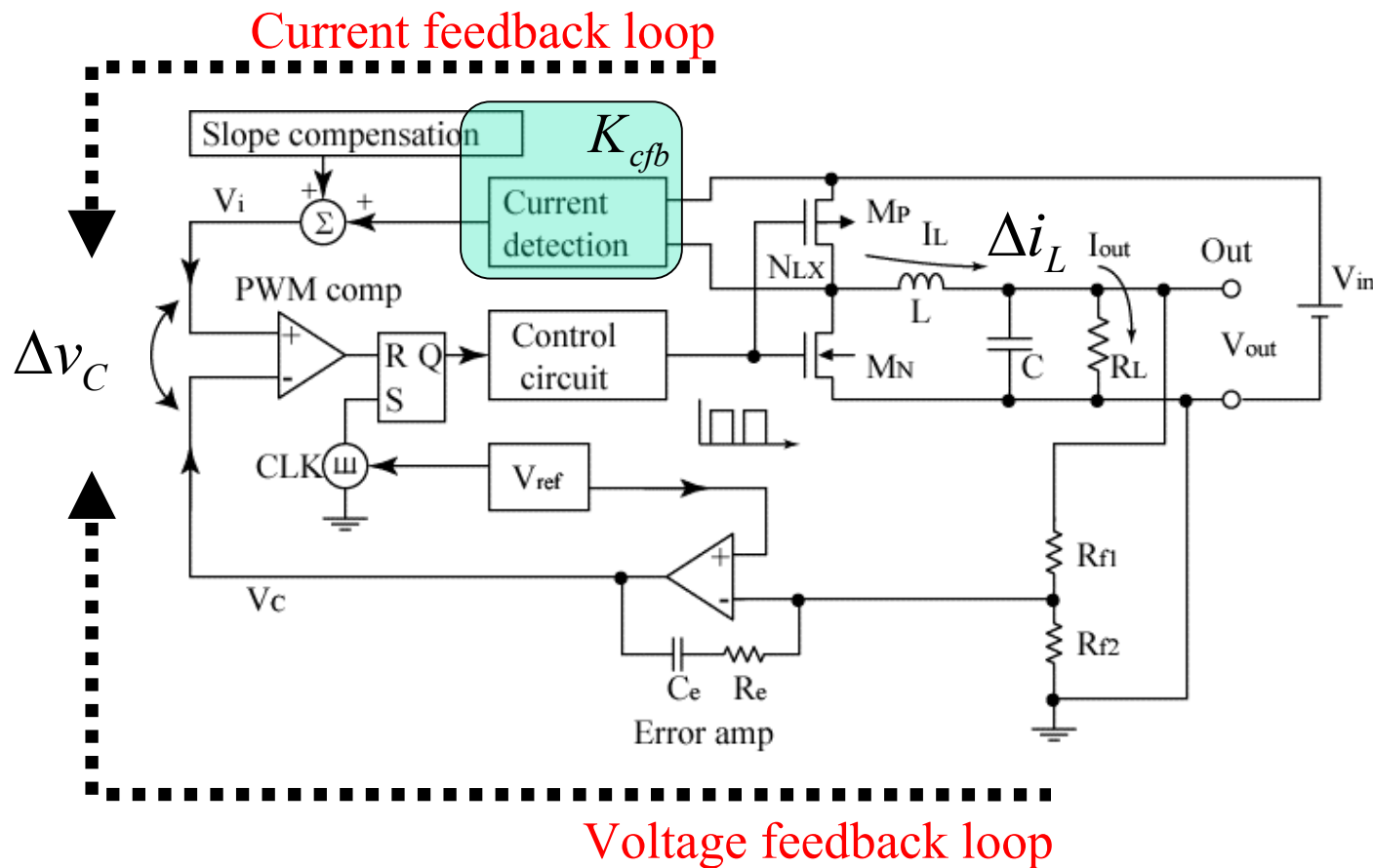


A Current-mode DC-DC Converter using a Quadratic Slope Compensation Scheme

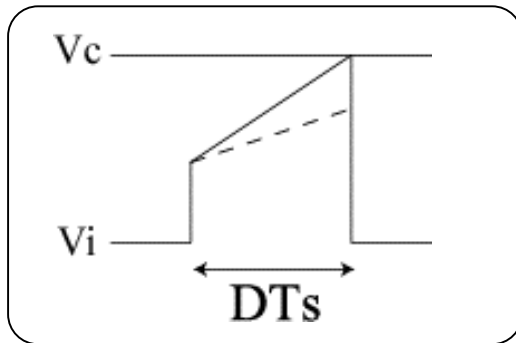
Chihiro Kawabata, Yasuhiro Sugimoto
Chuo University, Tokyo, Japan

