低功耗展頻時脈之設計
Low-Power 6-Gbit/s Spread Spectrum Clock Generator

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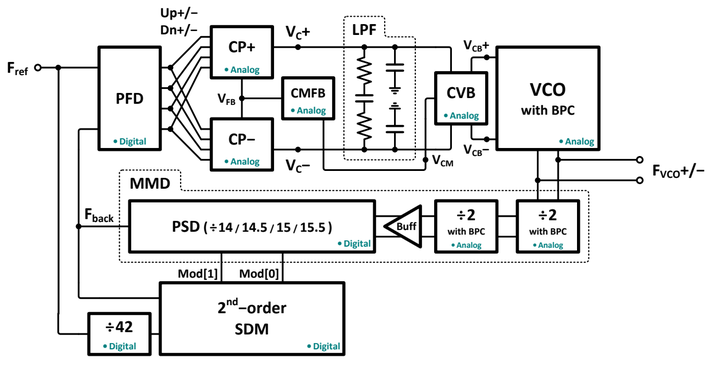
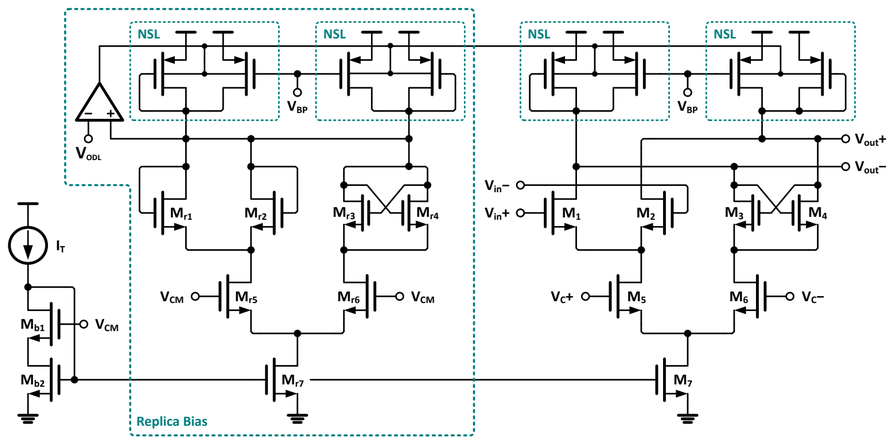
Research Target

- Complete design of SATA III SSCG
- Use process compensation technique for VCO, high speed divider in order to reduce power dissipation.
- Compensate the modulus chasm of MMD and let SSCG to achieve the specification of SATA III. Use 2nd−Order Sigma−Delta Modulator to achieve high EMI reduction with triangular profile.
- Improve this work by decreasing the power dissipation, needed IC area and the performance of Sigma-Delta Modulator.
- Complete layout of VCO and high-speed divider with BPC technique.

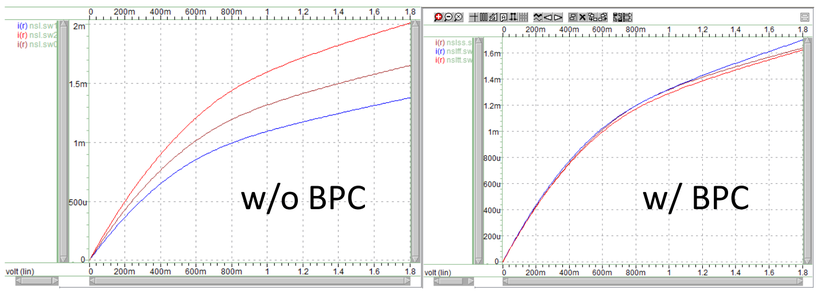
Introduction of Circuit Structure



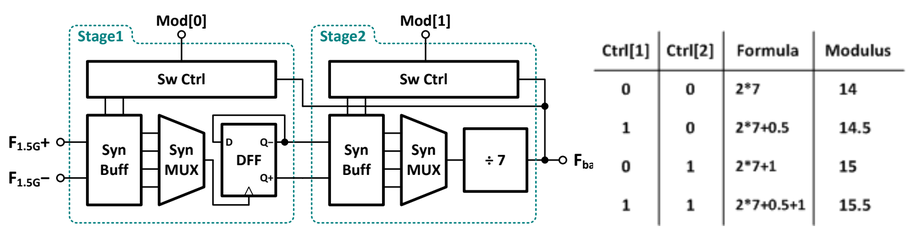
SATA III Spread Spectrum Clock Generator



