

**WIDEBAND ACTIVE-BALUN VARIABLE-GAIN LOW-NOISE
AMPLIFIER FOR MOBILE-TV APPLICATIONS**

by

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A thesis submitted in partial fulfillment of the
requirements for the degree of

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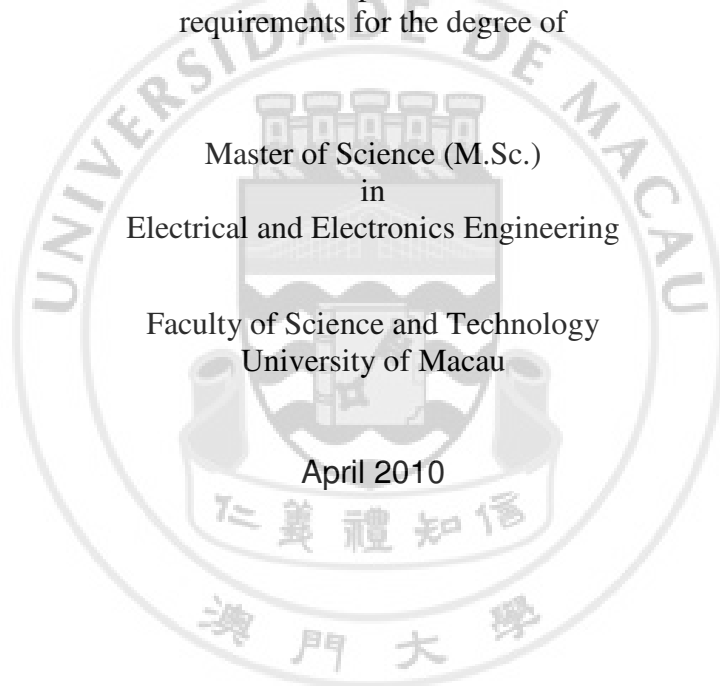
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April 2010



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Wideband Active-Balun Variable-Gain Low-Noise Amplifier for Mobile-TV Applications

ABSTRACT

The rapid development of wireless communications and CMOS technology has facilitated the integration of radio frequency (RF) systems as a System-on-Chip (SOC) for cost and power reductions. One of the applications is the RF TV tuner for Digital Video Broadcasting-Handheld (DVB-H). With the development of digital mobile TV industry the TV tuner system has gained wide attention recently.

Variable Gain Low-Noise Amplifier (VGLNA) is one of the most important modules in the TV tuner system. The main function of a VGLNA is to provide enough gain to suppress the noise of subsequent stages as well as adding as little noise as possible.

Recent works on wideband low-noise amplifiers (LNAs) based on an active-balun structure have shown reliable RF performances such as moderate noise figure (NF), high linearity and broadband input impedance matching. This structure has exhibited great potential in minimizing the required external components of multi-band mobile-TV tuners, i.e., an active-balun LNA requires just one radio frequency (RF) input pin and eliminates the need of external balun for each band, which is necessary in the current design.

This thesis will propose a novel active-balun LNA with forestage and poststage gain controls. With this forestage-poststage gain controls the system noise figure and linearity can be easily traded for different gain levels. In addition, the benefits of this design allow also the decrease in circuit complexity, chip area and the power consumption. In this architecture just one Single to Differential (S2D) amplifier is required.

The first part of this work will introduce the theoretical MOSFET noise model and conventional VGLNA circuits. The second part will present the circuit level design based on the proposed architecture. The VGLNA was designed with two passive attenuators inter-operating with an active core to optimize the RF performances under different reception scenarios. It was implemented in a 0.18 μm CMOS process with 1.8V of voltage-supply.

Finally, the simulation results of the whole circuit are presented. The VGLNA supports both VHF-III (170 to 240 MHz) and UHF (470 to 860 MHz) bands while offering low NF and $S_{11} < -10$ dB at all gain levels. The forestage and poststage gain controls flexibly benefit reception at different signal-to-interferer levels. The circuit achieves good performances in the required frequency bands and satisfies the requirements of the mobile TV tuner applications.



