ABSTRACT

To theoretically show how to set up a PFC boost regulator using current sense transformers using the UCC3817 control IC.

1 Schematic

![Schematic Diagram]

Figure 1.

2 Theory of Operation

1. Current sense transformers T1 and T2 are used to sense the input current to the PFC stage.

2. The sum of these two currents will represent boost inductor current.

3. Resistors R1 and R2 are used to reset the current sense transformers.

4. $R_{\text{SENSE}}$ is the current sense resistor used to shape the input current waveform.

5. Capacitor $C_f$ is used to filter out high frequency noise.
3 Setting Up the Circuit

1. Current sense transformer secondary turns ratio
   
   \[ N_S = \frac{I_{L(\text{boost})}}{\frac{1}{R_{\text{SENSE}}}} \text{ if } N_P = 1 \]
   
   b. \[ N = \frac{1}{N_S} \]
   
   c. The turns \( N \) can be set to reduce losses.
   
   d. The current sense transformers' turn ratios need to be the same.

2. The following calculations can be used to select transformer reset resistors \( R_1 \) and \( R_2 \).
   
   a. DCR is the dc resistance of \( T_1 \)'s primary.
   
   b. \( L_M \) is \( T_1 \)'s primary magnetizing inductance.
   
   c. \[ R_1 = R_2 = 100 \times \left( L_M \times \left( \frac{f_S}{0.9} + DCR \right) \right) \times \left( N_S \right)^2 \]
   
   d. These calculations should work as long as the duty cycle \( D \) is below 90%.

3. The maximum reverse voltage stress of diode \( D_1 \) and \( D_2 \) can be calculated as follows. Where \( I_m \) is \( T_1 \) and \( T_2 \) magnetizing current.
   
   a. \[ V_{D1} = V_{D2} = I_m \times N \times R_1 \]

4 Conclusion

1. A current sense transformer can be used in PFC pre-regulator application using the \( UCC3817 \) PFC control device.

2. Special care must be given to current sense transformer reset by properly selecting reset resistors \( R_1 \) and \( R_2 \).

3. Current sense transformer \( T_1 \) will add negligible voltage stress to transistor \( Q_1 \).

4. You can use current sense transformers in a PFC pre-regulator.

5. \( R_{\text{SENSE}} \) should be much smaller than \( R_{\text{IMO}} \) and \( R_{\text{CAI}} \).

6. Treat the rest of the design as if \( R_{\text{SENSE}} \) were the resistor used in a direct measurement application.
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