Voltage-Controlled Oscillator with BPC Technique

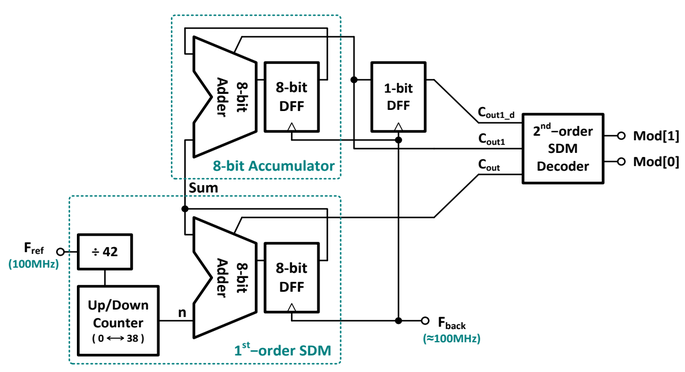


Simulation Of NSL



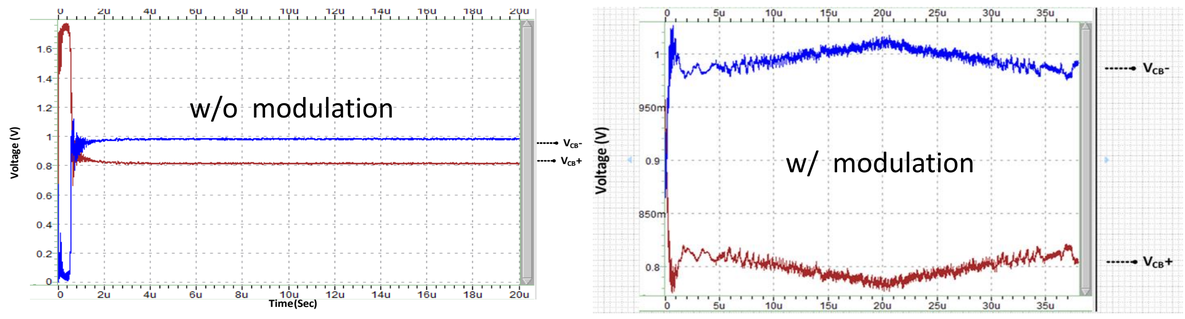
Ctrl[1]	Ctrl[2]	Formula	Modulus
0	0	2*7	14
1	0	2*7+0.5	14.5
0	1	2*7+1	15
1	1	2*7+0.5+1	15.5

