ASK THE EXPERTS

What are Feedback, Feed-Forward and Predistortion Tradeoffs?

Editor,

My question is about the correction schemes used in power amplifiers. There is an old adage, "You don't get something for nothing," and I'm wondering how that applies to things like feed-forward error correction and digital predistortion. Certainly, there are some tradeoffs.

Thanks in advance,
William Allen

Tradeoffs include Cost, Complexity and Performance Factors

Mr. Allen,

Thank you for a good question. The first, and most obvious, tradeoff in any error correction scheme is the added complexity. More circuity, higher cost, more production line adjustments and increased maintenance are all traded for performance. These things can be minimized with good design and stable operation. DSP and microprocessors can dramatically reduce the cost of implementing a linearization system, but there will always be a significant up-front engineering cost.

Another typical tradeoff is bandwidth. Power amplifier performance is rarely constant over a wide frequency range, and the same may be true of the analog portion of the correction circuitry. Of course, this may not be a big issue in a typical narrowband system, but future software-defined radio systems are intended to operate over wider bandwidths than today's wireless bands.

Long-term stability can be a difficult factor to predict. For example, LDMOS power transistors commonly used in wireless base stations have well-known changes in operating characteristics over time and temperature. Unless automated calibration is included, a regular maintenance and recalibration schedule will be required to keep the amplifiers within spec.

Some methods reduce the gain of the amplifier or limit the peak power. In these cases, additional amplifier stages may be needed to achieve the overall gain from small signal input to power output.

The most significant performance issue may be noise, but this also depends on the linearization method being used. All feedback and feed-forward methods will add some noise to the system. Once again, good design will minimize the impact. Digital predistortion adds some overhead to the data that is modulated and transmitted, a type of "noise" that reduces the maximum data rate.

Despite the value of modern linearization schemes, the search for better intrinsic linearity in power devices continues. A modest improvement in device technology can greatly reduce the amount of correction that is required. When multiplied by tens of thousands of base station amplifiers, the savings in cost can be dramatic.

Another Note on RFID History

Thanks for a good report on RFID in the June issue of *High Frequency Electronics*. The authors did a good job.

Deserving of more depth, however, was the first profit making application of RFID, for access control, that is, locks and keys. The work was done by Schlage Electronics, subsidiary of the Schlage Lock Company. The system was described in the *Business Week* issue of 7/16/73. *Popular Science* also described the system in 1973. We made millions of keys, in the form of proximity cards. The system was shown to General Motors in 1976 and rejected at the time as being "Too Buck Rogerish." The system did not use integrated circuits and swept in frequency from 3 to 32 MHz. The code generation was derived from identifying a number of frequency slots.

For the Sielox Company, later sold to Checkpoint of New Jersey, in 1980, the RFID system used different operating principles and worked at the frequency we chose of 13.56 MHz. After several hassles, the FCC approved this frequency selection. The code generation was essentially the same as in disc memory drives.

Charles Walton

Do You Have a Question?

Questions and comments in this column come from the readers of *High Frequency Electronics* and occasionally from the customers of component, instrument and EDA tool suppliers that are involved in our part of the electronics industry.

Send your question to us by e-mail to: editor@highfrequencyelectronics.com, or if you prefer, send it by postal mail to *High Frequency Electronics*, 403 Venture Ct., Unit 7, Verona, WI 53593. Our fax number is 608-845-3976. We'll try our best to find the answer you need, then publish it here for everyone's benefit.