Analog design tools

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Introduction

Most analog designers are using design tools developed for use on the computer. Many such tools are available via TI's Amplifiers home page (amplifier.ti.com) by selecting Design Resources, then Engineering Design Utilities. These tools operate as stand-alone Windows® operating system applications, Web-based applications, or Microsoft® Excel spreadsheets. This article lists available analog tools and provides some information about each.

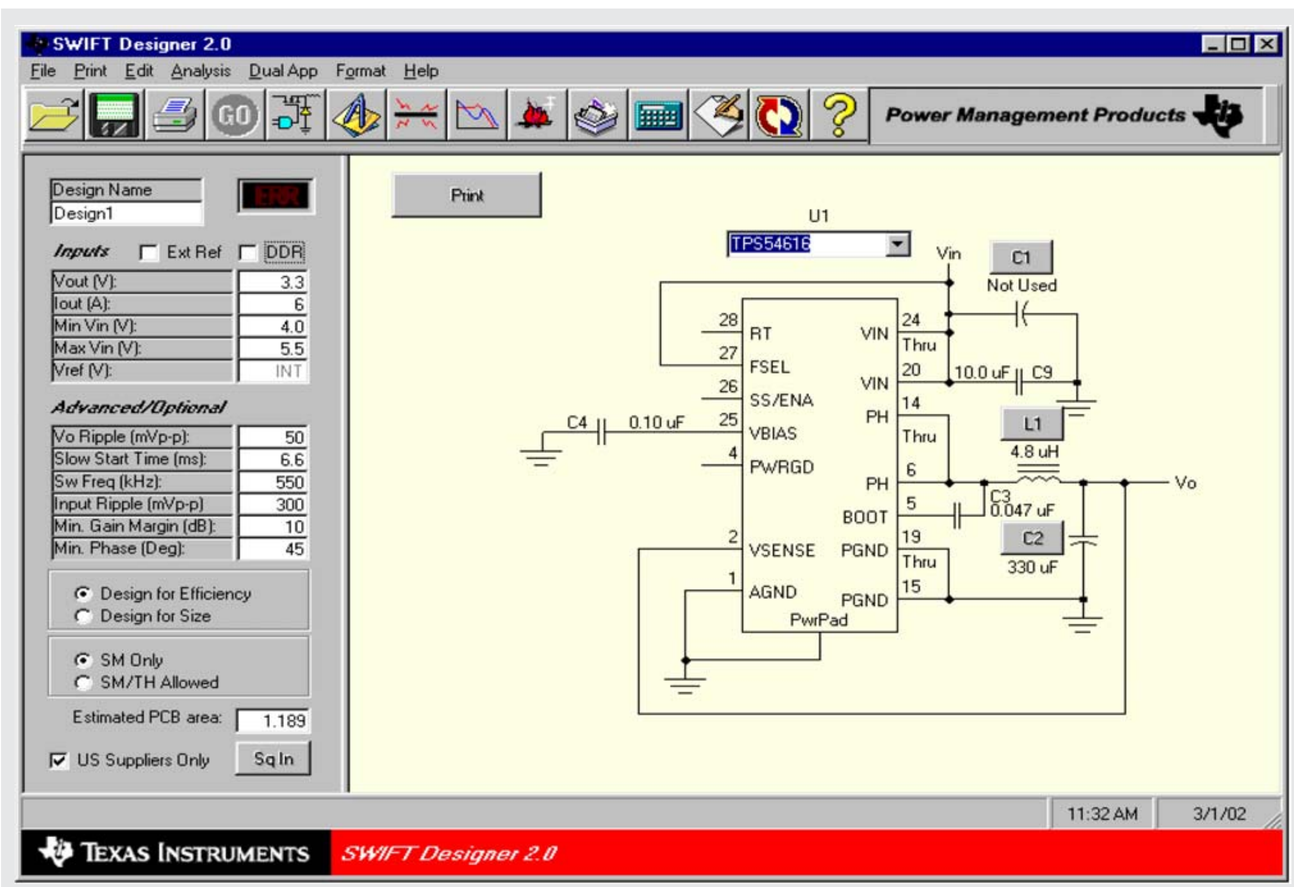
Windows application tools

These tools were developed as Windows applications because they are the most comprehensive and computer-intensive. They can be downloaded and installed on the user's computer.