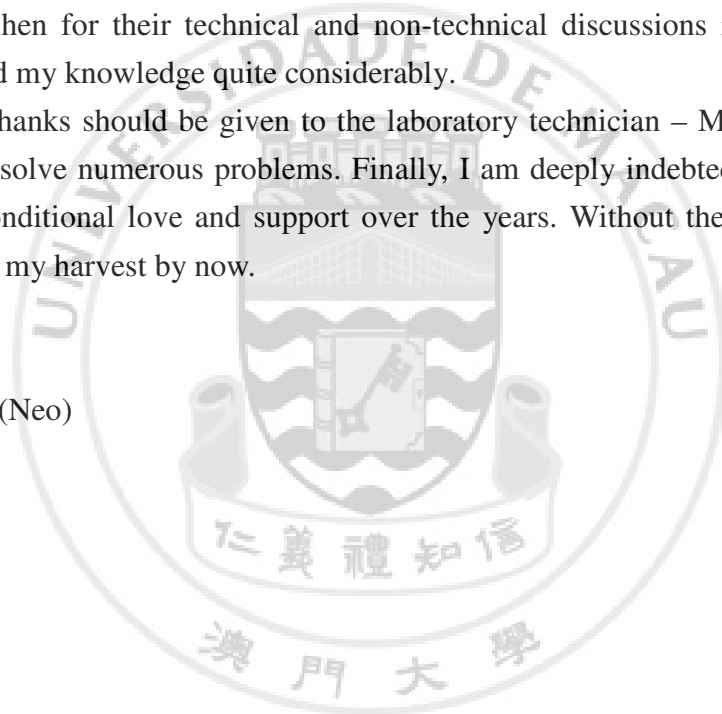
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Lo Keng Wai (Neo)
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LIST OF ABBREVIATIONS

ATT	: attenuator
BW	: bandwidth
CMFB	: common mode feedback
CMOS	: complementary metal oxide semiconductor
CG-CS	: common gate common source topology
DC	: direct current
DVB-H	: digital video broadcasting handheld
IC	: integrated circuit
IF	: intermediate frequency
IIP3	: third-order input intercept point
NF	: noise figure
OpAmp	: operational amplifier
PSRR	: power supply rejection ratio
RC	: resistor-capacitor
RF	: radio frequency
S2D	: single-to-differential
SNR	: single to noise ratio
SOC	: system-on-chip
TV	: television
UHF	: ultra high frequency
VGLNA	: variable gain low noise amplifier
VHF	: very high frequency



TABLE OF CONTENTS

Abstract	I
Acknowledgements	III
List of Abbreviations	V
Table of Contents	VII
List of Figures	XI
List of Tables	XIII
Chapter 1: Introduction	1
1.1 Background	1
1.2 Narrowband LNA	2
1.3 Wideband LNA	3
1.4 Noise canceling technique	6
1.5 Noise figure and linearity of LNA	6
1.6 Research objectives	8
1.7 Statement of originality	8
1.8 Thesis organization	9
1.9 References	10
Chapter 2: Low Noise Amplifier basic concepts	11
2.1 Introduction	11
2.2 Noise in MOSFET	11

2.2.1 Source of noise	12
2.2.2 Noise models of the MOS transistors	16
2.3 Basic Low Noise Amplifier Topology	17
2.4 Common gate common source (CG-CS) topology	20
2.4.1 Balancing (balun operation)	21
2.4.2 Noise canceling operation	22
2.4.3 Distortion canceling	23
2.4.4 Noise analysis of the CG-CS topology	24
2.5 References	28
Chapter 3: A State-of-the-Art CMOS Variable-Gain Low-Noise Amplifier	29
3.1 Introduction	29
3.2 Single-to-differential stage	30
3.3 Performance analysis	32
3.4 Attenuator design	34
3.5 Architecture of VGLNA	35
3.6 References	36
Chapter 4: Architecture of the proposed variable gain low noise amplifier	37
4.1 Introduction	37
4.2 MOS-Based attenuator	38
4.2.1 Impedance matching and S parameter	40
4.2.2 Analysis of the circuit of the MOS-based attenuator	41
4.3 CAP-Based attenuator	42
4.4 The Active-Balun LNA core	44

