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Novel Design of VCO with Output Peak to Peak Control

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Abstract - Voltage controlled oscillator is widely used in many electronics devices. It is used to generate the signals for broadcast by radio and television transmitters, clock signals that regulate computers and quartz clocks, and the sounds produced by electronic beepers and video games. In this paper we propose a novel way to modify the existing VCO and provide an enhancement to control the output voltage level which can be used in any application of varying required voltage level. The simulation is done using tanner using 250nm dimension.

Keywords *- VCO, Pulse Generator, and Schmitt trigger circuit, pulse generating circuit.*

I. VCO USING SCHMITT TRIGGER CIRCUIT

A voltage-controlled oscillator or VCO is an electronic oscillator designed to be controlled in oscillation frequency by a voltage input. The frequency of oscillation is varied by the applied DC voltage.

1.1. Schmitt trigger

The Schmitt Trigger is a type of comparator with two different threshold voltage levels. Whenever the input voltage goes over the High Threshold Level, the output of the comparator is switched high (if is a standard ST) or low (if is an inverting ST). The output will remain in this state, as long as the input voltage is above the second threshold level, the Low Threshold Level. When the input voltage goes below this level, the output of the Schmitt Trigger will switch. The high and low output voltages are actually the positive and negative power supply voltages of the comparator. The comparator needs to have positive and negative power supply (like + and -) to operate as a Schmitt Trigger normally.

The schematic symbol of the Schmitt trigger is shown in Fig1.along with typical transfer curves. We should note the similarity to the inverter transfer characteristics with the exception of a steeper transition region. Curve A in Fig 2.corresponds to the output of the Schmitt trigger changing from a low to a high, while curve B corresponds to the output changing from a high to a low. The hysteresis present in the transfer curves is what sets the Schmitt trigger apart from the basic inverter.

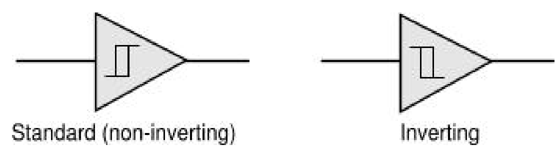


Fig. 1 : Schematic symbol of Schmitt trigger

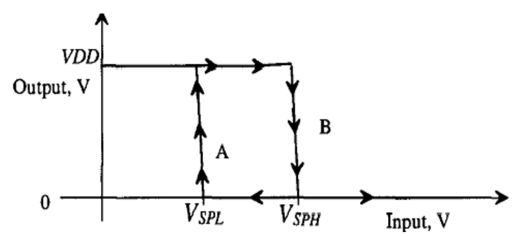
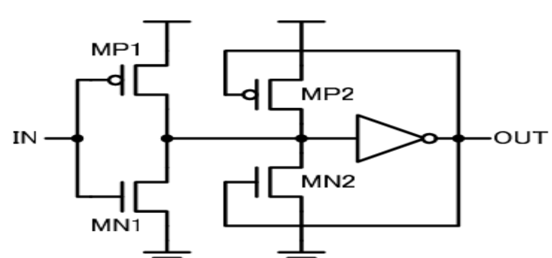


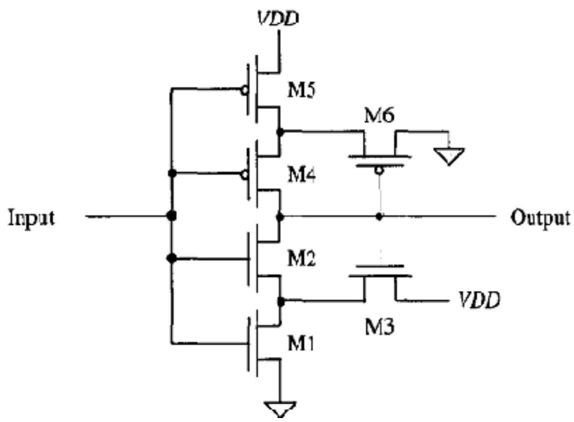
Fig. 2 : Transfer Curves

1.2 CMOS implementations of Schmitt trigger

CMOS implementation of Schmitt trigger circuit is as in fig 3, in this paper VCO is implemented using both the version of Schmitt trigger circuit.



