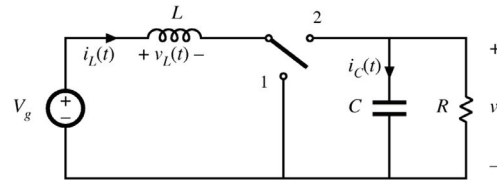
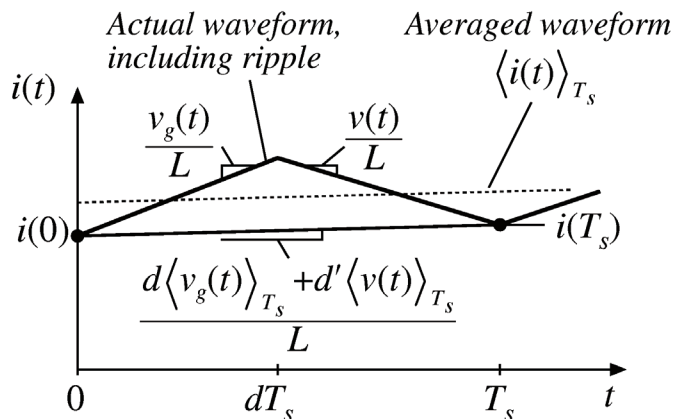


Averaging in Transient Operation



Averaging: Correct Prediction



The net change in inductor current over one switching period is exactly equal to the period T_s multiplied by the average slope $\langle v_L \rangle_{T_s} / L$.



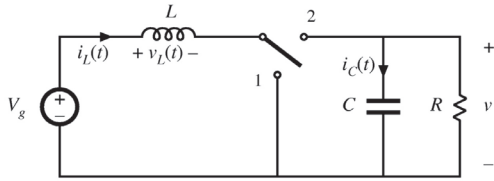
Averaging: Discussion

Small Signal Modeling: Linearization

(1) Perturb and Linearize

(2) 1st order Taylor Series Expansion

Equivalent Circuit Modeling: Boost Example

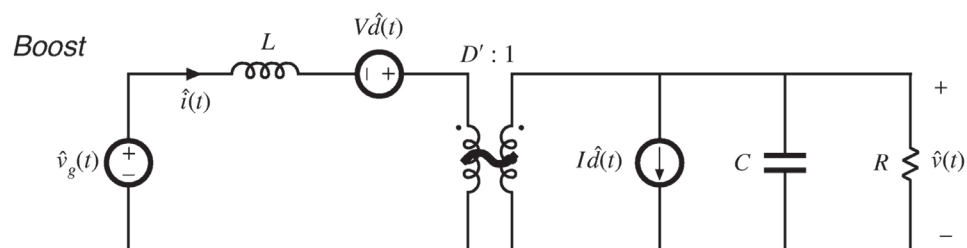


Linearization

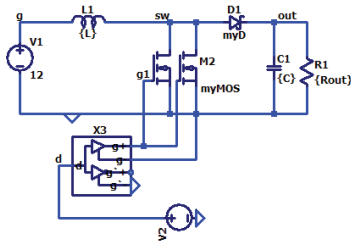
Equivalent Circuit Model



Boost Converter Averaged, AC, Linear Circuit Model



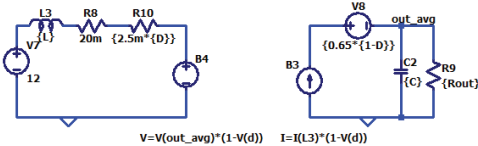
Model Simulation



```
.param
+ L = 22u
+ C = 22u
+ Rout = 48
+ D = .755
```

```
.ic V(out)=48 I(L1)=3.1A
.tran 0 (1500/202k) (800/202k) startup
.lib myParts.lib
```

Full Switching Model

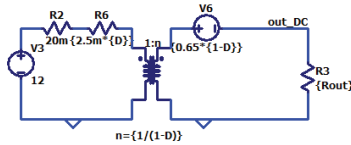


```
.ic V(out_avg)=48 I(L3)=4A
```

$$V = V(\text{out_avg}) * (1 - D)$$

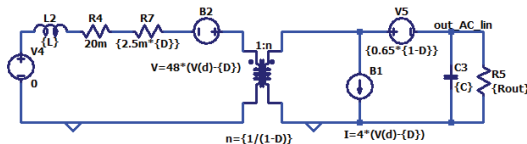
$$I = I(L3) * (1 - D)$$

Averaged, Nonlinear



$$n = \{1/(1-D)\}$$

DC Averaged Model



$$V = 48 * (V(d) - D)$$

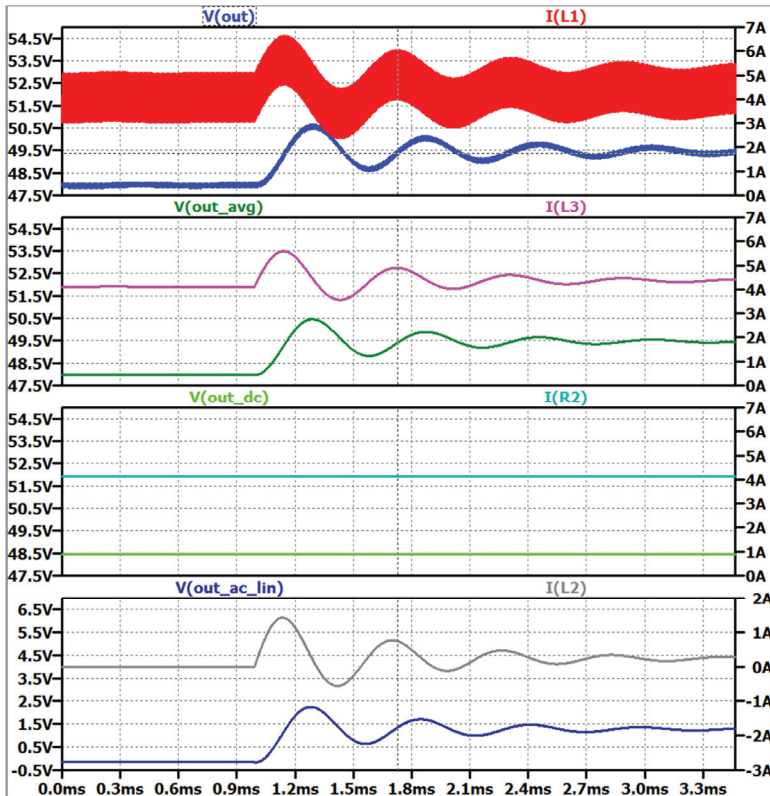
$$I = 4 * (V(d) - D)$$

```
.ic V(out_AC_lin)=0 I(L2)=0
```

AC Averaged,
Linearized Model



Model Comparison



Full Switching Model

Averaged, Nonlinear

DC Averaged Model

AC Averaged,
Linearized Model

