

Rarely Asked Questions

Strange stories from the call logs of Analog Devices

A Foolish Question about Op Amps and Capacitors

Q: Can you help with the strange interaction between the op amp and capacitors in my circuit?

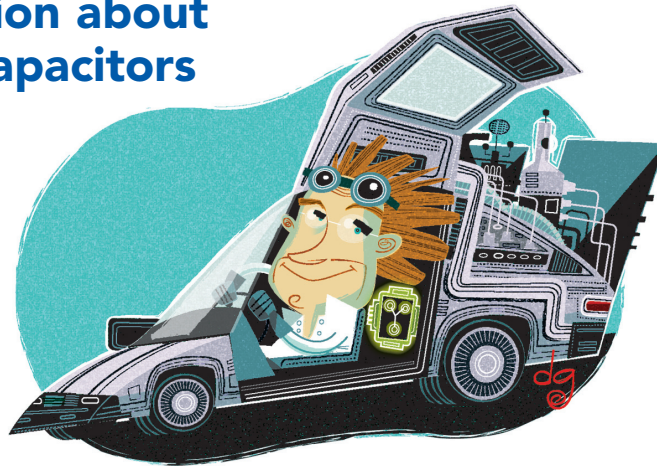
A: This sounded more like a Frequently Asked Question than a Rarely Asked Question, but turned out to be neither.

Interaction between op amps and capacitors goes back to the beginning of op amp time, with three classic problems occurring most frequently. I tried to narrow down the specific problem this customer was facing, figuring that it should only take a few minutes to solve... boy was I wrong.

The first classic problem in the study of op amp stability involves capacitance on the inverting input, and arises due to the interaction of the feedback resistor with the combined op amp input capacitance and parasitic capacitance at the inverting input. The capacitance and feedback resistor introduce a pole in the feedback response that can lead to decreased phase margin and instability. "No, no," he said, "It's something else." "Alright," I said, "No problem; let's move forward."

Output load capacitance was my next stop; capacitance found at the output can cause overshoot, ringing, and stability issues. The op amp output impedance and the load capacitance form a pole that alters the op amp transfer function and reduces phase margin, which leads to ringing and overshoot. "No, that's not it either," he said.

He finally said that it appeared to be an issue with the bypass capacitors (the third classical problem). I started to



launch into my standard litany on bypass capacitors when he stopped me. "This is no ordinary bypass capacitor issue," he cautioned, "It's something different." When he turned the power supplies off, the bypass capacitors stayed charged, and the op amp continued to deliver an output voltage. "That's perfectly common," I told him, "The output voltage will last until the bypass capacitors are discharged, but will go away in a few nanoseconds." "No," he said, "the capacitors never discharge." He'd wrestled with this problem for months now. He hadn't applied power to the circuit for over a month, but the capacitors were still charged and the circuit was still working! How could this be? Even a micropower device should have bled off the stored charge by now. When I asked him what type of capacitors he was using; he laughed and said, "Flux capacitors¹, of course!" April Fools!

¹ The Flux Capacitor is featured in "Back to the Future," a 1985 Universal Pictures movie in which a single Flux capacitor provided 1.2 Gigawatts of power, enough to enable time travel in the movie!

**To Learn More About
Op Amp Stability**

<http://dn.hotims.com/34930-100>



Contributing Writer
John Ardizzoni is a Senior Application Engineer at Analog Devices in the High Speed Linear group. John joined Analog Devices in 2002, he received his BSEE from Merrimack College in N. Andover, MA and has over 30 years experience in the electronics industry.

Have a question involving a perplexing or unusual analog problem? Submit your question to:
www.analog.com/askjohn

For Analog Devices' Technical Support, Call 800-AnalogD

SPONSORED BY