ALL Modulus Phase Switch Divider

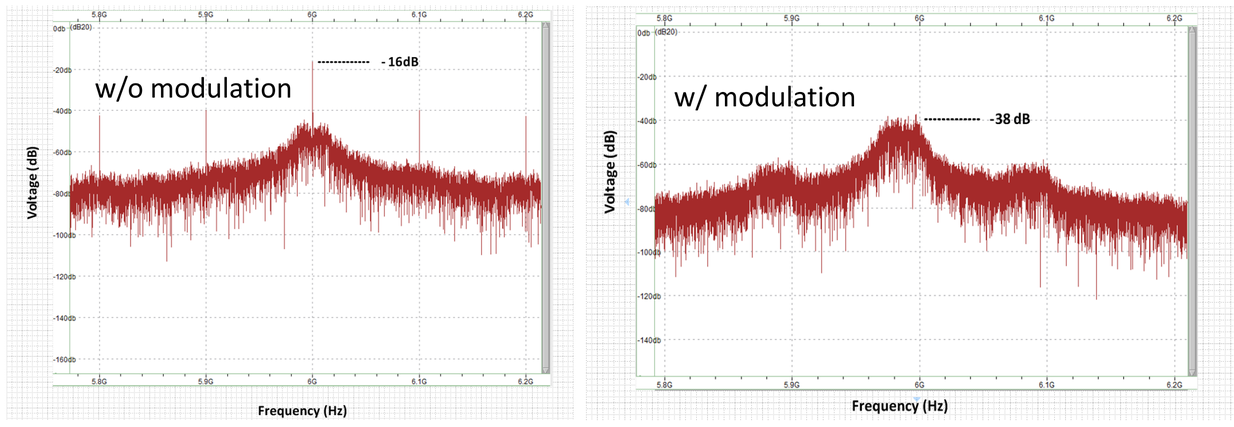


Schematic Of SATA III 2nd−order SDM

Experimental Results

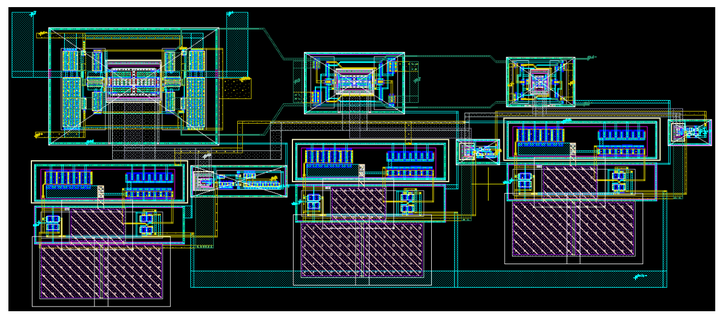


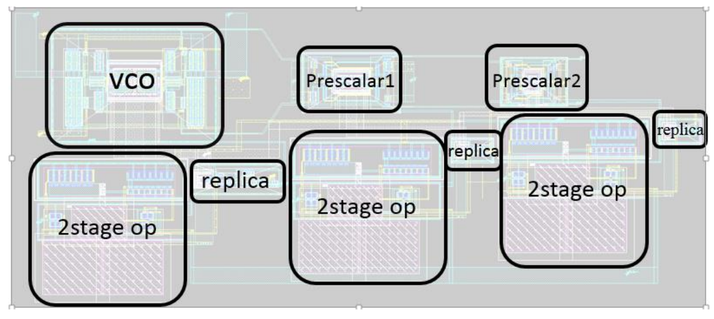
The control voltage of VCO w/o and w/ modulation



The spectrum of SSCG w/o and w/ modulation

Layout of VCO and high-speed divider(with BPC):





Conclusion

- By Using Bulk−Controlled Process Compensator Technique :
  a. Output frequency of VCO can be nearly independent to process variation.
  b. Optimum Division Operation of prescaler could be achieved.
  c. Chip yield could be improved by BPC scheme.
  d. Less current is needed and so power consumption is decreased.
  e. With lower KVCO, smaller capacitor used in low pass filter is needed.
- By using all Modulus Phase Switch Divider :
  - Cancel the modulus chasm of MMD and succeed SATA III specification.
- By using 2nd−order Sigma−Delta Modulator :
  - Achieve High EMI Reduction with Triangular profile.

Power Dissipation Comparison :

	VCO +Calibration	Divider	PFD/CP	Other	Total
JSSC[13]	13mW	31mW	3mW	-	47mW

	VCO+BPC	Divider*	PFD/CP	Other	Total
This Work	7.74mW	5.016mW	683.7uW	4.45mW	17.889mW

*5.01mW=1.404mW(1st Prescaler) + 0.225mW(2nd Prescaler) + 3.387mW(Buffer&PSD)