

DESIGN OF VOLTAGE CONTROL OSCILLATOR
(VCO) IN 0.18 μ CMOS

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DESIGN VOLTAGE CONTROL OSCILLATOR (VCO) IN 0.18 μ CMOS

by

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APPROVAL AND DECLARATION SHEET

This project report titled Design Voltage Control Oscillator (VCO) in 0.18u CMOS technology was prepared and submitted by Amier Hafizun b Ab. Rashid (Matrix Number: 031030037) and has been found satisfactory in terms of scope, quality and presentation as partial fulfillment of the requirement for the Bachelor of Engineering (Electronic Engineering) in Universiti Malaysia Perlis (UniMAP).

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MEREKA CIPTA PENGAWAL AYUNAN VOLTAN MENGGUNAKAN TEKNOLOGI 0.18u CMOS

ABSTRAK

Pengayun merupakan keperluan asas bagi kebanyakan sistem elektronik. Konsep asas bagi pengayun adalah ia mengeluarkan keluaran yang berkala tetap, biasanya dalam bentuk keluaran voltan. Pengawal ayunan voltan (VCO) di reka cipta menerusi teknik kasked dan teknik perubahan perbezaan mod asas Dengan pengukuran sehingga peringkat ke-4 pada frekuensi 2.0GHz dan kuasa disipisi 20mW. Untuk projek tahun akhir ini, spesifikasi yang tertentu telah ditetapkan sebelum sesi makmal dimulakan agar spesifikasi ini boleh dijadikan panduan semasa mereka cipta VCO. Antara spesifikasinya ialah frekuensi ditetapkan $f_0=2.0\text{GHz}$ dan keluaran arus I_{BIAS} mestilah dua kali ganda dibanding I_{REF} . M3 dan M4 beroperasi dalam keadaan kawasan mendatar, setiap satunya berfungsi sebagai perintang boleh ubah yang dikawal oleh V_{BIAS} . Sekiranya nilai V_{bias} lebih positif, nilai perintang pada M3 dan M4 akan meningkat, ini akan mengakibatkan nilai pemalar masa meningkat pada keluaran dan frekuensi osilator akan menurun. Keluaran VCO akan bersambung dengan masukan PMOS untuk mendapatkan nilai gelombang ayunan. Sebelum proses membina bentangan, perintang telah ditukar kepada transistor PMOS. Nilai kiraan bagi perintang telah dilakukan dan nilai lebar dan panjang juga telah ditentukan agar ia beroperasi seperti perintang. Rekaan dijalankan dengan menggunakan perisian mentor graphic. Bagi ujian dan menganalisa litar, senibina rekaan boleh mengesan kesemua parameter seperti arus, voltan dan kuasa. Seharusnya rekaan bagi hasil bentangan lawan litar (LVS), ianya lebih penting dari hasil pemastian peraturan rekaan (DRC).

ABSTRACT

This VCO are designated using cascade technique and differential common-mode change. The measured are 4 stages at 2.0GHz with power dissipation 20mWatt. For this final year project,mentor graphics software has use for design n simulate the circuit of VCO. VCO have a specification to approach to design a schematic n layout. The specification are the $f_0=2.0\text{GHz}$ and the output of I_{bias} must have a double output than the $I_{\text{bias}}/2$. $I_{\text{bias}} \leq 1\text{mA}$. To fulfill the specification, the value of length (L) and width (W) at NMOS $M_1, M_2, M_5, M_6, M_9, M_{10}, M_{14}$, and M_{15} and the value of resistor has been change. For example, the differential pair as one stage of ring oscillator has been considering. M_3 and M_4 operate in the triode regions, each acting as a variable resistor controlled by V_{bias} . As V_{bias} become more positive, the on resistance of M_3 and M_4 increases, thus raising the time constant of the output and lowering f_{osc} . The output of VCO will go through to the input of the PMOS to get the oscillation at the output waveform. To start design of VCO resistor has been changes to form of PMOS transistor. Calculation for PMOS transistor can be act as a resistor has been complete. In summary, the negative feedback circuit has a loop gain that satisfies two condition; $|H(j\omega o)| \geq 1$ and $\angle H(j\omega o) = 180^\circ$. The systems is then can be implemented in CMOS technologies which is called "Ring Oscillators". To perform the design, the methods are using the mentor graphic software. This software provides design architecture software and IC design software. For testing and analyze circuit, design architecture can check all the parameter such as current, voltage and gain. Thus, actually for this designing the layout versus schematic (LVS) result is more important than design rule check (DRC) result.

