

## Specifications and Applications Information

WITH DIAL FLASH INTERFACE

The MC34114 is a monolithic integrated telephone speech network designed to replace the bulky magnetic hybrid circuit of telephones. The MC34114 incorporates the necessary functions of transmission, receive amplification, and sidetone control, each with external gain adjustable. Loop length equalization varies the gains based on loop current. The microphone amplifier has a balanced, differential input stage designed to reduce RFI problems. A MUTE input mutes the microphone and receive amplifiers during dialing. A regulated output voltage is provided for biasing the microphone, and a separate output voltage powers an external dialer, microprocessor, or other circuitry. The MC34114 is designed to operate at a minimum of 1.2 volts, making party line operation possible.

Acircuits using the MC34114 can be made to comply with Bell Telephone, British Telecom BT1, and NT (Nippon Telegraph & Telephone) standards. It is available in a standard 18-Pin DIP, and a 20-Pin SOIC (surface mount) package.

### Operation Down to 1.2 Volts

Externally Adjustable Transmit, Receive, and Sidetone Gains  
Differential Microphone Amplifier Input Minimizes RFI Susceptibility

Transmit, Receive, and Sidetone Equalization on Both Voice and DTMF Signals

Regulated 1.7 Volts Output for Biasing Microphone

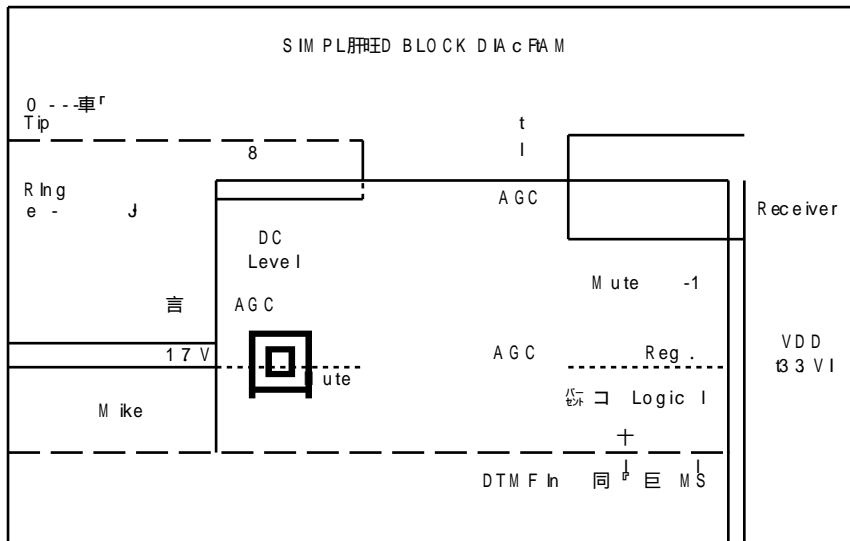
Regulated 3.3 Volts Output for Powering External Dialer or MPU

Microphone and Receive Amplifier Muted During Dialing

Differential Receive Amplifier Output Eliminates Coupling Capacitor

Operates with Receiver Impedance of 500 ohms and Higher

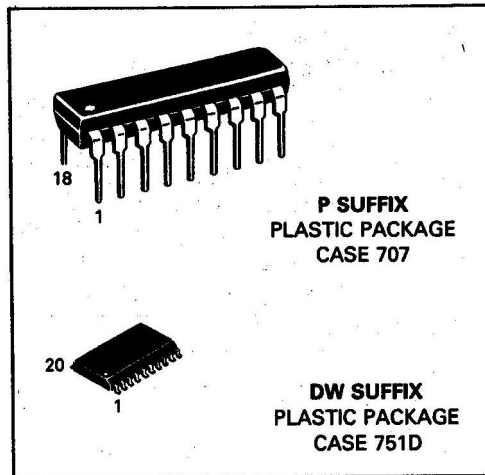
Complies with NTT, Bell Telephone and BT Standards