Version 1



Version 2

Fig. 3 : CMOS implementation of Schmitt trigger

II. VCO USING SCHMITT TRIGGER

Oscillator using the Schmitt trigger is shown in Fig.4. Here the MOSFETs MI and M4 behave as current sources mirroring the current in M5 and M6. When the output of the oscillator is low, M3 is on and M2 is off. This allows the constant current from M4 to charge C. When the voltage across C reaches VSPH the output of the Schmitt trigger swings low. This causes the output of the oscillator to go high and allows the constant current from Ml to discharge C. When C is discharged down to VSPL the Schmitt trigger changes states. This series of events continues, generating the square wave output. Here the Schmitt trigger used can replaced by any CMOS implemented Schmitt trigger giving rise to probably different waveform shape depending on the CMOS implementation of Schmitt trigger circuit.

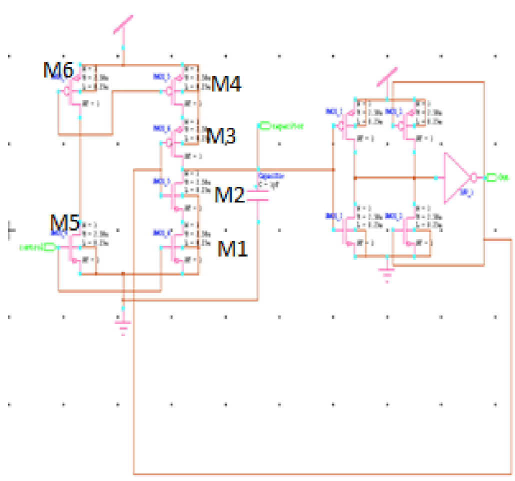


Fig. 4 : VCO Using Schmitt Trigger version1

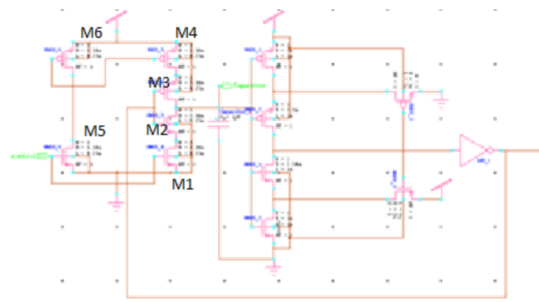


Fig. 5 **:** VCO Using Schmitt Trigger version1

III. PEAK TO PEAK CONTROL OF OUTPUT

By connecting the common-source like structure at the output of the VCOs, we can control the output voltage swing. The CS structure used is as in fig 6.

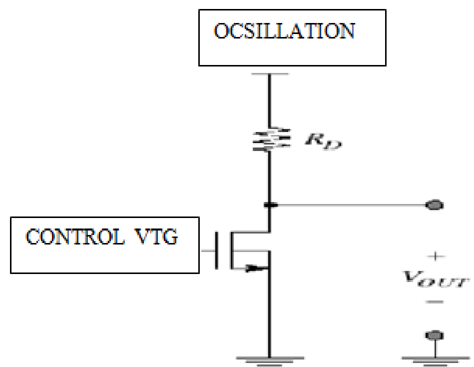


Fig. 6 : Peak to peak control of out put

IV. MODIFYING THE IMPLEMENTED VCO

The current mirror circuit used can be replaced by the pulse generating circuit which switches on the transistors as and when needed.

4.1 The pulse generating circuit

Figure 7 shows the pulse generating circuit used to modify the implemented VCO.

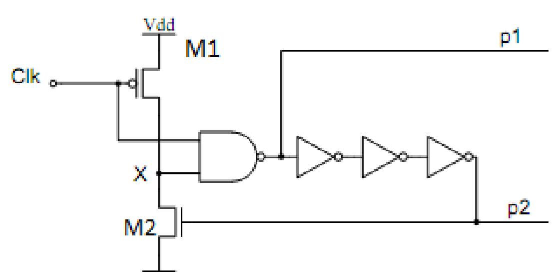


Fig. 7 : Pulse generating circuit

Intermediate node X is pre-charged high during the low phase of the global clock. When the clock rises, p1 falls. After some delay, p2 rises. This causes node X to discharge, causing p1 to rise. After some delay, p2 falls.

Waveform of above pulse generator circuit is as in fig 8.

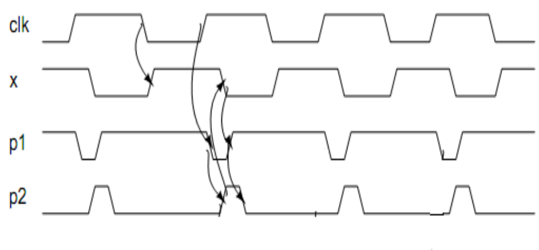


Fig. 8: Wave Form of Pulse Generator

4.2 Using the pulse generator in VCO

The above pulse generator circuit is used in VCO to turn on the transistor which charges the capacitors as and when needed, this increases the switching activity and power consumed but reduces the static power dissipation.

