Transmit Gain Adjustments For The MC34014 Speech Network

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INTRODUCTION

The MC34014 telephone speech network provides for direct connection to an electret microphone and to Tip and Ring. In between, the circuit provides gain, drive capability, and determination of the ac impedance for compatability with the telephone lines. Since different microphones have different sensitivity levels, different gain levels are required from the microphone to the Tip and Ring lines. This application note will discuss how to change the gain level to suit a particular microphone while not affecting the other circuit parameters.

CIRCUIT DESCRIPTION

Refer to Figure 1. The microphone is assumed to be an electret type, characterized by a high dynamic impedance. It is therefore considered to be an ac current source rather than a voltage source. If the microphone used has a dynamic impedance which is not high (compared to R_8), then the microphone must be modeled as a current source paralleled by its dynamic impedance. That impedance value must then be considered to be in parallel with R_8 in the following equations. The T_X amplifier has a fixed gain of -20, and the EQ amplifier gain varies from 0.25 to 0.75, depending on the loop current. Z_L is the line impedance. The transmit gain is defined as $V+/I_{mic}$ and is equal to:

$$\frac{V+}{I_{mic}} = \frac{R_6 \times Z_L \times A_{TX}}{(1 + R_6/R_A)R_9 + (A_{TX})\ (A_{EQ})\ (Z_L)}$$

where A_{TX} = gain of the transmit amplifier (20 V/V)
A_{EQ} = gain of the equalization amp. (0.25 to 0.75 V/V)
R_A = R_8//10 kΩ (10 kΩ = input impedance of Tx amp.)

The ac impedance of the circuit is defined as:

$$Zac = \frac{R_9\ (1 + R_6/R_A)}{(A_{TX})\ (A_{EQ})}$$

The receive gain (see data sheet for the equivalent circuit) is defined as:

$$Grx = \frac{R_4}{R_1} + \frac{(X_C//R_2)\ (A_{EQ})\ (A_{TXO})\ (A_{STA}) \times R_4}{((X_C//R_2) + R_3)\ (1 + R_6/R_A) \times R_2}$$

As can be seen from the above equations, changing R_6 while maintaining the R_6/R_A ratio constant will result in a transmit gain change (proportional to R_6) but will not affect the other parameters. For example, increasing R_8 and R_6 by a factor of 3 will increase the transmit gain by ≈10 dB.

Using the above procedure to increase the transmit gain results in increasing R_8, which supplies the bias current to the microphone. If the higher value of R_8 results in insufficient bias voltage at the microphone, then the alternate biasing scheme of Figure 2 should be used.

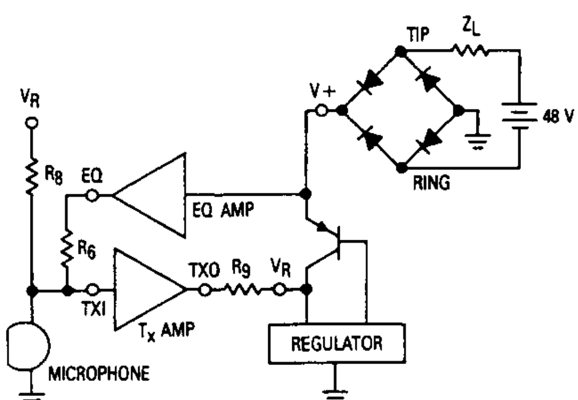


Figure 1. MC34014 Transmit Section

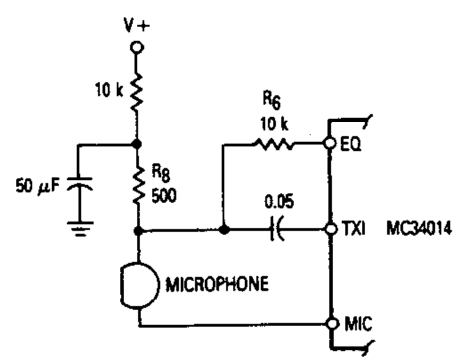


Figure 2. Alternate Biasing Scheme for Higher Voltage Microphones

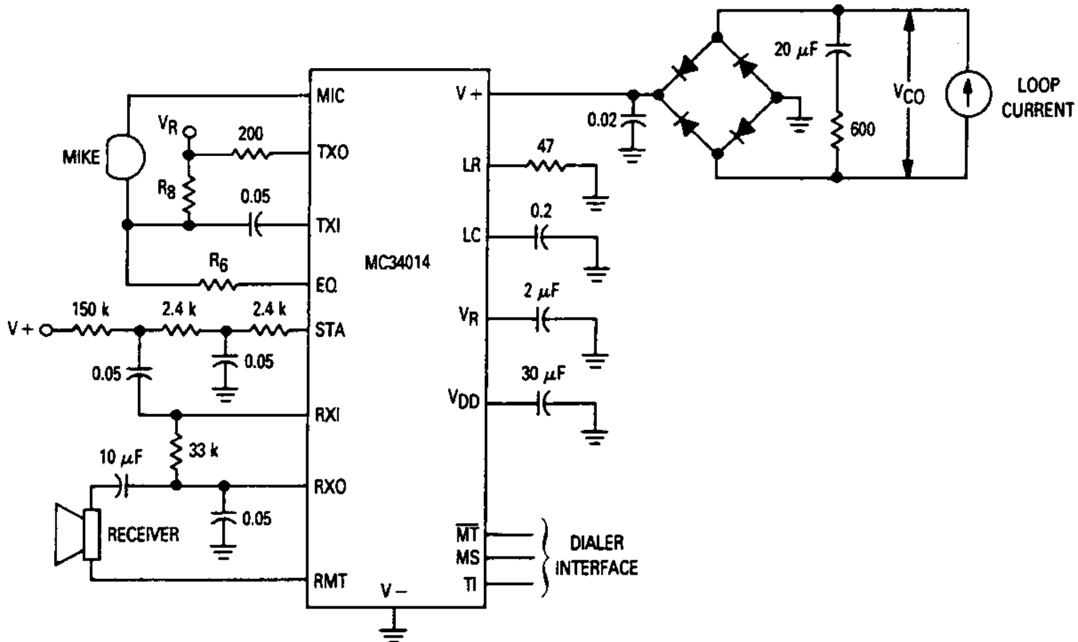
TEST RESULTS

Tests were conducted with a Primo EM-95A microphone, having a sensitivity of -53 dB ± 3 dB (0 dB = 1 V/μbar), and a Hosiden KUC2123 microphone which has a sensitivity of -60 dB ± 3 dB. The test circuit is shown in Figure 3. The tests consisted of applying a constant sound level to the microphones, and measuring the output at V_{CO}, while simulating line lengths of 0–21 Kfeet. The outputs of the two circuits were nearly identical at all line lengths.

CONCLUSION

Although the designs of the various parameters (transmit gain, receive gain, ac impedance, etc.) of the MC34014 speech network are not mutually exclusive due to the commonality of various components, it is possible to adjust the transmit gain independently to suit a particular microphone.

For further information on the MC34014 speech network, refer to the data sheet.



For Primo EM-95A microphone R_8 = 500 Ω, R_6 = 10 k
For Hosiden KUC2123 microphone R_8 = 1.5 k, R_6 = 30 k

Figure 3. Microphone Gain Test Circuit

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