

Rarely Asked Questions

Strange stories from the call logs of Analog Devices



Contributing Writer
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The Electromotive Force and Op Amps

Q: Is it okay to run an op amp on a single +10 V supply, or do I need to use ± 5 V supplies?

A: This question comes up more often than an RAQ, but less often than a FAQ, so I figured it could stand some discussion. The answer is yes and no. Yes, you can use a +10 V supply; and no, you don't need to use bipolar ± 5 V supplies... unless you want to. Bipolar supplies can make life easier, but you must understand the implications of using each voltage scheme.

Whether you call it supply voltage, potential difference, or electromotive force (I like saying electromotive force, don't you?), the important thing to remember is that it is the voltage across the amplifier supply pins that matters. Op amps don't have ground pins, so they can't tell the difference between +10 V, ± 5 V, or +7 V and -3 V; in each case they see 10 V across the supply pins. The supply voltages determine the operating point of the amplifier, however. The operating point is typically the mid-supply voltage of the power supplies. In this case, +5 V for a single +10 V supply and 0 V for ± 5 V supplies.

Why mid-supply though? The input range and output swing are ultimately bounded by the supply rails. Operating an op amp at mid-supply maximizes both input dynamic range and output swing. Operating with bipolar supplies is easier, because most signal sources and loads are referenced to ground (0 V or mid-supply for symmetrical bipolar supplies). In this



case, the input signal source, output load, and op amp all have the same common reference point. When a single supply is used, however, the input and output range are shifted from 0 V, so a new operating point needs to be established. The new operating point can be anywhere within the amplifier's input range and output swing capabilities, but is usually centered on the mid-supply voltage to maximize input range and output swing. As you can imagine, this complicates things a bit, as the signal is now riding on a dc level (mid-supply voltage). This dc level can be isolated at input and output (ac coupling) or accommodated by the system.

When questions like this arise, it's always best to read the datasheet to understand the full implications of using amplifiers in single-supply applications. "May the force be with you," electromotive force, that is.

Have a question involving a perplexing or unusual analog problem? Submit your question to:
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