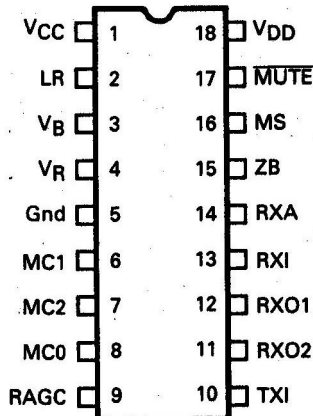
# MC34114

TELEPHONE SPEECH  
NETWORK WITH  
DIAL FLASH INTERFACE

SINGLE MONOTONIC  
INTEGRATED CIRCUIT



### PIN CONNECTIONS (Top View) (DIP Package)



### ORDERING INFORMATION

| Package              | Part Name |
|----------------------|-----------|
| 18 Pin Plastic DIP   | MC34114P  |
| 20 Pin Surface Mount | MC34114DW |

| Parameter  | Value         | Unit |
|--|---------------|------|
| Vcc Supply Voltage   | -10. +12      | Vdc  |
| voltage at VDD (Externally Applied Vcc = 0)  | 細10. +60      | Vdc  |
| Voltage at 和能 MS Vcc > 15 Volts)   | -10. VDD +0.5 | Vdc  |
| Voltage at 岡田 MS Vcc = 0)  | -10. +60      | Vdc  |
| Voltage at RAGC to < Vcc < 12 Volts)   | -10. +60      | Vdc  |
| Current through Vcc, LR  | 130           | mA   |
| Current into ZB (Pin 15)   | 30            | mA   |
| Storage Temperature  | -65. +150     | °C   |
| Maximum Ratings are those values beyond which the device can be operated at the risk of damage. The values are not meant to imply that the device is guaranteed to operate at these limits. The Recommended Operating Conditions provides conditions for reliable operation. |               |      |

| RECOMMENDED                                | Min  | TYP | Mix   | Unit |
|--|------|-----|-------|------|
| Power Meter                                |      |     |       | Vdc  |
| Vcc Voltage Speech Pulse Model             | +12  |     | +10.5 | Vdc  |
| (One Dialing Mode)                         | +3.3 | -   | +10.5 | Vdc  |
| LQOP Current into Vcc = Speech Pulse Model | 40   |     | 120   | mA   |
| (One Dialing Mode)                         | 15   |     | 120   | mA   |
| Receiver Impedance                         | 50   |     |       | n    |
| Voltage at 雨能 MS Vcc > 15 Volts)           | 0    | -   | VDD   | Vdc  |
| RI (Resistor from Vcc to VBI)              | 100  |     | 1800  | n    |
| Ambient Temperature                        | -20  | -   | +70   | °C   |

All measurements are not necessarily concurrent.

ELECTRICAL CHARACTERISTICS TA = 25. °C. See Figure 11

Per 8 metal

SUPPLY CURRENT

Supply Current into Vcc Pin 20 Pen. R12 25k, VDD unoaded

Speech Mode (Figure 27) Vcc = 1.2 Volts  
Vcc = 3.5 Volts  
Vcc = 8.0 Volts  
Vcc = 10.5 Volts  
Tone Mode (Figure 41) Vcc = 3.3 Volts  
Vcc = 8.0 Volts  
10 Volts

4.0  
細  
0  
—  
—  
—

12  
14  
—  
—  
—

|   |        |     |       |        |      |
|---|--------|-----|-------|--------|------|
| VR Voltage (R = 65 V, Vcc = 2.5 V, Figure 51)     | VR     | 16  | 17.02 | 18.505 | Vdc  |
| Load Regulation (ID < 300 fA, Vcc = 2.5 V)        |        | -70 | ±20   | +70    | mVdc |
| Line Regulation (IR = 65 J, -2.5 < VCC < 10.5 V)  | VDD    | 3.1 | 3.3   | 3.7    | Vdc  |
| VDD Voltage (Vcc = 3.8 V, ID = 0, Figure 6)       | IDDMAX | -70 | ±30   | +70    | mVdc |
| Line Regulation (VDD = 0.5 V, Vcc < 10.5 V)       |        | 0.8 | 1.0   |        | mA   |
| Maximum Output Current (Vcc = 3.8 V, VDD = 3.0 V) | Ikg    | 2.2 | 2.5   |        | mA   |
| Input Leakage Current (Vcc = 0, Pulse, Tone Mode) |        |     | 0.2   | 0.5    | mA   |
| Input Leakage Current (Vcc = 0, Pulse, Tone Mode) |        |     | 180   |        | mA   |

