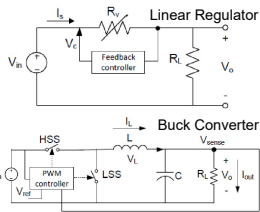




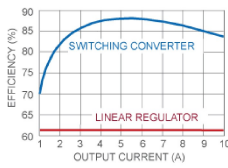
Design of 3MHz DC/DC Buck Converter, Voltage Mode, CCM, PWM control for Low Power Applications and High Slew Load Transients in 130nm CMOS Technology

Dimitar Metodiev Andonov, Supervisor Professor Alex Leung
Department of Electronic Engineering, The Chinese University of Hong Kong

MOTIVATION

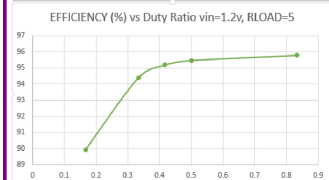
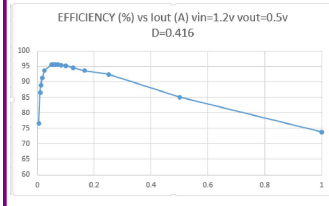
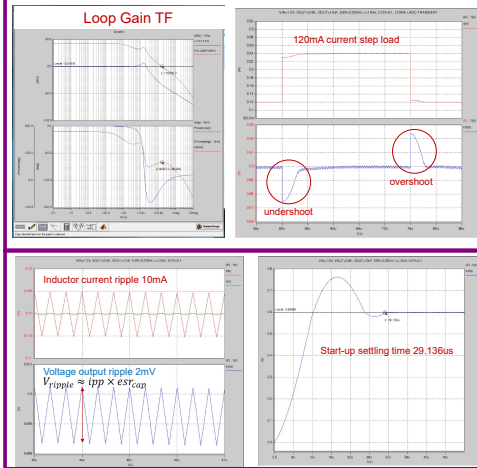
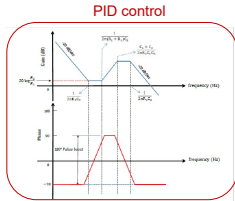
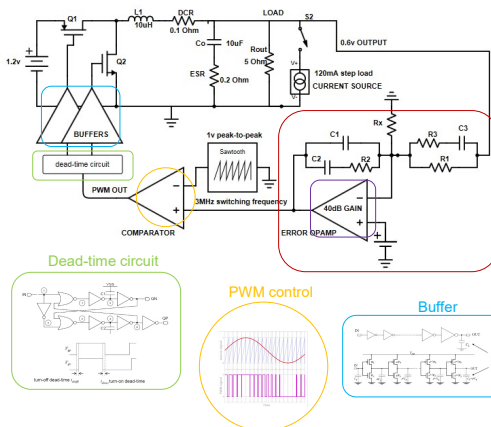


EFFICIENCY APPROXIMATIONS		L O	
VIN	1.2V	1.2V	
IIN	1A	1A	
VOUT	0.6V	1V	
IOUT	1A	1A	
VOUT/VIN %	EFFICIENCY = 50%	EFFICIENCY = 83.3%	

