gain with large stability. In Nano- scale CMOS; the linearity depreciates due to supply voltage reduction and high-field mobility effects. Although narrowband low noise amplifiers (LNAs) may only need high third-order linearity, ultra-wideband (UWB) has made LNAs sensitive to both second-order and third-order distortions due to large numbers of in-band interferences, and the cross-modulation/inter-modulation caused by blockers or transmitter leakage. Therefore, the cancellation both of them is vital for UWBLNAs acquiring high IP2 and IP3.The derivative superposition technique [1], uses two parallel transistors biased in weak and strong inversion region, respectively. The auxiliary transistor generates a positive third-order derivative of the dc transfer characteristic to cancel the negative generated by the main transistor. This results in increased linearity within wide dc operating range. However, second-order interaction at high frequencies often limits the effect. Moreover, the gate-induced noise of the weak inversion transistor even degrades the NF. Modified derivative superposition method alleviates the problems but complicates input matching [2], [3]. In contrast, post-distortion technique (PS) is attractive for improving Noise Figure and enhancing input matching [4], [5]. But the auxiliary transistor with fixed bias in [7] encounters difficulties in cancelling nonlinear distortion. In this letter, a novel post-distortion technique for the UWB LNA is introduced. By adjusting bias technique and scaling of a PMOS transistor, the second and third order distortion current of LNA are absorbed over a wide frequency range, simultaneously.

LOW-NOISE low-power-consumption amplifiers are of special interest in the phased-array radars and military security application when the units must operate with limited power resources such as in space-based systems. In DARPA's antimonide based compound semiconductor (ABCS) program used LNA for reduction of noise in amplifier; this objective was pursued through the development of narrow energy-gap channel devices such as InAs/AlSb high-electron mobility transistors (HEMTs), with the intent of superseding conventional GaAs- and InP-based HEMT technologies by exploiting the higher low-field mobilities of pure InAs channels. DC power consumption levels up to 4× lower than that in InP were predicted for ABCS HEMTs. We report an InP-HEMT X-band low-noise amplifier (LNA) featuring an ultralow dc power consumption of 0.6 mW: To the best of our knowledge, this represents the lowest power consumption ever reported for an X-band LNA operating at room temperature. Low-power-dissipation CMOS- and BiCMOS-based X-band LNAs have also been reported with sub milliwatt dissipation Levels but with significantly higher noise figures. The results indicate that appropriately designed InP-based pHEMTs remain extremely attractive contenders for the realization of high-performance low-power-dissipation MMICs.

II. REVIEW OF TECHNIQUES

In this paper [8], three MMIC low-noise amplifiers using dual-gate GaAs HEMT devices in a balanced amplifier configuration presented. The designs target three different frequency bands including 4-9 GHz, 9-20 GHz, and 20-40 GHz. These dual-gate balanced designs demonstrate the excellent qualities of balanced amplifiers in terms of stability and matched characteristics, while demonstrating higher bandwidth than designs with a single-stage common-source device. Additionally, noise performance is excellent, with the 4-9 GHz LNA demonstrating <1.75 dB noise figure (NF), the 9-20 GHz LNA <2.75 dB NF and the 20-40 GHz LNA <2.5 dB NF. Demonstrating high gain and excellent bandwidth, the dual-gate devices seem a logical choice for the balanced Two anti monide-based compound semiconductor (ABCS) microstrip monolithic microwave integrated circuits (MMICs), i.e., InAs/AlSb metamorphic high electron-mobility transistors (HEMTs)[9], fabricated and characterized on a GaAs substrate. The single-stage wideband LNA demonstrated a typical associated gain of 16 dB (0.3-11 GHz) with less than a 1.7-dB noise figure (2-11 GHz) at 5-mW dc power dissipation, and the three-stage wideband LNA demonstrated a typical associated gain of 30 dB (0.3-11 GHz) with less than a 2.6-dB noise figure (2-11 GHz) at 7.5-mW dc power dissipation. We believe these wideband LNA MMICs demonstrate the lowest dc power consumption with the highest gain-bandwidth product of any MMIC to date. These results demonstrate the outstanding potential of ABCS HEMT technology for ultra-low-power wideband applications.

The noise models of InP and GaAs HEMTs are compared with measurements at both 300 and 20 K. The critical parameter, Tdrain, in the Pospieszalski noise model is determined as a function of drain current by measurements of the 1-GHznoise of discrete transistors with 50- Ω generator impedance. The dc I-V for the transistors under test are presented and effects of impact-ionization are noted. InP devices with both 100% and 75% indium mole fraction in channel are included. Examples of the design and measurement of very wideband low-noise amplifiers (LNAs) using the tested transistors are presented. At 20-K physical temperature the GaAs LNA achieves 10-K noise over the 0.7-16-GHz range with 16 mW of power and an InP LNA measures 20-K noise over the 6-50-GHz range with 30 mW of power. In this paper[10],monolithic microwave integrated circuit(MMIC)broadband lownoise amplifiers (LNAs) for cryogenic applications based on a 100-nm metamorphic high-electron mobility transistor (mHEMT) technology in combination with grounded coplanar waveguide are reported. A three-stage LNA, operating in 4-12 GHz and cooled to 15 K exhibits an associated gain of 31.5 dB ± 1.8 dB and average noisetemperature of 5.3 K (NF=0.079 dB) with a low power dissipation of 8 mW. Additionally another three-stage LNA 25-34 GHz cooled to 15 K has demonstrated a flat gain of 24.2 dB ± 0.4 dB with 15.2 K (NF=0.22 dB), average noise temperature, with a very low power dissipation of 2.8 mW on chip. The mHEMT-based LNA MMICs have demonstrated excellent noise characteristics at cryogenic temperatures for their use in radio-astronomy applications .To improve the performance of G-band equipment for humidity sounding of the atmosphere, a high-gain and low-noise amplifier is needed [11].