両石盲 = 0 Volts

MOTOROLA

MC34114

2 - 198

P8r meter

SYmbel

## MICROPHONE AMPLIFIER

|   |        |             |                     |              |             |
|---|--------|-------------|---------------------|--------------|-------------|
| Gain 每瓦 = VDDI  | GMIC   | 28          | 30                  | 32           | dB          |
| Input Common Mode Rejection Ratio (0 kHz)                                   | CMRR   | 20          | 26                  | -            | dB          |
| Input Impedance Each Input  | RINMIC | 14          | 20                  | 27           | kn          |
| MCODCBias Voltage Vcc > 3.4 V, 兩石 i Hi<br>Vcc 芝 1.2 V 兩石線 = Hi<br>簡石遠 = 0 V | VMCODC | 0.85<br>0.6 | 1.1<br>0.71<br>0.08 | 1.25<br>0.93 | Vdc         |
| MCOMax Voltage Swing THD = 5%, Vcc > 2.7 V<br>THD = 5%, Vcc = 1.2 V         | VMCOAC | -           | 2.0<br>500          | -            | VpP<br>mVpP |
| MCO Output Impedance  | ZMCO   | -           | 270                 | -            | n           |
| MCO Output Current Capability (Hb = 5%)                                     | MCOC   | -           | 160                 | -            | A           |
| Gain Reduction when Muted 同石遠 己 0 Volts, f = 10 kHz                         | GMUT   | 55          | 70                  | -            | dB          |

## RECEIVE AMPLIFIER

|  |       |            |            |            |             |
|--|-------|------------|------------|------------|-------------|
| RX Bias Current (Iute = Hi)  | IR    | -          | 50         | -          | nA          |
| RX01, RX02 Bias Voltage Vcc 去 1.2 V<br>Vcc > 3.0 V, I                            | RxDC  | 580<br>585 | 630<br>650 | 695<br>720 | mVdc        |
| RX01-RX02 Offset Voltage Vcc > 3.0 V   | Rxvos | -35        | 0          | +35        | mVdc        |
| RX01-RX02 Max Voltage Swing THD 3.5%, Receiver = 0<br>THD = 5%, Receiver = 150 n | VRXAC | -          | 2.2<br>800 | -          | VpP<br>mVpP |
| Intemal Feedback Resistor (form utin)  | RFINT | -          | 1.0        | -          | kn          |
| RX01 & RX02 Source Current   | IRX   | 2.6        | 3.2        | 3.5        | mA          |

## INTERNAL CURRENT AMPLIFIERS

|  |      |      |      |      |     |
|--|------|------|------|------|-----|
| TXI Output Impedance                     | RTXI | 0.85 | 1.0  | 1.15 | kn  |
| ZB Output Impedance                      | RzB  | -    | 500  | -    | n   |
| RXA Output Impedance                     | RRXA | -    | 10   | -    | krL |
| AC Current Gain                          |      |      |      |      | A   |
| TXI to Vcc (VRAGC = 0 V)                 | GTX  | -    | 100  | -    |     |
| TXI to Vcc (VRAGC = 1.3 V)               |      | -    | 50   | -    |     |
| ZB to RXA (VRAGC = 0 V, RXA = AC Gnd)    | Gz8  | -    | 0.5  | -    |     |
| ZB to RXA (VRAGC = 1.3 V, RXA = AC Gnd)  |      | -    | 0.25 | -    |     |
| TXI to RXA (VRAGC = 0 V, RXA = AC Gnd)   | G去   | -    | 1.22 | -    |     |
| TXI to RXA (VRAGC = 1.3 V, RXA = AC Gnd) |      | -    | 0.61 | -    |     |