TABLE OF CONTENTS

	Page
ACKNOWLEDGEMENT	i
APPROVAL AND DECLARATION SHEET	ii
ABSTRAK	iii
ABSTRACT	iv
TABLE OF CONTENTS	v
LIST OF TABLES	viii
LIST OF FIGURE	ix
LIST OF ABBREVIATIONS	xi
CHAPTER 1 INTRODUCTION	
1.1 Overview	1
1.2 Project Objective	1
1.3 Scope of Study	2
1.4 Expected Finding	2
1.5 Organization of Work	3
CHAPTER 2 LITERATURE RIVIEW	
2.1 Transistor	5

2.1.1	N Metal Oxide Semiconductor (NMOS)	5
2.1.2	P Metal Oxide Semiconductor (PMOS)	6
2.2	Basic Operation of VCO	7
2.3	Technique Design	8
2.3.1	Cascade Technique	8
2.3.2	Differential Pair with MOS Loads Technique	9
2.3.2.1	Advantage of Differential Pair	10
2.4	Basic Differential pair	11
2.5	Common Mode Stage with Triode Load	12
2.6	Low Voltage Analog	13
2.6.1	Low Voltage Analog Circuit	13
2.6.2	Low Voltage Analog Design	13
2.7	Bulk Connections	15
2.8	Second-Order Effects	16
2.8.1	Body Effect	16
2.9	Layout Design Rules	18
2.10	Design Rule Background	19
2.10.1	Well Rules	19
2.10.2	Transistor Rules	19
2.10.3	Contact Rules	21
2.10.4	Metal Rules	22
2.10.5	Via Rules	22
2.10.6	Other Rules	23

CHAPTER 3 METHODOLOGY

3.1	Overview	24
3.2	Circuit Description	25
3.3	Design Specification	26

3.2.1	Specification	26
3.2.2	Design Approach	27
3.4	Simulation	31
3.5	Layout	32

CHAPTER 4 RESULTS AND DISCUSSION

4.1	Overview	33
4.2	Analysis	33
4.2.1	Current Analysis	33
4.2.2	Volatge and Frequency analysis	35
4.3	Layout Result	36
4.4	Layout versus Schematic (LVS) Result	37
4.5	Design Rules Check (DRC) Resul	38

CHAPTER 5 CONCLUSION

5.1	Summary	40
5.2	Recommendation for future project	41
5.3	Commercialization Potential	42

REFERENCES	43
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APPENDICES	45
-------------------	-----------

Appendix A	46
-------------------	-----------

Appendix B	49
-------------------	-----------

Appendix C	51
-------------------	-----------

LIST OF TABLES

Table No.	Title	Page
3.1	Specification of VCO	29
4.1	Netlist for Layout	38

LIST OF FIGURES

Figures No.	Title	Page
2.1	Cross Section of a NMOS	4
2.2	Symbol of NMOS	5
2.3	Cross Section of a PMOS	5
2.4	Symbol of PMOS	6
2.5	Double Amplitude	6
2.6	Triple Amplitude	7
2.7	Cascade schematic	7
2.8	Differential Pair Schematic	8
2.9	Differential Pair Operational Circuit	9
2.10	Differential Pair Circuit	9
2.11	Differential Pair Circuit Lable	10
2.12	Common Mode Circuit	11

2.13	Bulk-driven MOS transistor, (a) cross section and (b) symbol of an N-channel MOSFET in P-well technology	13
2.14	(a) wafer cross-section showing bulk connection and (b) crosssection inverter bulk connection	14
2.15	Channel charge with (a) equal source and drain voltages,(b) unequal source and drain voltage.	15
2.16	NMOS device with negative bulk voltage.	16
2.17	Variation of depletion region charge with bulk voltage	17
2.18	(a) and (b) show CMOS n-well process transistor and well/substrate contact construction	20
2.19	Substrate Contact	21
3.1	VCO design schematic diagram	24
3.2	Probe position in circuit	30
3.3	Flow Chart VCO design	32
4.1	Biasing Current	34
4.2	Biasing Current divide by two	34
4.3	Output Voltage	35
4.4	Show the layout result	36
4.5	LVS layout result	37
4.6	Show the DRC layout	39

LIST OF ABBREVIATIONS

μ_n	Electron Mobility
μ_p	Hole Mobility
CM	Common-Mode
C_{OX}	Gate Oxide Capacitance per Unit Area
CMOS	Complimentary Metal-Oxide Semiconductor
DRC	Design Rules Check
G_{ND}	Ground
IC	Integrated Circuit
LOCOS	Local Oxidation of Silicon
LVCM	Low Voltage Current Mirror
LVS	Layout versus Schematic
MOS	Metal Oxide Semiconductor
NFET	Negative-Field Effect Transistor
NMOS	N-Metal Oxide Semiconductor
PMOS	P-Metal Oxide Semiconductor
SDL	Schematic Driven Layout
V_{DD}	Supply Voltage
V_{DS}	Drain/Source Voltage
V_{GS}	Gate/Source Voltage
V_{TH}	Threshold Voltage