Feedback Control System Design of Buck Converter

1. Feedback Control Design First Look

In this section, the design of controller system of Buck Converter (DC-DC) is implemented via schematics.

(output reference)

**system input**

y

error

yref

u

output

e

**-**

**+**

GP(s)

GC(s)

Plant System

Controller

Fig. Feedback Control System Schematic

There are 3 steps to modeling the Plant ( GP(s) )

1. Model the dynamic states
2. Simplify & linearize the system
3. Find the transfer function
4. Modeling the Plant System Gp(s)

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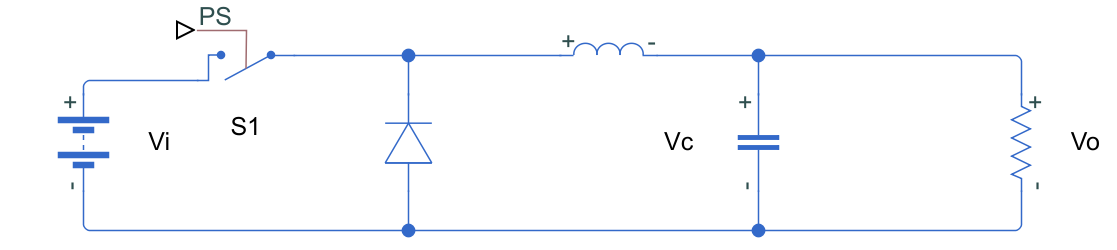


Fig. 1 Buck Converter

How to derive switching circuit into a plant system?

We always start with the dynamic states. Dynamic states are just components that are governed by an equation that has a derivative.

If we look at the schematic for the buck converter above, the two components are governed by differential equations are ‘’Inductor and Capacitor’’.

1. Simplify & Linearize the System

Inductor Current Capacitor Voltage

New Variables:

y

output

States

(X1,X2,X3….)

u

system input

x1 D = u

x2 y = VC = x2

State Equations

x1 D = u

x2 y = VC = x2

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1. Find the Transfer Function

We use Laplace Transform & rearrange the terms.

Input = u

Output = y = x2

Consider x2 = Y

This was our transfer function of GP(s) plant system.

1. Modeling the Controller System GC(s)

Multiply PID equation by

Our total transfer function for the system

was calculated in previous page. Put into the above equation:

Put eq. into TF eq.

It can be observed from denumerator, the system is having order equation that means it has 3 poles.

Performance Characteristics:

1. Stability
2. Rise time, Overshoot, Settling Time