Figure 9 uses the version 2 Schmitt trigger.

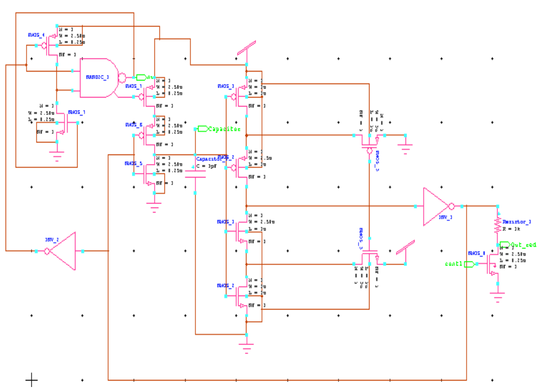
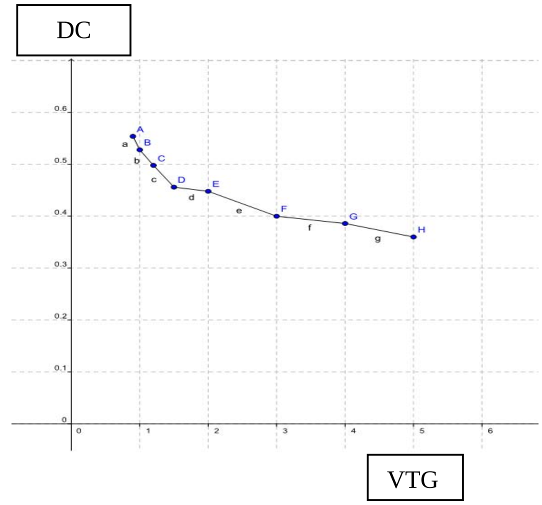


Fig. 9 : Modified VCO using version 2 Schmitt trigger

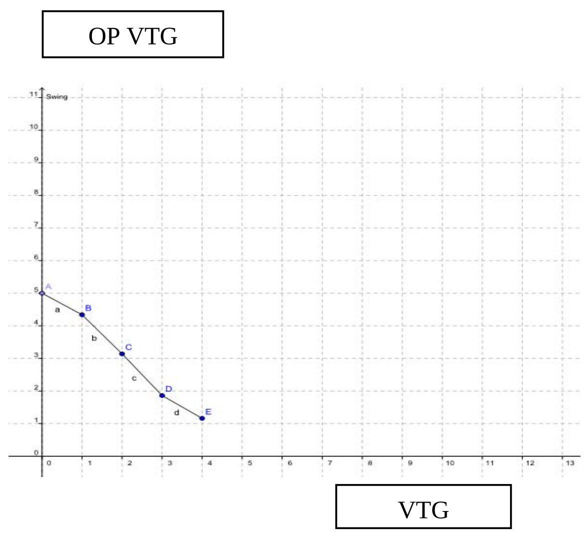
V. RESULTS

	VCO using V1 Schmitt trigger	VCO using V2 Schmitt trigger	VCO using V2 Schmitt trigger(Using pulse generator)
Power consumed	2.0228e-002 watts	6.736781e-003 watts	9.767792e-003 watts
No. of transistor	13	15	20

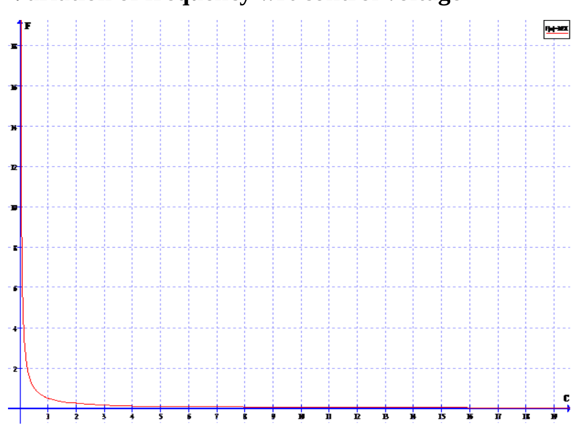
Variation of duty cycle wrt control voltage



Variation of output voltage wrt control voltage



Variation of frequency wrt control voltage



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