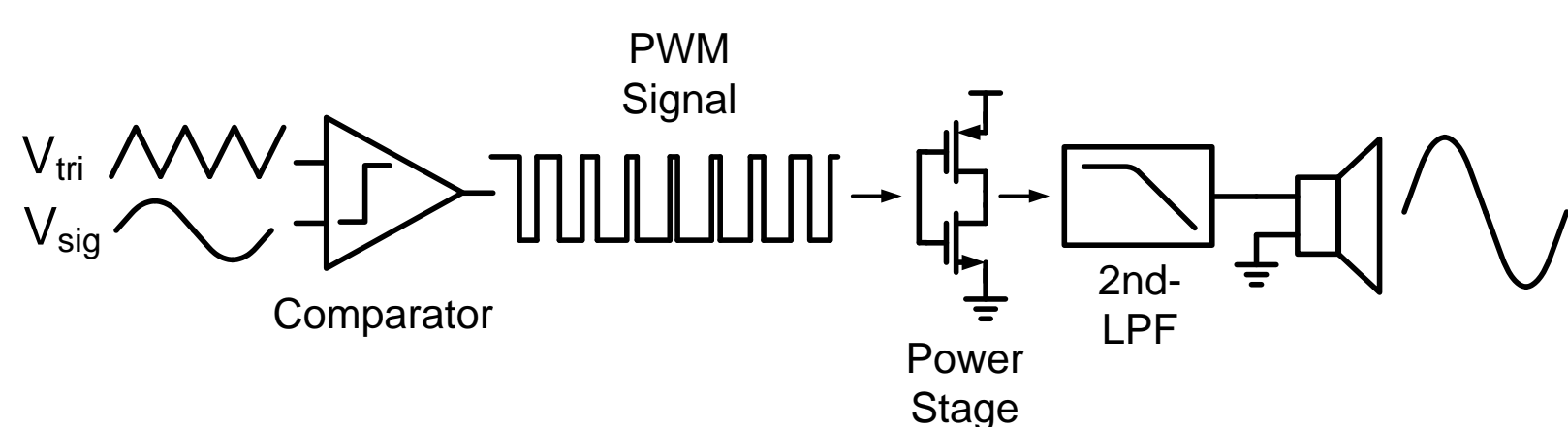


INTRODUCTION

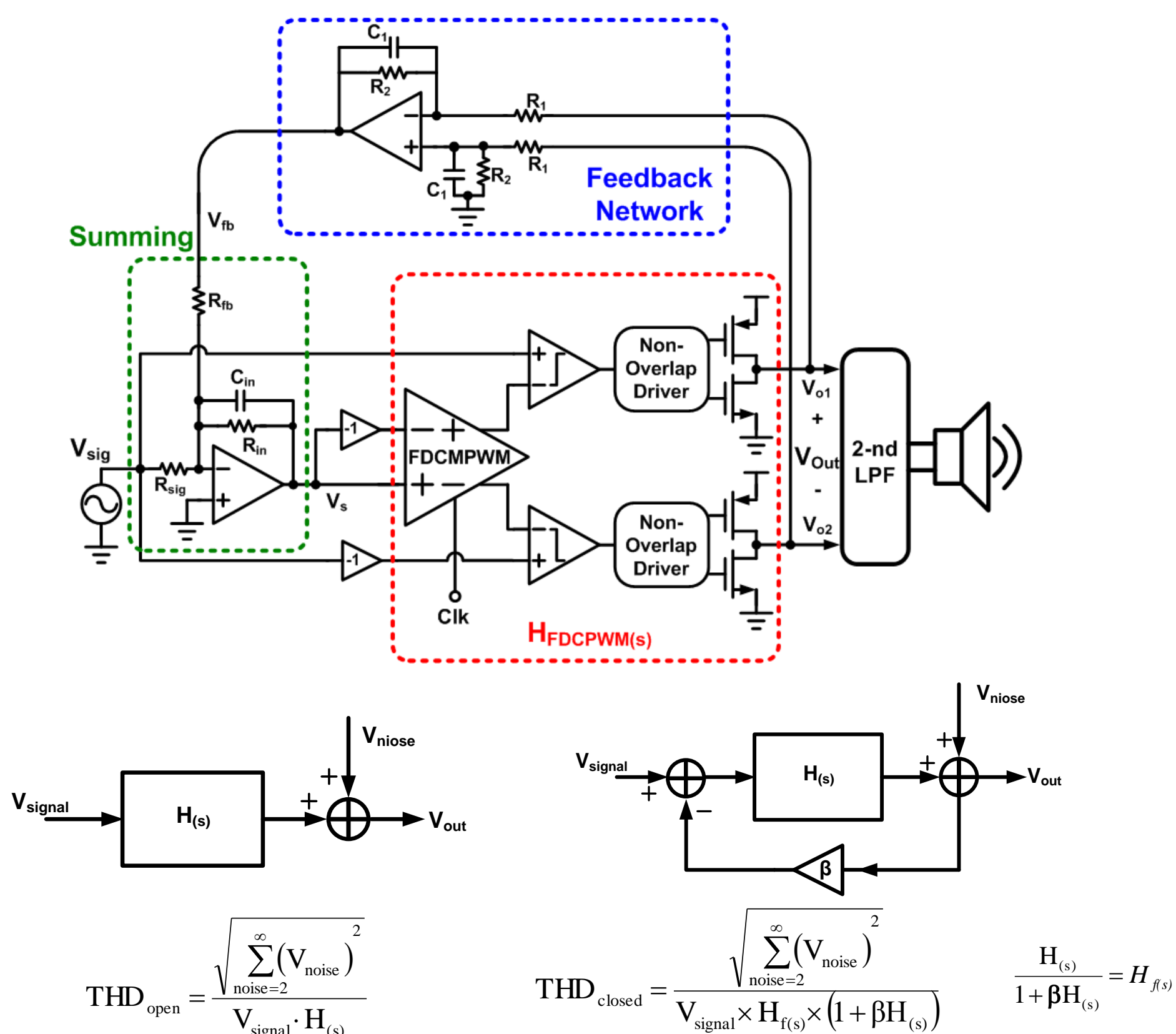
- The transistors in traditional linear amplifier like Class A and Class AB amplifier which operate in active region for BJT or in saturation region for MOSFET have the good operation linearity, but the efficiency is relatively low due to the power consumption of the output stage transistor.
- The switching mode amplifier meaning the output stage transistors operate in fully off/on state like Class D amplifier has less power consumption and get higher operation efficiency; however, the switching mode leads poor linearity comparing to the linear amplifier.
- On the basis of the power saving, the switching mode amplifiers are more suitable for portable device.

