

THEORY OF OPERATION- AR-316
VOLTAGE CONTROLLED AMPLIFIER

Audio inputs are summed in by R2, 4, 5, and into the inverting input of U1, which is a current-controlled gain circuit. The inputs, after mixing at the input, appear as an output current. This is converted to a voltage by U2, a conventional inverting op amp. The output is of the same polarity as the input, because the two inversions cancel.

Control signals are summed through R18, 19, 20, 21, and 22, and U3. In the LINEAR mode, the output of U3 varies from 0 to +5 volts. This is coupled through emitter follower Q1 into Q2. The two base-emitter drops cancel, since opposite polarity transistors are used. So, the emitter voltage of Q2 varies between 0 and -5 volts. This voltage across R33, determines the current from emitter to collector of Q2, and into the control terminal of U1, the variable gain circuit. When R23, the INITIAL GAIN CONTROL, is to the left, its output of -15 volts is balanced by the +15 volts across R25, so U3 output is 0, as is the current into U1. Then, the gain is 0. (Off). Turning up R23, or applying a positive control input voltage, causes U3 output to become negative, which turns on Q2 and U1. R13, across U2, trims the maximum gain to be unity at full control input of +10 volts.

In the EXPONENTIAL mode, action is similar except (1) R33 is shorted, which makes the current through Q2 change much more rapidly (exponentially) as its base voltage changes, and (2) the resistors across U3 are changed to provide a smaller drive voltage. U3 output now varies between 0 and -0.33 volts. R31 varies the emitter current through Q1, then changing its base-emitter drop by a total of 0.05 volts. This is not significant in the LINEAR mode, but is in the EXPONENTIAL mode, where it is used to trim the maximum gain, also to unity.

Thus, in both modes, the gain varies from essentially 0 to 1 as the INITIAL GAIN control is varied over its full range. However, in the LINEAR mode, the gain is .5 (-6db) at the mid-position, or with a +5 volt control signal. In the EXPONENTIAL mode, the gain at this point is only 0.003 (-50 db).

Finally, R10 introduces a variable D C offset into U1, which balances out its own internal offset. This prevents varying control signals from carrying a changing D C offset at the final output.