4.5 Improvement of the PSRR	45
4.6 Simulation Results	46
4.7 References	55
Chapter 5: Conclusions and Future Work	57
5.1 Conclusions	57
5.2 Recommendations for future work	58





LIST OF FIGURES

Figure 1.1:	Block diagram of direct conversion receive.	1
Figure 1.2:	Source degeneration LNA.	3
Figure 1.3:	Configuration of shunt-series amplifier.	4
Figure 1.4:	Combining balun and LNA into a single Balun-LNA integrated circuit.	5
Figure 1.5:	Dynamic Range of a system.	6
Figure 2.1:	Drain current noise model.	12
Figure 2.2(a):	Gate noise circuit model.	13
Figure 2.2(b):	Equivalent voltage noise source model.	13
Figure 2.3:	Flicker noise model.	16
Figure 2.4(a):	MOSFET noise model.	16
Figure 2.4(b):	Equivalent input referred noise model.	16
Figure 2.5(a):	Resistive termination.	18
Figure 2.5(b):	$1/g_m$ termination.	18
Figure 2.5(c):	Shunt-series feedback.	18
Figure 2.5(d):	inductive degeneration.	18
Figure 2.6:	The basic CG-CS topology in which the noise of the CG-transistor can be canceled at the outputs.	20
Figure 2.7:	Small signal equivalent of a CG-stage.	21
Figure 2.8:	Noise Figure (NF), voltage gain (A_V) and gain imbalance (ΔA_V) versus impedance scaling factor ' n ' for three different cases.	26
Figure 3.1:	Schematic of single-to-differential circuit.	31
Figure 3.2:	A modified S2D circuit.	31
Figure 3.3:	Noise figure analysis for S2D.	33
Figure 3.4:	A five steps resistive attenuator.	34

Figure 3.5:	Simplified schematic of VGLNA.	35
Figure 4.1:	VGLNA with two S2Ds and an on-chip capacitor C_1 .	38
Figure 4.2:	Proposed VGLNA with Forestage-Poststage Gain Controls.	38
Figure 4.3:	Schematic of the proposed VGLNA with Forestage-Poststage Gain Controls.	39
Figure 4.4:	MOS-based ATT., m_{LG} is control switch, $G_0 \sim G_3$ are transistors biased at triode region.	39
Figure 4.5:	Two-Port Network.	40
Figure 4.6:	MOS-based ATT and its equivalent circuits at different attenuation levels.	41
Figure 4.7:	CAP-based ATT., transmission gates are employed for all switches.	42
Figure 4.8:	Transmission gate switch characteristic.	44
Figure 4.9:	NF and IIP3 at all gain steps at VHF-III band.	47
Figure 4.10:	NF and IIP3 at all gain steps at UHF band.	47
Figure 4.11:	Simulated S_{21} at different gain steps.	48
Figure 4.12:	Voltage gain versus gain steps at UHF band.	49
Figure 4.13:	Voltage gain versus gain steps at VHF-III band.	49
Figure 4.14:	NF versus frequency at UHF band	50
Figure 4.15:	NF versus frequency at VHF-III band.	50
Figure 4.16:	IIP3 simulation at UHF band.	51
Figure 4.17:	IIP3 simulation at VHF-III band.	51
Figure 4.18:	Simulated S_{11} versus frequency in VHF-III and UHF band.	52
Figure 4.19:	Simulated PSRR- versus frequency.	52
Figure 4.20:	Simulated PSRR+ versus frequency.	53

LIST OF TABLES

Table 4.1:	Gain control of the MOS-based attenuator.	42
Table 4.2:	Gain control of the CAP-based attenuator.	43
Table 4.3:	Summary and Performance Comparison.	53