MOTIVATION

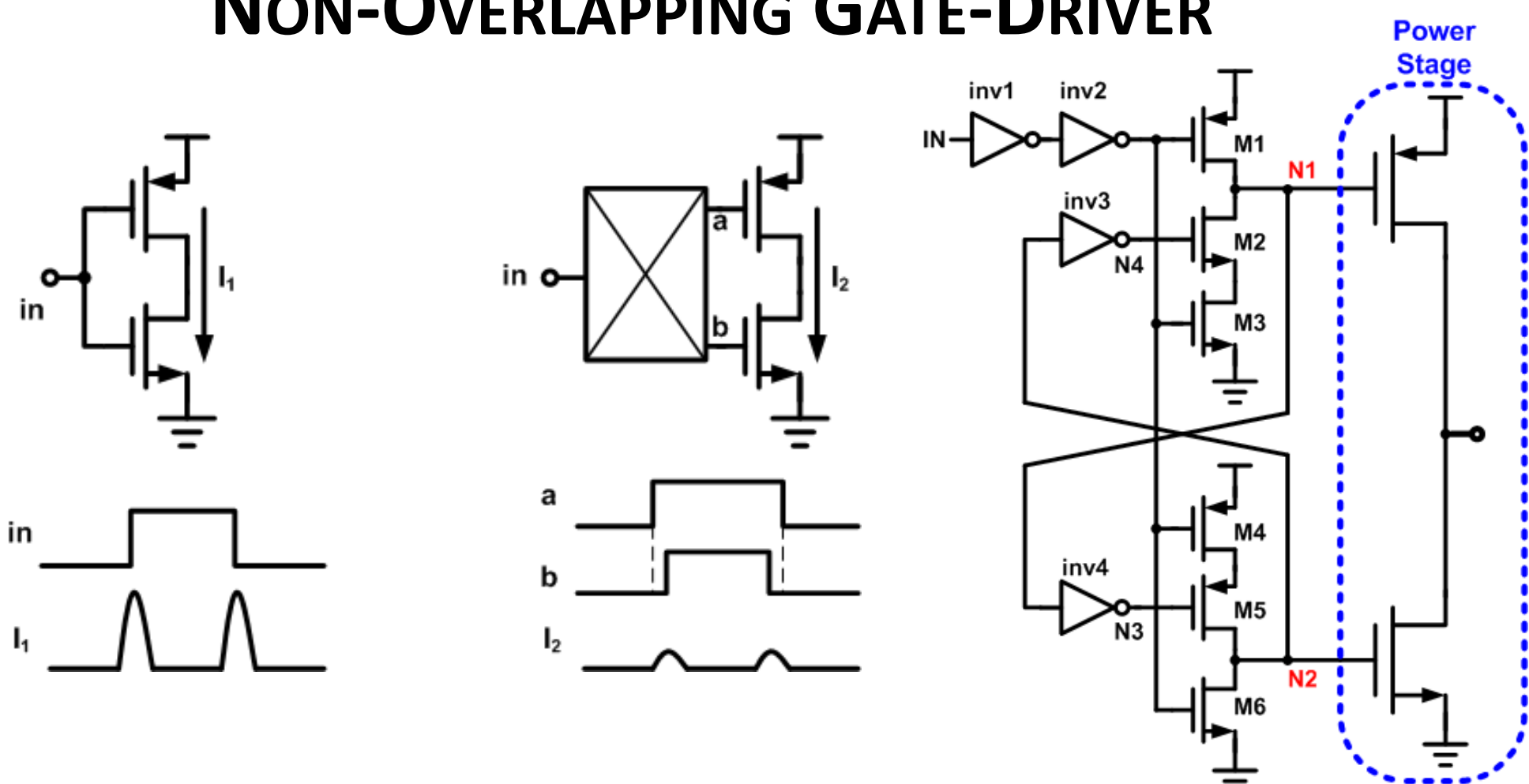


- With the output load 8ohm in mobile phone.
- Using a signal controlled current to produce a differential PWM signal which are fully linear to the input audio signal.
- To achieve high operation efficiency.
- Using a negative feedback technique to enhance the linearity.