Block diagram of a current-mode, MOS, buck DC-DC converter

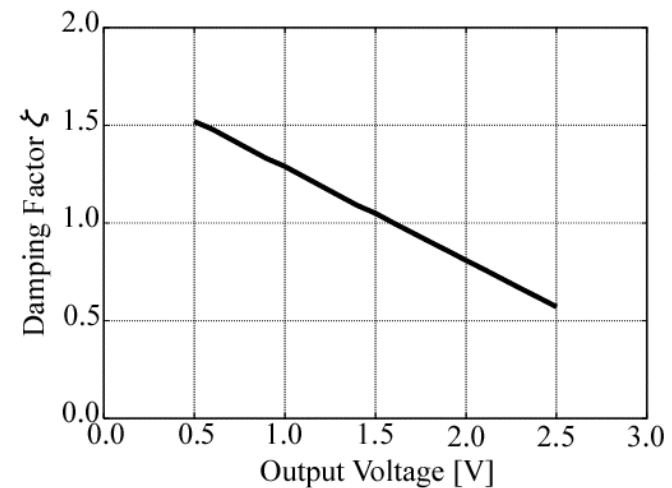
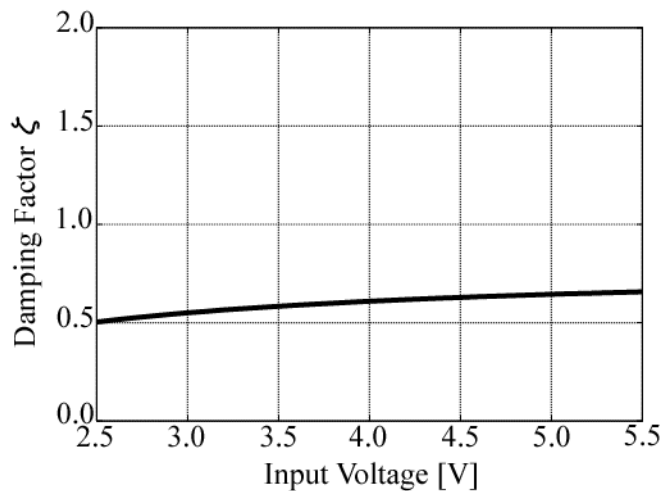


The **slope compensation** must be applied to the current feedback loop.

Conventional slope compensation and the damping factor



A linear slope is the standard.

