ACKNOWLEDGEMENT

I would like to acknowledge my deep sense of gratitude to my supervisor **Dr. Avireni Srinivasulu**, Department of Electronics and Communication Engineering, Vignan's Foundation for Science, Technology and Research University, Vadlamudi, Guntur, for his constant valuable guidance and encouragement. He gladly accepted all the pains in going through my work again and again, and giving me opportunity to learn essential research skills. His ability to quickly understand the depth of the problem and suggesting a clear solution has always surprised me. This thesis would not have been possible without his insightful and critical suggestions, his active participation in constructing right models and a very supportive attitude. I will always remain grateful to him for giving direction to my life.

I express my sincere thanks to **Dr. C. Thangaraj,** Vice Chancellor, **Dr. B. Ramamoorthy,** Rector, **Dr. N. Usha Rani**, Head of the Department of Electronics and Communication Engineering, for providing the necessary facilities for carrying out the research work. I would like to thank the doctoral committee panel, **Dr. P. Subbaraj**, **Dr. M. S. S. Rukmini, Dr. Venkateswarlu** and **Dr. N. Ramraj** for providing me with their suggestions.

I would like to thank teaching and non-teaching staff members of Department of E.C.E who have been kind enough to advise and help in their respective roles.

I would like to express my heartiest thanks to my colleague **Mr. V. Vijay** for valuable comments, suggestions and discussions. I am grateful to **Mr. Y. Samrat** for his uncountable help during the hardware implementation in Cadence lab despite of his numerous duties and busy schedule.

I would like to acknowledge the support of my parents, **Kamala** and **Venkati**, and my sisters **Raja kumari**, **Uma Rani** and **Usha Rani** for their continuing support and encouragement.

P. Chandra Shaker

ABSTRACT

SOME NEW OPERATIONAL TRANS-RESISTANCE AMPLIFIER BASED SINUSOIDAL/SQUARE WAVEFORM GENERATORS

KEYWORDS: Analogue signal processing blocks, Duty cycles, Operational transresistance amplifier, Oscillators, Square waveform generators, Waveform generators.

Waveform generators have wide range of applications in numerous electronic devices, including electronic instruments, measurement systems, telecommunications, power conversion control circuits and signal processing applications. Several waveform generator circuits have existed in the literature based on operational amplifier (op-amp) as a main active element. However, these circuits are not able to operate at high frequency due to fixed gain bandwidth product and less slew rate.

To conquer the above disadvantages several circuits have been presented in the literature based on current-mode devices. When wide bandwidth, low power consumption and low voltage operation are needed simultaneously, current mode devices are preferred rather than voltage mode devices. Current mode circuits feature the advantage of high bandwidth, better linearity, larger dynamic range and non-interference between the gain and bandwidth.

In recent past, an active current mode device operational transresistance amplifier (OTRA) has made considerable attention of the analog IC designers. OTRA is a three terminal active device. Several implementations have emerged using OTRA such as Voltage Gain Amplifiers (VGAs), filters, Proportional Integral and Derivative (PID) controllers, analogue multiplier, immitance simulators, oscillators and waveform generators.

Sinusoidal waveform generators with independent control of condition of oscillation and frequency of oscillation play an important role in communications and signal processing application. It has also been seen that the OTRA is very useful as an analogue building block and receiving regular attention in waveform generators, oscillators, and design of amplifiers and filters. The OTRA provides a constant bandwidth virtually independent of the gain. Characterized by low input and output

impedances, it leads to circuits that are insensitive to stray capacitances, providing current processing at the input terminal which are virtually grounded.

In this thesis, a generalized configuration with a grounded passive component is proposed to realize few sinusoidal oscillator circuits. A minimum component oscillator circuit, eight grounded passive component sinusoidal oscillator circuits and two sinusoidal oscillator circuits with grounded resistance and capacitance are realized from the generalized configuration.

Quadrature oscillator is an important building block for many electronics and communication applications. Part of this thesis discusses two quadrature sinusoidal oscillator circuits with independent control of condition of oscillation and frequency of oscillation. In addition, two square waveform generators and their advantages with respect to the existing square waveform generators in the literature are presented in detail.

The operation principles and non-idealities of all the proposed circuits are described in detail. All the proposed circuits are designed and developed using Cadence 0.18 μm CMOS model parameters. The proposed OTRA based circuits can be operated at ± 1.8 V supply voltages. The performances of the circuits are explored through Spectre simulation model parameters. The proposed circuits are also designed and checked for waveform generation on a laboratory bread board using IC AD 844 AN.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

CC	Current Conveyor
CC-CDBA	Current Controlled Current Differencing Buffered Amplifier
CCCDTA	Current Controlled Current Differencing Transconductance Amplifier
CCII	Second-Generation Current Conveyor
CDBA	Current Differencing Buffered Amplifier
CDTA	Current Differencing Transconductance Amplifier
CFOA	Current Feed-Back Operational Amplifier
CMOS	Complementary Metal Oxide Semiconductor
DCCCS	Differential Current Controlled Current Source
DCCII	Second Generation Differential Current Conveyor
FTFN	Four Terminal Floating Nuller
IC	Integrated Circuit
JFET	Junction Field Effect Transistor
KCL	Kirchhoff's Current Law
MDCC	Modified Differential Current Conveyor
MOS-C	MOSFET and Capacitors
MOSFET	Metal Oxide Semiconductor Field Effect Transistor
OTA	Operational Transconductance Amplifier
OTRA	Operational Transresistance Amplifier
PID	Proportional Integral and Derivative
RF	Radio Frequency
VCVS	Voltage Controlled Voltage Source
VDTA	Voltage Differencing Transconductance Amplifier
VDBA	Voltage Differencing Buffered Amplifier
VGA	Voltage Gain Amplifiers
VLSI	Very Large Scale Integration