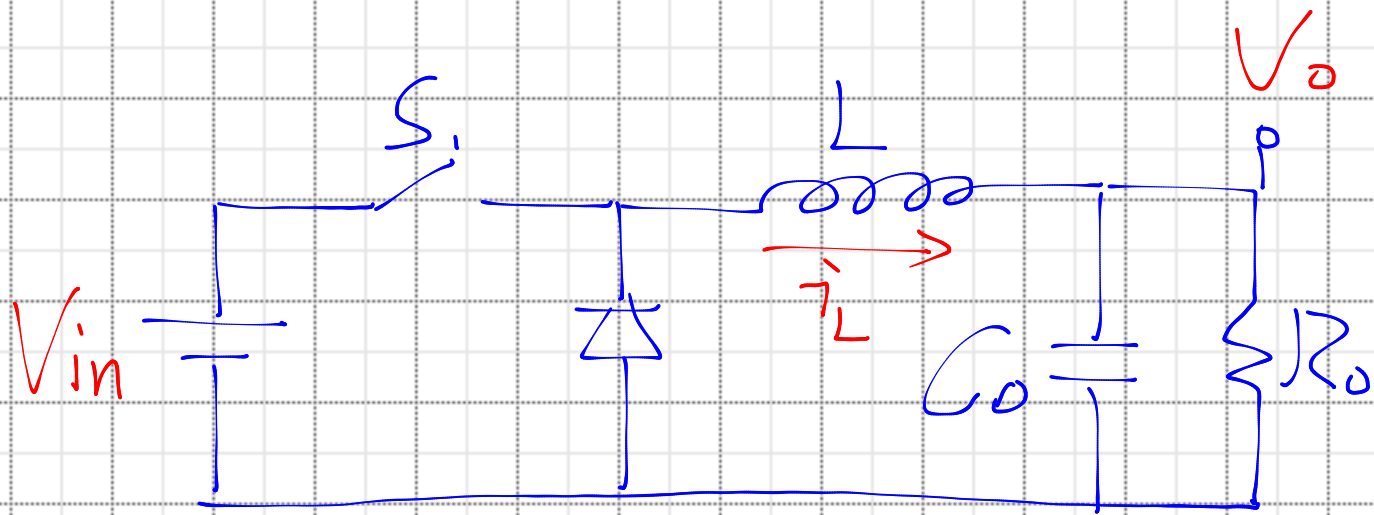


Using Primary Side Regulation IC (CC/CV) For AC/DC Buck Converter.

△ Assumptions:

1. Buck Converter operates in DCM.

△ Circuit diagram:



△ Waveforms and key equations:

$$* I_p \cdot \frac{(V_{in} - V_o)}{L} \cdot T_{on} = \frac{V_o}{L} \cdot T_{off} \quad (1)$$

$$\Rightarrow T_{off} = \frac{(V_{in} - V_o)}{V_o} T_{on} \quad (2)$$

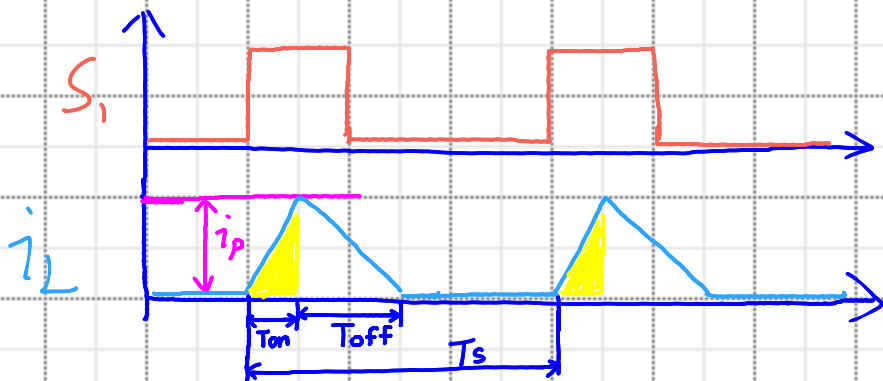
$$* I_o = \frac{1}{2} I_p \cdot \frac{(T_{on} + T_{off})}{T_s} = \frac{1}{2} I_p \cdot \frac{V_{in}}{V_o} \cdot \frac{T_{on}}{T_s}$$

