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Using Log Power Detector ICs

Engineers often find uses for integrated circuits other than the specific intended applications. This is especially true if the engineer works in a small company with a limited budget, is outfitting a home laboratory on an even smaller budget, or perhaps is simply experimenting out of curiosity.

An interesting family of ICs developed in recent years are logarithmic power detectors. These devices' primary application is for power detectors in transmitting equipment or received signal strength indication (RSSI) detectors in receiving equipment. Perhaps anticipating experimentation, some manufacturers' applications data recognizes the wider range of potential uses, giving examples of some less-common ways these devices might be applied.

One practical example is a benchtop small-signal power meter. Rather than connect an oscilloscope or spectrum analyzer, an engineer can save time and effort using a dedicated—and very low cost—power meter with excellent accuracy over a wide frequency range.

Internal Architecture

Log power detector ICs are all built similarly, with the functional block diagram of the Linear Technology LT5537 shown in Figure 1. Several successive-detection cells are included, along with a voltage reference, summing and buffering circuits, and various compensation circuits to improve linearity and bandwidth. The number of cells determines the log accuracy, although more cells (and better accuracy) usually places limits on the upper bandwidth.

A power meter using such a device is very simple. A resistive circuit can provide a 50 ohm input termination (or other desired impedance), with additional resistors and DC blocking capacitors providing a passive match to the input impedance of the device, which may be in the kilohm range. R-C or L-C frequency compensation may be added to improve the frequency response.

The output of the device is then buffered by a simple op-amp circuit to provide DC gain and offset to drive an analog or digital meter, or the input to another indicating device such as a PC sound card used as an analog-to-digital converter. That's about it!

Typical linearity (accuracy of log output versus input power) can be as good as 0.2 or 0.3 dB over a signal level range as wide as 80 dB. The variations in log response are cyclical with power level, since a finite number of detection cells are used. The accuracy "ripple" of an Analog Devices AD8307 is shown in Figure 2. A motivated engineer might improve the accuracy by using two devices with an offset that cancels much of the ripple. In the above plot, it appears that a 7 dB offset would overlap the peaks and valleys to provide a flatter response.

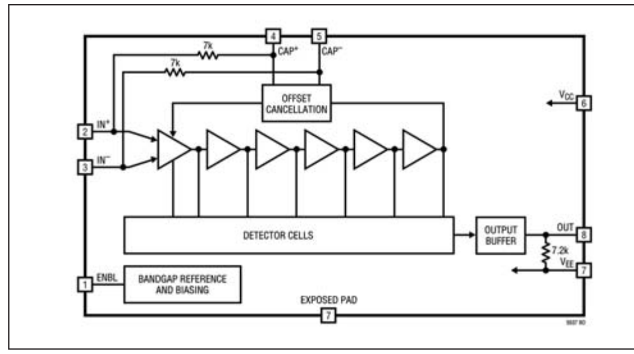

Figure 1 · Block diagram of a typical log power detector IC (Linear Technology LT5537).

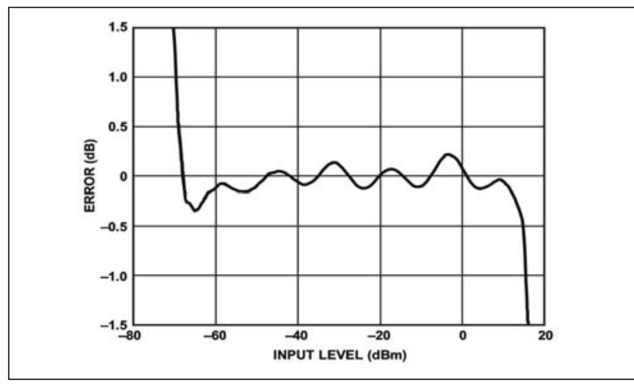

Figure 2 · A typical log accuracy vs. input power plot for the Analog Devices AD8307.

Example Devices

The Analog Device AD8307 has nine log detector cells and maintains 0.3 dB accuracy over an 80 dB range. It has a log input threshold of –84 dBm and is specified for up to 500 MHz operation. It has a 10 to 90% scale response time of 400-500 ns.

The Linear Technology LT5537 has an input log threshold at –77 dBm, with more than 80 dB range where the accuracy is 1 dB or better. It is specified for operation to 1 GHz and has a response time specified as 110 ns for a –30 to 0 dBm step.

The Hittite HMC601LP4 represents a different set of specs, with a –100 dBm input threshold and operation up to 4 GHz. With fewer log cells, the 1.0 dB accuracy range is 68 dB up to 2 GHz, and 46 dB at 4 GHz. The simpler design has a fast response time of 50 ns from no input to 0 dBm (20 MHz).