

## Circuit Component Value Estimation in Buck Converter Using Efficiency Curve

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We propose an estimation method of the circuit component values in the power stage of the step-down DC/DC power supply circuit. Our method is to fit the power conversion efficiency curve with the measured values using the theoretical loss equations.

Fig. 1 shows the circuit diagram of the power stage of the synchronous rectification type step-down DC/DC converter and the loss and current paths generated in the circuit components.

The efficiency of the DC / DC converter can be expressed by the following equation<sup>1</sup>.

$$\eta = \frac{V_{out} I_o}{V_{out} I_o + P_{loss}}$$

Fig. 2 shows the measured and calculated power conversion efficiency values for various output voltages and load currents. Fig. 3 shows the results when the natural frequencies are matched using parameters (Table I). It can be seen that the measurement and estimated values of the resonance peak of the gain near the resonance frequency as well as the phase are well matched.

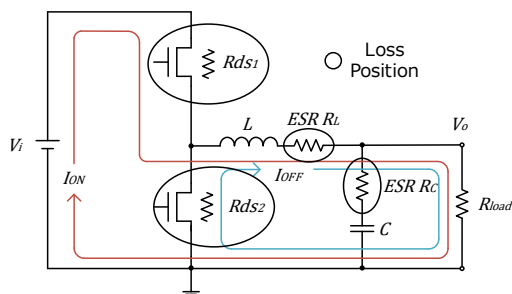


Fig.1 Power stage of a synchronous buck converter.

Table I. Estimated parameters of the evaluation board at output voltage 3V.

Inductor ESR $r_L$	10m $\Omega$
Capacitor ESR $r_C$	1m $\Omega$
High side ON resistance of MOSFET $R_{ds1}$	30m $\Omega$ at 3V
Low side ON resistance of MOSFET $R_{ds2}$	45m $\Omega$ at 3V
Static bias current of IC $I_{IC}$ .	4.8mA at 3V

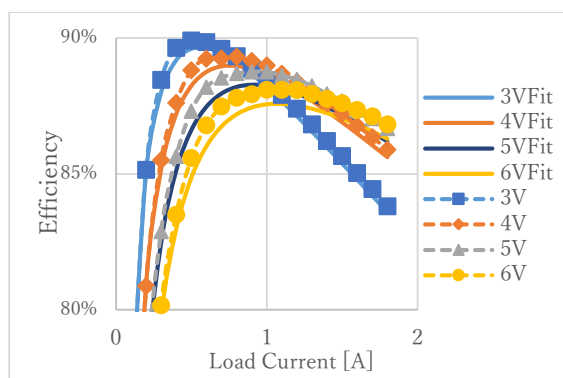


Fig. 2 Measured and estimated efficiency conversion curves.

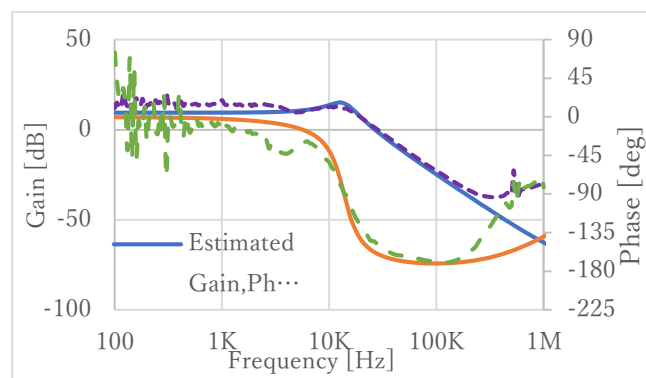


Fig. 3 Estimated and measured transfer function of power stage.

<sup>1</sup> T. Kohama, T. Tahara, "Estimation of Power Conversion Efficiency for Low-Voltage Buck-Converter", 87<sup>th</sup> Technical Report of Fukuoka Univ. (Sep. 2011).