$$= \frac{1}{2} \frac{(V_{in} - V_o)}{L} \cdot \frac{V_{in}}{V_o} \cdot \frac{T_{on}^2}{T_s}$$

$$\text{And } P_o = V_o \cdot I_o = \frac{(V_{in} - V_o) \cdot V_{in} \cdot T_{on}^2}{2 \cdot L \cdot T_s}$$

$$\Rightarrow T_{on} = \sqrt{\frac{2 \cdot P_o \cdot L \cdot T_s}{(V_{in} - V_o) \cdot V_{in}}} = \frac{L \cdot I_p}{V_{in} - V_o}$$

$$\Rightarrow I_p = \sqrt{\frac{2 P_o \cdot (V_{in} - V_o) \cdot T_s}{L \cdot V_{in}}} \quad (4)$$



△ CCM/DCM Boundary inductance calculations:

During CRM,

$$L \cdot i_p = (V_{in} - V_o) \cdot T_{on} = V_o \cdot T_{off} = V_o \cdot (1-D) \cdot T_s, \text{ where } D = \frac{T_{on}}{T_s}$$

⇒ Average output current I_o :

$$I_o = \frac{1}{2} i_p = \frac{V_o \cdot (1-D) \cdot T_s}{2L}$$

⇒ Inductance at CRM can be derived from $P_o = V_o \cdot I_o$

$$\Rightarrow L_{CRM} = \frac{V_o^2 \cdot (1-D) \cdot T_s}{2P_o}$$

UCC287x0 design flow chart:

Acquire V_{in} , V_o informations



Acquire $P_{o,max}$



Decide L by checking the inductance to be operated at $f_{sw,max}$, $P_{o,max}$, and $V_{in,min}$



Check S_1 current waveform than determine R_{cs} value.



Based on the fixed I_p determine the "actual" f_{sw}



Check f_{sw} & I_p Relation in Datasheet Fig.16. See if my design fall in Fig.16 range?

Yes

Done

Note: T_{off} duration check might be necessary when V_{in} closed to V_o .

No. $f_{sw} > f_{sw,max}$ → Increase I_p value

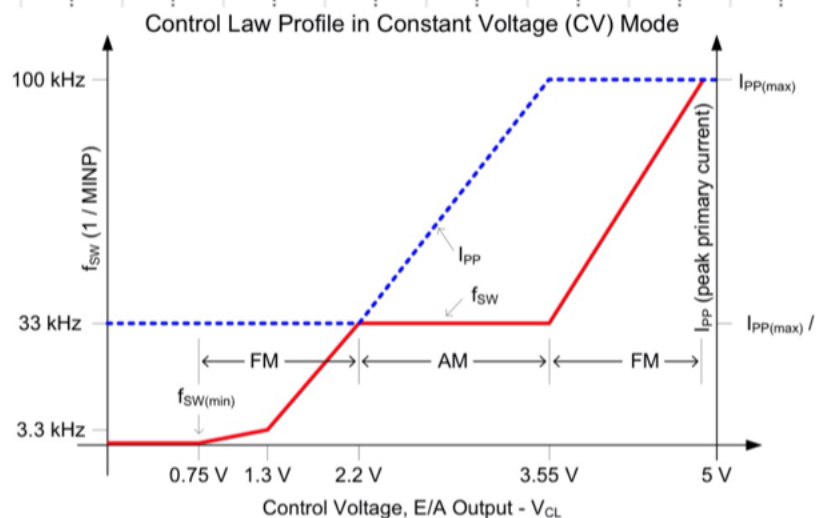


Figure 16. Frequency and Amplitude Modulation Modes (during voltage regulation)

Questions :

1. What's the maximum output power can a AC/DC Buck achieved when using PSR ICs, such as UCC287x0 or UCC28910?
2. Do I need to check the conditions that operates at light load, minimum operation frequency?