

## Selecting Appropriate Compensation: Type-II or Type-III

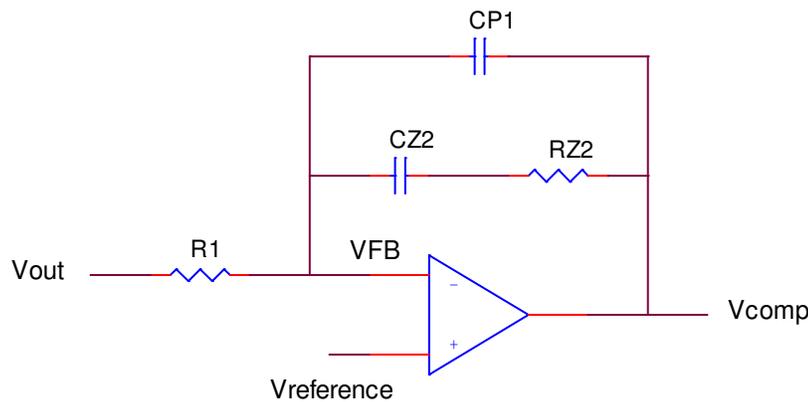
**Part Number:** Any Sipex controller requiring Type-II or Type-III compensation

**Application Description:** buck converter utilizing external compensation

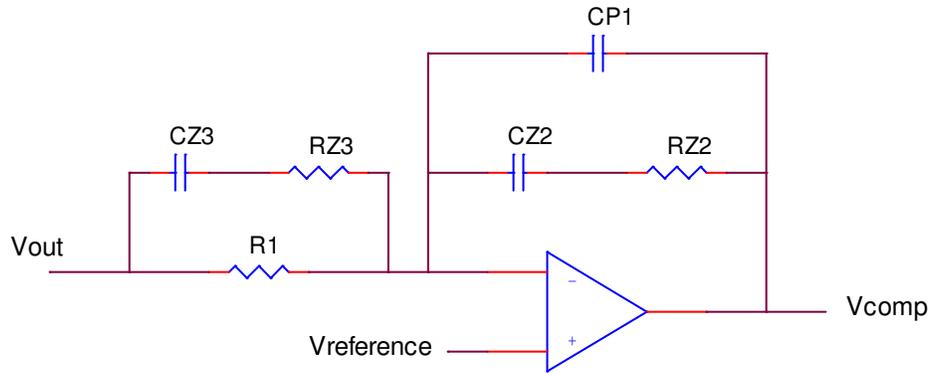
**Circuit Description:**

Sipex buck controllers in general require either a Type-II or Type-III compensation. Type-II requires fewer components and corresponding compensation calculations are relatively easy. However, it can only be used in converters where output filter capacitor has a relatively high ESR. Where output capacitor ESR is low a Type-III compensation is usually necessary.

This report outlines a procedure for determining which one of the two compensation types is appropriate for a given application. Schematic of Type-II and Type-III compensation are also shown for reference.



**Figure 1:** Type-II compensation showing controller’s internal Error Amplifier



**Figure 2:** Type-III compensation showing controller's internal Error Amplifier

Note: Type II Calculations discussed in this application note can be quickly iterated with the Type II compensation Calculator on the web at:

<http://www.sipex.com/files/ApplicationNotes/TypeIICalculator.xls>

Note: Type III Calculations discussed in this application note can be quickly iterated with the Type III compensation Calculator on the web at:

<http://www.sipex.com/files/ApplicationNotes/TypeIIICalculator.xls>

### Procedure for selecting Type-II or Type-III compensation

Calculate the double-pole frequency of converter's output filter from:

$$f_{LC} = \frac{1}{2\pi\sqrt{LC}}$$

Where:

L is the output filter inductor

C is the output filter capacitor

Calculate the ESR ZERO frequency of the output capacitor from:

$$f_{ESR} = \frac{1}{2\pi \cdot C \cdot ESR}$$

Where:

C is the output filter capacitor

ESR is the Equivalent Series Resistance of output capacitor

If  $f_{ESR}/f_{LC}$  is equal to or greater than 5 then use a Type-III compensation and follow guidelines in Sipex Application Note or Design Manual to derive appropriate component value. If  $f_{ESR}/f_{LC}$  is less than 5 then use a Type-II compensation

Note: If following the above procedure a Type-II compensation is implemented but proves to have insufficient phase-margin then use a Type-III.

For further assistance:

Email: [Sipexsupport@sipex.com](mailto:Sipexsupport@sipex.com)  
WWW Support page: <http://www.sipex.com/content.aspx?p=support>  
Live Technical Chat: <http://www.geolink-group.com/sipex/>  
Sipex Application Notes: <http://www.sipex.com/applicationNotes.aspx>  
Type III Calculator: <http://www.sipex.com/files/ApplicationNotes/TypeIII Calculator.xls>  
Type II Calculator: <http://www.sipex.com/files/ApplicationNotes/TypeII Calculator.xls>



## Sipex Corporation

Headquarters and  
Sales Office  
233 South Hillview Drive  
Milpitas, CA95035  
tel: (408) 934-7500  
faX: (408) 935-7600

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