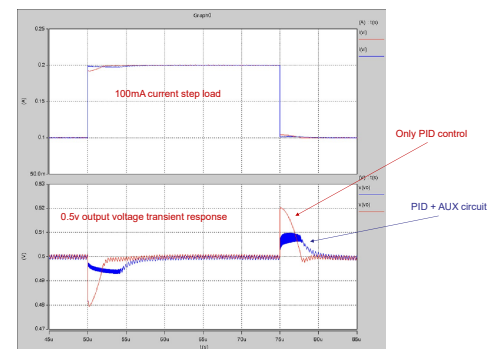
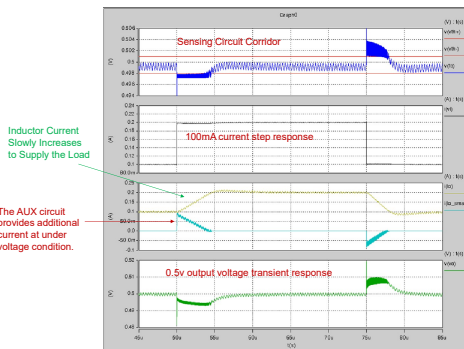
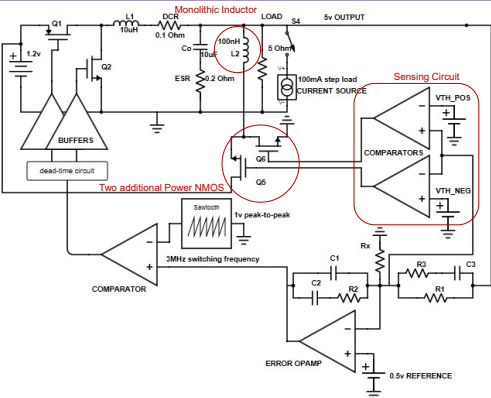


Switching mode DC/DC converter are critical building blocks for portable devices. Their main advantage over LDOs is their high efficiency. Modern digital loads, such as DSPs and CPUs, GPUs require high slew load rates. Four methods are suggested to improve the transient response.

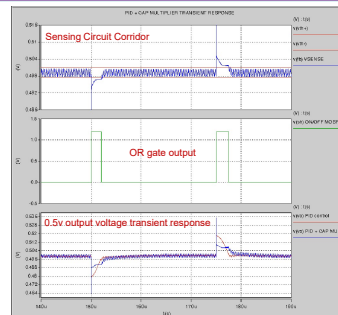
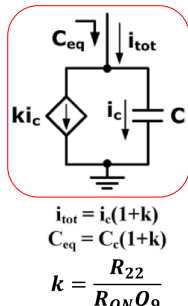
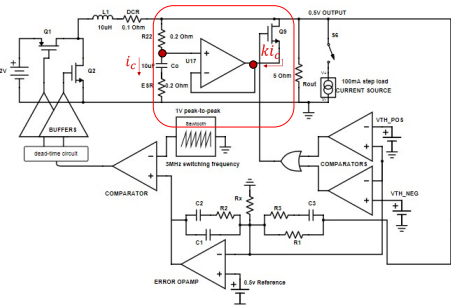
PID COMPENSATION HIGH SWITCHING FREQUENCY



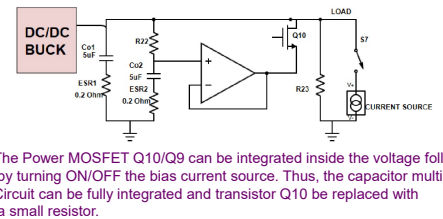
PID + AUX CIRCUIT WITH MONOLITHIC INDUCTOR



PID + CAPACITOR MULTIPLIER



The R22 increases the ESR of the output capacitor, therefore it also increases the voltage ripple. To avoid this, the capacitor multiplier can be connected in parallel to a smaller output capacitor. Thus, the equivalent ESR is decreased and the voltage ripple improved.



CONCLUSION

- Four methods were suggested to improve the transient response of the buck converter:
1. Increasing the switching frequency (switching loss in MOSFETs increases)
 2. Increasing the BW of the Loop Gain (limitations due to the switching frequency noise and the Output Cap)
 3. Current Source Auxiliary Circuit (two additional power MOSFETs - increased production cost)
 4. Capacitor Multiplier (one power MOSFET - it can be integrated in future design versions)

REFERENCE

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[2] H. Lee, P.K. T. Mok, and W.-H. Ki, "A novel voltage-control scheme for low-voltage DC-DC converters with fast transient recovery," in Proc. IEEE Int. Symp. Circuits Syst. (ISCAS), 2000, pp. 256-259.
[3] Byungcho Choi, "Pulsewidth modulated DC-TO-DC Power Conversion", IEEE press, WILEY

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