SWIFT™ Designer

Figure 1 is a screen shot from SWIFT (Switcher with Integrated FET Technology) Designer. The software generates a complete design solution using TPS54610, TPS54616, or TPS54672 buck PWM regulator devices. SWIFT provides the designer with a schematic, bill of materials, efficiency graph, and response graph for the completed design.

Figure 1. SWIFT Designer screen display showing TPS54616 PWM regulator



FilterPro™ for Windows

FilterPro is a Windows application that can be downloaded from the Web and installed in the user's computer. It is supported with an Application Report (Reference 2).

FilterPro allows a designer to develop a low-pass filter with up to 10 poles by using a Sallen-Key or multiple-feedback (MFB) circuit type. In addition, the filter type can be either Bessel, Butterworth, or Chebyshev.

Figure 2 is a screen shot from FilterPro.

Web-based tools

An advantage of Web-based tools is that they usually download quickly because they comprise HTML pages whose file sizes are small. No installation program must be run, and the tools don't need to be installed permanently on the designer's hard drive.

Some tools, such as the Resistor Value Selection utility, contain JavaScript programs that perform calculations usually done by programs written for Excel or Windows.

Fully differential component calculator

When a fully differential amplifier is employed, it is important to balance the two feedback paths with the same resistor ratio to prevent an offset from being present between the two outputs. When a single-ended input is to be terminated and connected to one of the inputs, this termination must be accounted for in the feedback ratio for that input. Doing this results in a gain change. In addition, the termination resistor value used should take into account the input impedance of the amplifier circuit. For these reasons, it is difficult to calculate optimal component values for a fully differential amplifier design whose input is single-ended and terminated.

The program shown in Figure 3 (on page 52) is a JavaScript application that accepts your entry of source resistance (R_S), feedback resistor (R4) or gain resistor (R3), and desired differential gain (A). It then calculates the other resistors.

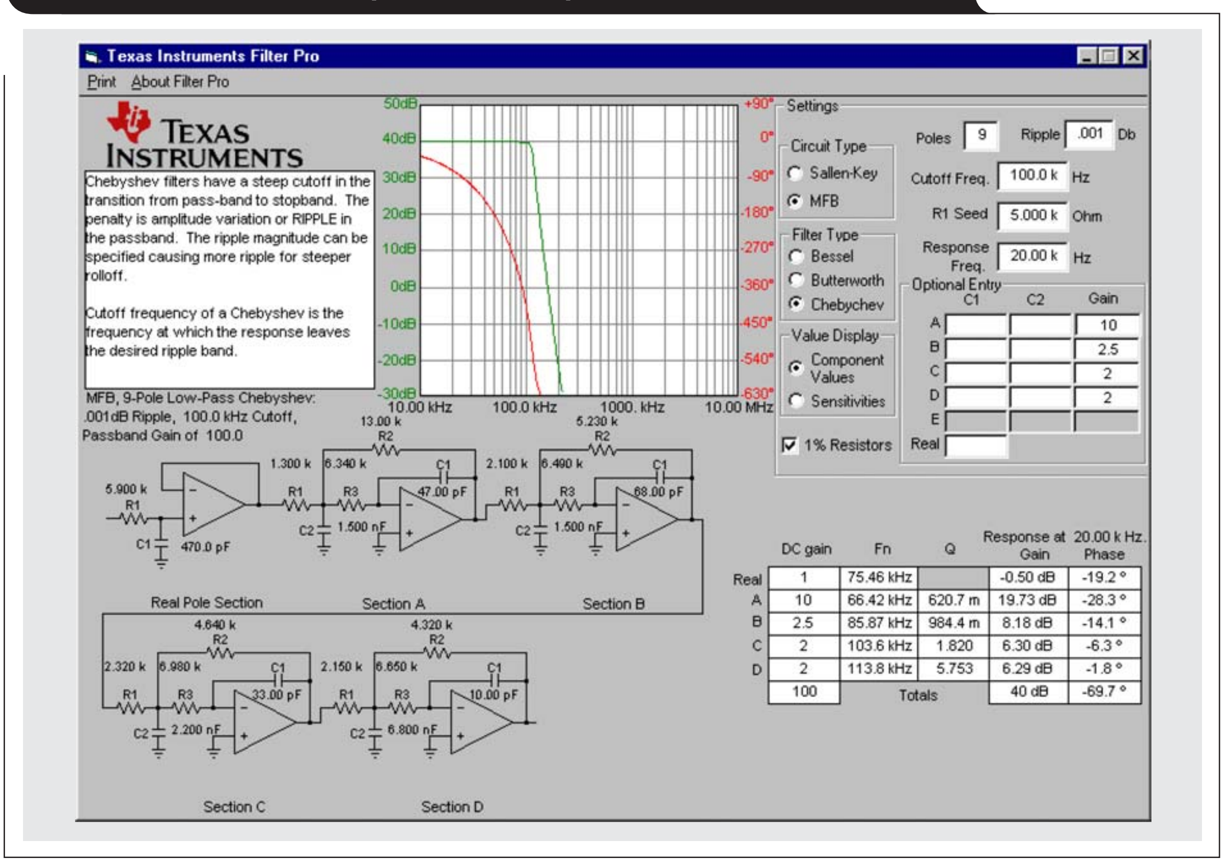
Selecting the "E96" or "E192" radio buttons will cause the calculated resistor values to be selected from the E96 group (96 values per decade) or E192 group (192 values per decade), respectively. E96 values are commonly known as 1% resistors, while E192 values are known as 0.5% resistors. Tighter tolerances are available for these groups. When the "Exact" radio button is selected, the values are not selected from the E96 or E192 groups.