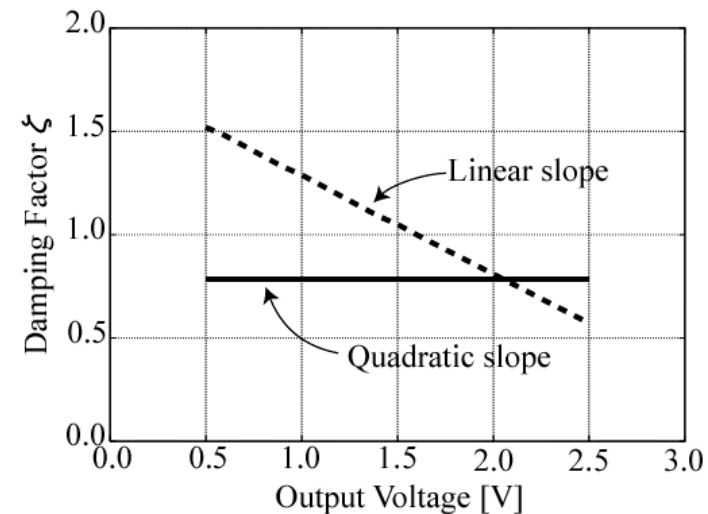
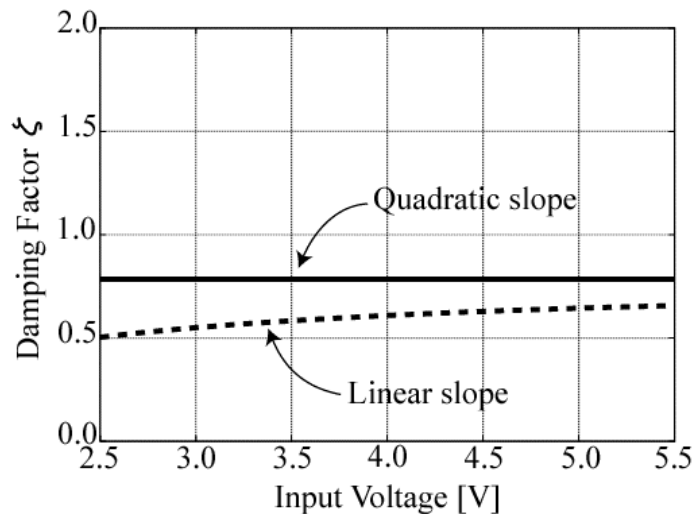
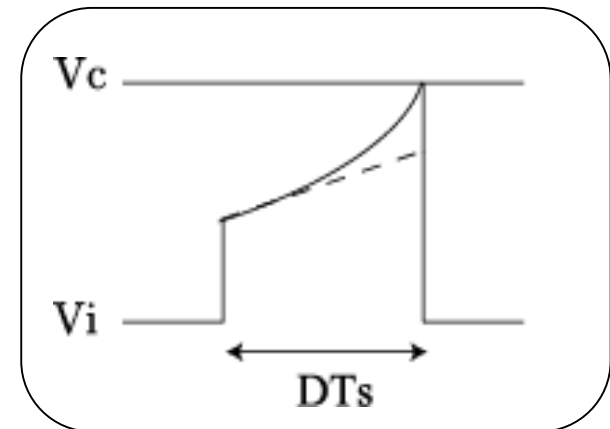


However, the damping factor ζ becomes **dependent on V_{in} and V_{out}** .

The proposed quadratic slope and its damping factor

$$\zeta = \frac{\pi}{2} \left(\frac{1}{2} + \frac{2LD}{V_{in} K_{cfb} f_x} m_c - \frac{V_{out}}{V_{in}} \right)$$

$$m_c = \frac{V_{in} K_{cfb} f_s}{2L} \quad \rightarrow \quad \zeta = \frac{\pi}{4} = 0.8(\text{const.})$$



Yes, we can have the damping factor ζ independent of V_{in} and V_{out} .

Experimental results

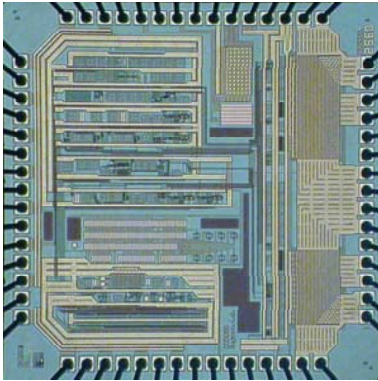
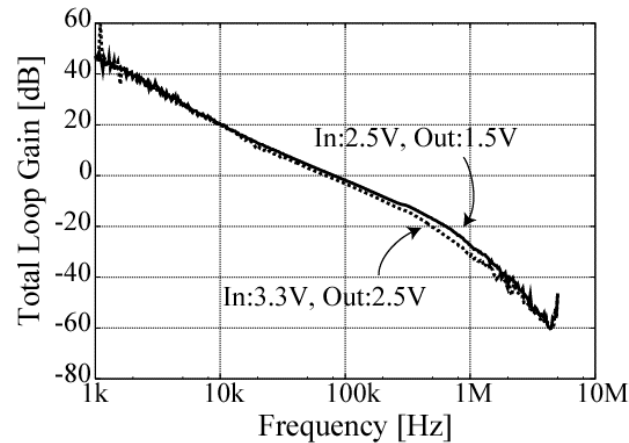


Table 1. Overall chip performance

Input voltage	3.3V ~ 2.5V
Output voltage	2.5V ~ 0.5V
Max. load current	500mA
Process	0.35um CMOS



The constant frequency characteristics were obtained.

1. A quadratic slope compensation scheme was proposed.
2. The quadratic slope realized that the damping factor and the frequency characteristics of the current feedback loop were constant.
3. A test chip of a current-mode DC-DC converter verified the effect of the quadratic slope.