With UnitedSiC JFETs, as with power MOS, there is variation in threshold voltage between devices. However, because of reduced TVTC, dynamic current sharing is improved. This is not to say that switching loss is perfectly uniform between devices, but rather that the hottest device is less likely to carry ever-increasing current during switching. This point also applies to UnitedSiC cascodes because the JFET in the cascode handles the high voltage during switching; the cascode MOSFET turns on or off before the JFET completes its switching process. Regarding conduction loss, the positive temperature coefficient of on-resistance ensures thermal equilibrium where no single device goes into thermal runaway due to static current imbalance. As a result, UnitedSiC JFETs and cascodes are highly reliable when paralleled because they are highly stable thermally during both static conduction and during switching.

6.2 Active Mode

As with power MOS, part-to-part variation in threshold voltage and temperature-dependent gain is a challenge for steady-state active mode operation of parallel UnitedSiC JFETs. A typical way to solve this challenge is to use individual feedback control of each JFET with an operational amplifier and a current sense resistor [5], as depicted in the simplified schematic in Figure 8.

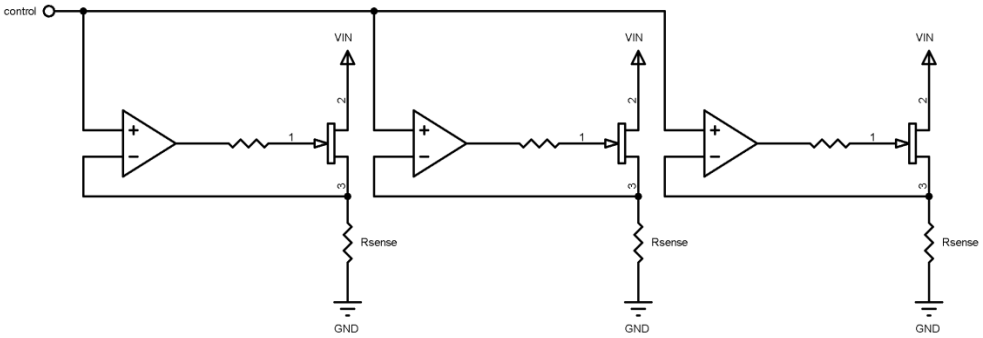

Figure 8 Simplified example of paralleling UnitedSiC JFETs for steady-state active mode operation

With its negative threshold voltage, each operational amplifier of course requires a negative power supply in order to drive the gate of a UnitedSiC JFET.

7 Demonstration

A prototype electronic load board was constructed with six separate channels, each with a UnitedSiC UJ3N120035K3S as the JFET. A top view in Figure 9(a) shows circuitry for the six channels, with each operational amplifier receiving its command signal from a digital control card, and a cooling blower that consumes only about 14 W. In Figure 9(b) the JFETs are visible, "sandwiched" between the circuit board and the heat sink, with no electrically insulating material between the JFET backside drain pad and the heat sink. Each UJ3N120035K3S is always thermally stable for any combination of current and voltage (up to BV_{DS}) resulting in 220 W of power dissipation.