$R_{R3,\ R4}$ is the input impedance represented by R3 and a portion of R4 as determined by the action of the amplifier and its gain.

Limits

1. The gain entry is the differential gain of the total circuit. The voltage divider consisting of R_s, R_t, and the amplifier input resistance causes a gain of 0.5 at the input of R3. A gain of 2 from this point to the outputs will cause a total differential gain of 1. A gain entry of less than 0.5 is not allowed. A total gain of less than 0.5 would cause the amplifier to be less than unity gain; therefore it may not be stable. The maximum gain entry is 1000.

Figure 2. FilterPro screen display showing 9-pole MFB filter with 40-dB gain



2. The input impedance of the stage reflects the active response of the amplifier combined with the values of R3 and R4. The design is not valid if the stage input impedance is less than the source resistance.
3. Values entered for R3 and R4 must be positive numbers.
4. Resistor values, whether entered or calculated, must be equal to or between 1 Ω and 1 MΩ.

Excel tools

These tools are Excel spreadsheet files that operate under Microsoft® Excel when downloaded. The Excel method is good for many engineers and designers who need to do a simple task with little effort. It is also very helpful to those who are developing Excel applications, because they can either edit the downloaded tool as needed or insert parts of it into their own Excel tools.

Like the Web-based tools, Excel tools download quickly and don't require a large amount of hard drive space.

Conclusion

Using design tools developed by Texas Instruments, a designer can develop analog applications with fewer complex calculations. In addition, the interactive nature of many of these tools enables iterative design techniques that are not feasible without them.

The functionality and number of these applications have increased dramatically over the past year, and many future additions are expected.

References

For more information related to this article, you can download an Acrobat Reader file at www-s.ti.com/sc/techlit/*litnumber* and replace *"litnumber"* with the **TI Lit. #** for the materials listed below.