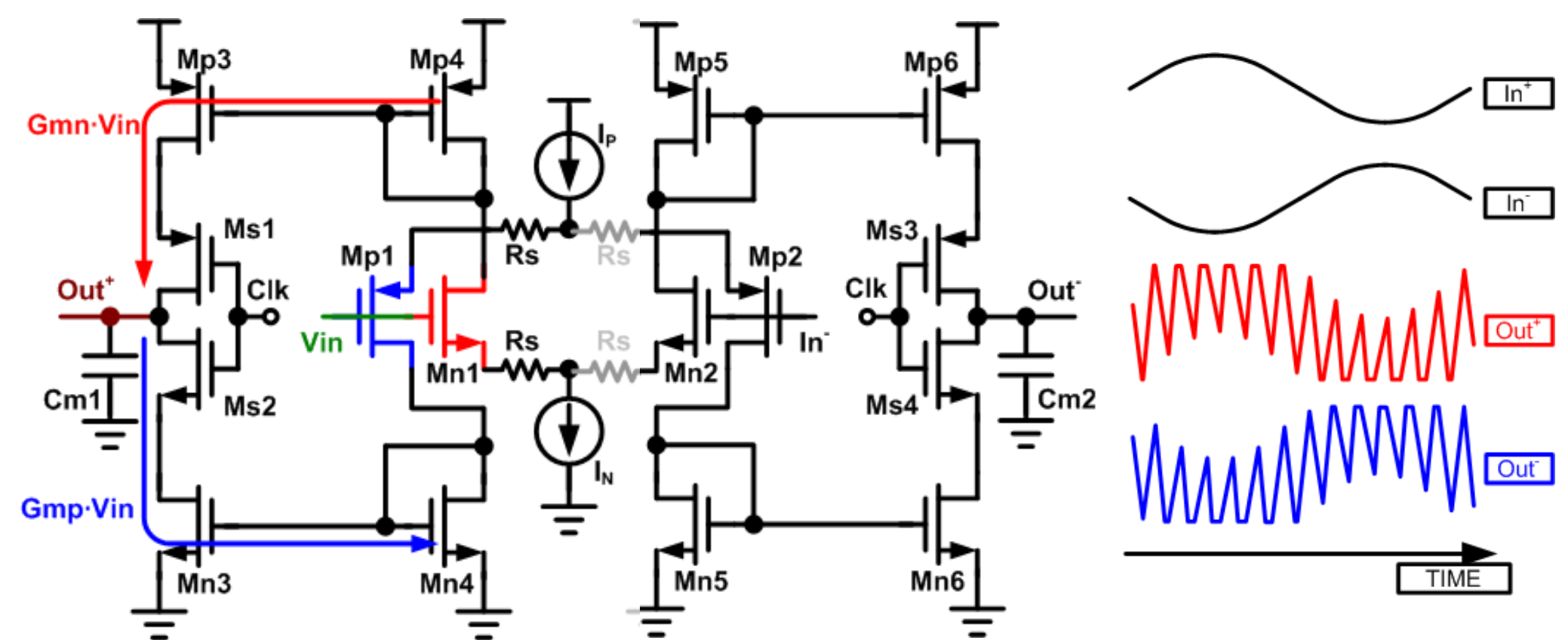
CIRCUIT DESIGN



NON-OVERLAPPING GATE-DRIVER



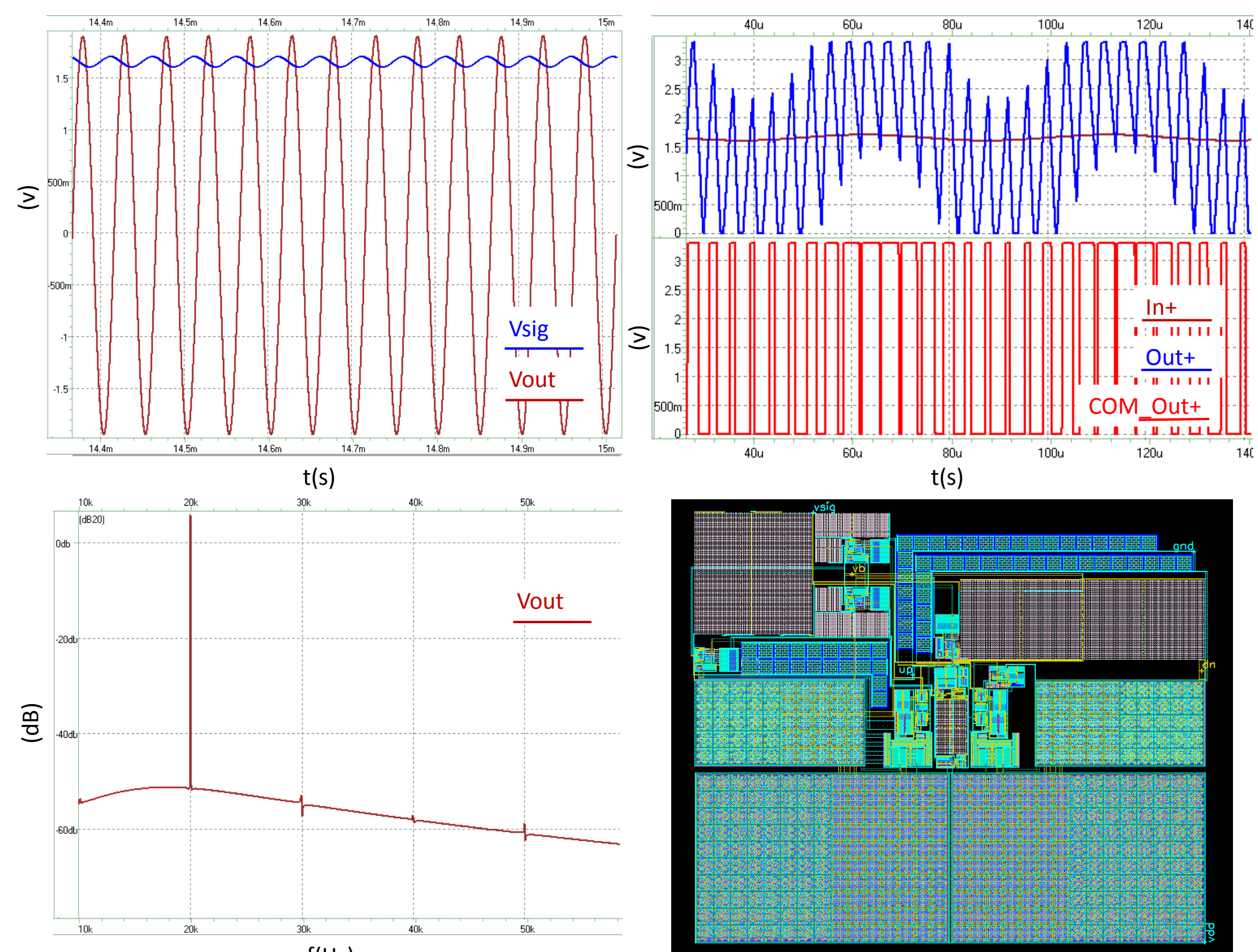
FULLY DIFFERENTIAL CURRENT MODE PWM



$$I = \frac{1}{2} \times K \times (V_{GS} - V_t)^2 = \frac{1}{2} \times K \times V_{eff}^2 \Rightarrow g_m = \frac{2 \times I}{V_{eff}}$$

$$g_m = K \times (V_{GS} - V_t) = K \times V_{eff}$$

SIMULATION & LAYOUT



COMPARISON

Parameter	2005[22]	2006[23]	2007[24]	2010[25]	2010[26]	This Work
Process	0.35-μm CMOS	0.35-μm CMOS	0.35-μm CMOS	0.35-μm CMOS	0.18-μm CMOS	0.35-μm CMOS
Supply Voltage	1.5V	3.3V	1.5V	1.5V	1.8V	3.3V
Carrier Frequency	40KHz	250KHz	500KHz, 1MHz	1MHz	500KHz	250KHz
Output Load	4ohm, 8ohm	8ohm	4ohm, 8ohm	4ohm, 8ohm	8ohm	8ohm
Power Efficiency	91.6%	82%	88.6%	92%	93.6%	90.6%
THD	0.24%	0.045%	0.3%	0.19%	0.026%	0.165%
Chip Area (mm ²)	1.5x1.5	N/A	2.42x2.39	2.35x2.35	Chip: 1.08x1.08 Core: 0.76x0.76	Core: 0.862x0.707

CONCLUSION

- FDCMPWM has proved the pulse width variation is a linear function of input signal
- FDCMPWM using constant bias current to gain a constant transconductance GM so it can effectively degrade the effect of process variation
- A Class D audio amplifier with feedback network has the better linearity performance