
Level shifter builds high-voltage op-amp block

by Leon C. Webb

Ball Corp., Aerospace Systems Division, Boulder, Colo.

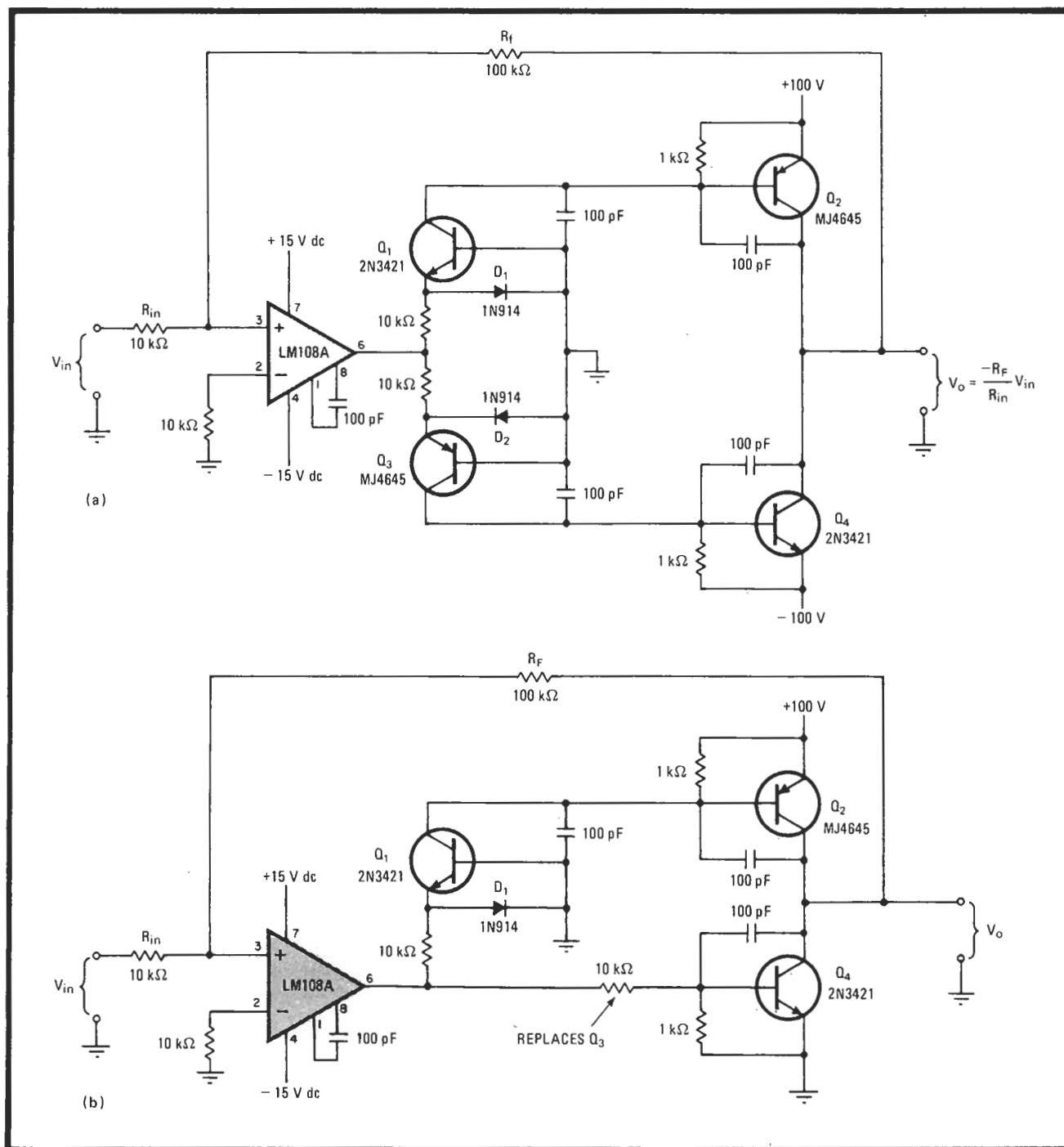
Placing a level-shifting network inside the major loop of an operational amplifier adapts it for high-voltage applications. The output swing of the circuit, which can be in the hundreds of volts, is limited only by the breakdown voltage of the active devices (in this case, transistors) used. At the same time, the op amp is isolated from high potentials, even in the absence of its ± 15 -volt supply voltages, by the attenuator formed by the amp's gain-

controlling resistor and the input resistance of the circuit and by the clamping action of the circuit's common-base stages.

The method can be applied to op amps that will generate either bipolar or unipolar voltage swings. As shown in (a) for the general voltage amplifier, which generates a bipolar swing, the op amp's output is transformed into an emitter current that flows through either transistor Q_1 or Q_3 , depending upon the polarity of the output voltage from the LM108A. As a result, a corresponding base current is applied to either transistor Q_2 or

transistor Q_4 , respectively, thereby turning it on to a greater or lesser degree. Thus, V_o assumes a value equal to a $-10V_{in}$, where the voltage multiplication holds true for $-10\text{ v} < V_{in} < 10\text{ v}$.

If only a unidirectional output is desired, the configuration shown in (b) will suffice. This circuit, which delivers only positive output voltages, has the same transfer function (that is, $V_{out} = -10 V_{in}$) for $-10\text{ v} < V_{in} < 0\text{ v}$. If a negative-only voltage output is required, stage Q_1 is replaced by a 10-k Ω resistor. The level-shifter's supply voltage must also be negative. □



Translation. Level-shifter adapts operational voltage amplifier (a) for high-voltage duty. Output swing of circuit is limited only by the shifter's supply voltage and the breakdown voltage of transistors used. For unidirectional output swings (b), simplified circuit will suffice.