Document Title	TI Lit. #
1. "Op Amps for Everyone," Design Reference	slod006
2. "FilterPro™ MFB and Sallen-Key Low-Pass Filter Design Program," Application Report	sbfa001

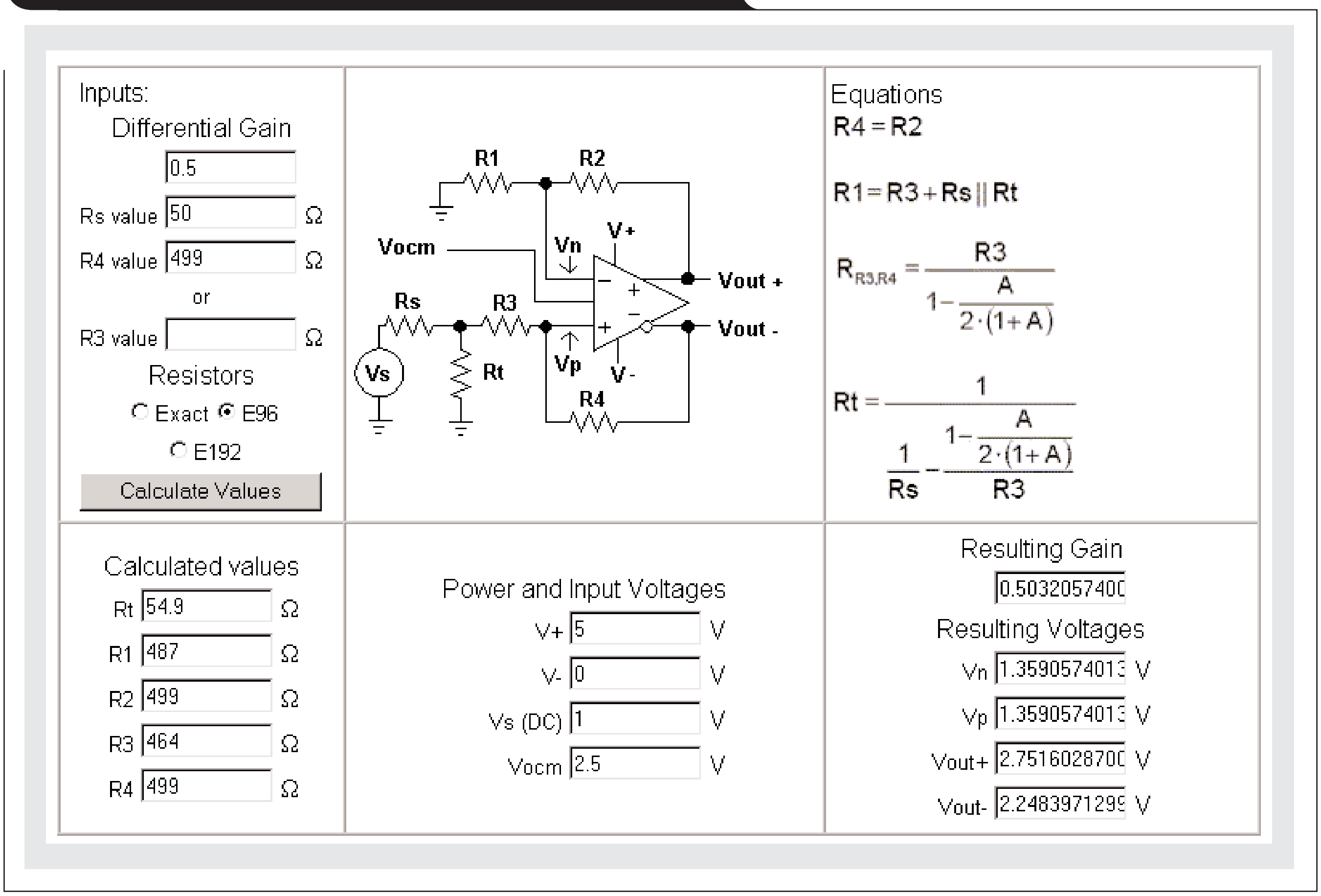
Related Web sites

amplifier.ti.com

www.ti.com/sc/device/*partnumber*

Replace *partnumber* with THS4131, TL431, TLC555, TPS6734, TPS7101, TPS7201, TPS7301, TPS54610, TPS54611, TPS54672 or UAF42

Figure 3. Fully differential amplifier component calculator



Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

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