

Do-it-Yourself ASICs



Q: What should I do if I can't find an analog IC that performs the required function?

A: Every couple of years the feedback I receive convinces me that it's time for me to remind analog engineers that they must behave like engineers and design circuits, rather than simply assembling systems from ready-made blocks.

So, what should you do? Build your own *application specific integrated circuit* (ASIC)! We all tend to think of integrated circuits (the IC bit of ASIC) as single silicon chips, but the idea predates monolithic ICs by decades. The [Op Amp Applications Handbook](#) shows an early integrated circuit: Philbrick's [K2-W](#) op amp, a plug-in module containing two vacuum tubes, which entered the commercial market in 1952. With the invention of the transistor, modular circuit functions became quite common—they were not usually called “integrated circuits,” but that's exactly what they were. Such “integrated circuits” were not necessarily bought as ready-made modules; instead they might be well-known circuit functions—often named for their originators—which were incorporated into a design. Some examples include the [Colpitts oscillator](#), the [Eccles-Jordan flip-flop](#), and the [Doherty amplifier](#).

So, when I say “build your own ASIC,” I'm not suggesting that you start designing your own monolithic chip. If you need a lot of them this may be worthwhile, but systems that require less than 10,000 pieces rarely benefit from such an approach. Field programmable analog arrays (FPAA) are sometimes useful for subsystems that use large numbers of op amps, but are rarely cost-effective for small systems incorporating other functions.

I'm also not suggesting that you make a subsystem as a neat module, although you can if you like. I recently acquired a 3D printer, and find a lot of the gadgets that I make are now much more neatly boxed than when I had to make the boxes by hand from tinfoil, PCB stock, wood, or sheet plastic.

What I am suggesting, however, is that if you need a well-defined subsystem and cannot find a ready-made ASIC, you should neither despair, nor try to design it as an integral part of your total system. Instead you should consider designing it as a separately defined subsystem. This probably simplifies the design; it certainly simplifies testing and evaluation, and is a worthy expression of the [Maker Philosophy](#), the [Maker's Bill of Rights](#), and the [Crafter's Manifesto](#).

Modern analog ICs are easier to use than ever before, allowing an assembly of building blocks such as op amps, voltage references, multipliers, converters, and analog switches to perform complex functions. I recently designed a single-sideband (SSB) radio receiver. The automatic gain control (AGC) system of the receiver should track signals that change at up to 20-dB/sec. There is no signal during speech pauses, so the AGC should not change at these times. After a pause of a second, however, the system should revert quickly to full gain. This AGC system was available as a monolithic ASIC between 1967 and 1993, but it has not been made since—my substitute used an rms-to-dc converter and a few op amps.