Here we describe and report the performance of several low noise amplifier microchips intended for 183-GHz water vapor profiling application. The chips are manufactured in metamorphic high electron mobility transistor technology having a gate length of 50 nanometers. The measured results show a noise figure of 4-7 dB and 15-22 dB gain from 170 to 200 GHz.

Aiming for the simultaneous realization of constant gain, accurate input impedance match, and minimum noise figure over a wide frequency range, the circuit topologies and detailed design of two broadband dual-loop negative feedback power-to-current low noise amplifiers (LNAs) are presented in this paper[12]: 1) a resistive indirect-feedback power-to-current LNA, which requires an active part with two output terminal pairs, and 2) a transformer feedback power-to-current LNA, which requires a transformer in its current feedback path having a high turn ratio with high magnetic coupling. For both LNAs the feedback networks and active part implementations are discussed in detail. It is shown that for this purpose a novel stacked transformer can be realized using only two metal layers. The two LNAs are designed to be implemented in a 0.2 m GaAs p-HEMT technology process to verify the theory presented. Counter measures are applied to deal with the effects of bond wires and the effects of transformer parasitic on the circuit performance are analyzed. Simulation results show that the resistive indirect-feedback power-to-current LNA exhibits a 0.6-0.8 dB noise figure, an input return loss well below dB, a 200 mS voltage-to-current gain (which corresponds to 23 dB power gain for a 50 load) from 0.3 GHz to 4 GHz, a dBm third-order input intercept point (IIP3) and a 23 dBm second-order input intercept point (IIP2) at 2 GHz. It consumes 73 mA current from a 4 V power supply. The transformer-feedback power-to-current LNA achieves a 0.5-0.8 dB noisefigure, an input return loss of less than dB, a 22 dB power gain from 0.8 GHz to 4 GHz, and a 0 dBm IIP3 and 22 dBm IIP2 at 2 GHz while drawing 53 mA current from the 4 V power supply

This paper [13] outlines the popular circuit tuning strategies reported for the implementation of reconfigurable low-noise amplifiers (LNAs). It presents a continuously-tuned LNA intended for multi-standard applications as well as enhancing the yield of conventional narrowband LNAs. The presented LNA is designed and implemented in a 0.25μm silicon-on-sapphire (SOS) CMOS process. It uses MOS-varactors at the output to continuously tune its load resonance frequency and input matching frequency without the need of a tunable input network, achieving optimized power consumption and noise figure (NF). The post-layout simulations show that the designed LNA can be continuously tuned from 2.6 GHz to 3.5 GHz. Over this frequency range, an input IP3 of -12 dB, gain of 17 dB and a NF of less than 2 dB have been achieved with 3.4 mW of power consumption at 1.8V. The noise models of InP and GaAs HEMTs are compared with measurements at both 300 and 20 K. The critical parameter [14],

T-drain, in the Pospieszalski noise model is determined as a function of drain current by measurements of the 1-GHznoise of discrete transistors with 50- Ω generator impedance. The dc I-V for the transistors under test are presented and effects of impact-ionization are noted. InP devices with both 100% and 75% indium mole fraction in channel are included. Examples of the design and measurement of very wideband low-noise amplifiers (LNAs) using the tested transistors are presented. At 20-K physical temperature the GaAs LNA achieves 10-K noise over the 0.7-16-GHz range with 16 mW of power and an InP LNA measures 20-K noise over the 6-50-GHz range with 30 mW of power.

III. CONCLUSION

From the review of Low Noise Amplifier (LNA), we concluded that product is versatile used in modern application. Low Noise Amplifier (LNA)provided high current gain and high input impedance in a single package, many number of development reported in Darlington products like HEMT, HEBT ,Impedance matching network, narrow energy gap transistor used in application GaAs, InAs and Gap, post – pre distortion techniques, MOS Varactor technique, multi transformer technique etc, all techniques used to enhance noise rejection capability of LNA , improve gain and bandwidth, but technology required more Noise Figre, gain, bandwidth with fast transmission of data so that more discussion and research demanded for Darlington product. We compare and discuss four recent techniques in table-1, We have reviewed LNA from origin and discuss development and find Different technologies are used for implementing the different designs in the global Foundries.

TABLE 1 REVIEW OF WORK

Parameters	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Noise Figure	<1.75 dB	2.6-dB	20-K	0.22 dB	4-7 dB	0.6-0.8 dB	< 2 dB	10-K
Power Dissipation		7.5-mW	16 mW	8 mW			3.4 mW	16 mW
Technology used	Dual-Gate GaAs HEMT Devices	0.1-mum gate-length InAs/AlSb metamorphic high electron-mobility transistors (HEMTs)	T drain, in the Pospieszalski noise model	metamorphic high-electron mobility transistor (mHEMT) technology in combination with grounded coplanar waveguide	metamorphic high electron mobility transistor technology	Dual-Loop Negative Feedback	MOS-Varactors	T drain, in the Pospieszalski noise model
Gain	-	16dB	-	31.5dB	22dB	23dB	17dB	-

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