## DC INTERFACE

|   |                |        |                          |                  |     |
|---|----------------|--------|--------------------------|------------------|-----|
| LR Level Shift Vcc-VLRI<br>LOOP = 20 mA, 兩石能尊 VDDI<br>OLOOP = 80 mA, 研石路 = VDDI<br>LOOP 2 20 mA, 間石遠 & MS = 0 V<br>LOOP 芝 80 mA, 簡石油 MS = 0 V | AVLRS<br>AVLRT | -<br>- | 2.8<br>3.5<br>3.8<br>5.0 | -<br>-<br>-<br>- | Vdc |
| Vcc Boost OLOOP = 20 mA, 兩石遠 & MS<br>Switched from Hi to Low 己 620 瑚  | AVL            | 0.7    | 1.0                      | 1.2              | Vdc |
| RAGC Current VRAGC = 0 V<br>VRAGC 3.10 V  | IRAGC          | -      | -40<br>-12               | -                | A   |

Parameter

Symbol

## LOGIC INPUTS

|   |                                |                       |                 |                 |                 |
|---|--------------------------------|-----------------------|-----------------|-----------------|-----------------|
| Input Impedance ( $V_{CC} > 1.2V$ )<br>$V_{CC} = 0V$ (Arabic) $< 60V$ )   | R <sub>MUT</sub>               | -                     | 60<br>>60       | -               | kil<br>mil      |
| Input Low Voltage   | V <sub>IL</sub> M <sub>T</sub> | 0                     | 4               | 10              | V <sub>dc</sub> |
| Input High Voltage  | V <sub>H</sub> M <sub>T</sub>  | V <sub>DD</sub> - 0.5 | 11              | V <sub>DD</sub> | V <sub>dc</sub> |
| Holdover Voltage for Receiver to return<br>to full gain after Pin 17 switches from 0 to V <sub>DD</sub>               | T <sub>MUT</sub>               | 80                    |                 | 25              | m Sec           |
| MS Input Impedance ( $V_{CC} > 1.2V$ )<br>$V_{CC} = 0V$ , 同正云 = 0 Pen Or V <sub>DD</sub> I<br>$V_{CC} = 0$ , 両右路 = 01 | R <sub>MS</sub>                | -                     | 60<br>>50<br>40 | -               | kn<br>細n        |
| Input Low Voltage   | V <sub>IL</sub> M <sub>S</sub> | 0                     | 11              | 0.3             | V <sub>dc</sub> |
| Input High Voltage  | V <sub>H</sub> M <sub>S</sub>  | 2.0                   | -               | V <sub>DD</sub> | V <sub>dc</sub> |

SYSTEM SPECIFICATIONS: f = 1.0 kHz unless noted, TA = 25 °C. Refer to Figure 1

Parameter

Symbol

## PHONE INTERFACE

|   |                 |                      |                      |                       |                 |
|---|-----------------|----------------------|----------------------|-----------------------|-----------------|
| V <sub>CC</sub> DC Voltage (Pin 1)<br>Bell Telephone Standard and NTT Specs. (R <sub>2</sub> = 43 $\Omega$ , R <sub>3</sub> = 13 $\Omega$ ) | V <sub>CC</sub> |                      |                      |                       | V <sub>dc</sub> |
| Speech Mode<br>I <sub>LOOP</sub> = 10 mA<br>I <sub>LOOP</sub> = 20 mA<br>I <sub>LOOP</sub> = 30 mA<br>I <sub>LOOP</sub> = 120 mA            |                 | 17<br>30<br>35<br>85 | 20<br>34<br>41<br>99 | 23<br>37<br>45<br>105 |                 |
| Tone Mode<br>I <sub>LOOP</sub> = 20 mA<br>I <sub>LOOP</sub> = 30 mA   |                 | 39<br>45             | 41<br>51             | 43<br>55              |                 |
| British Telecom Standard<br>R <sub>2</sub> = 43 $\Omega$ + 2.5 V Zener, R <sub>3</sub> = 13 $\Omega$  |                 |                      |                      |                       |                 |
| Speech Mode<br>I <sub>LOOP</sub> = 10 mA<br>I <sub>LOOP</sub> = 20 mA<br>I <sub>LOOP</sub> = 30 mA<br>I <sub>LOOP</sub> = 70 mA             |                 | -<br>t-<br>-         | 43<br>59<br>69<br>10 |                       |                 |
| AC Terminating Impedance I <sub>LOOP</sub> = 20 mA (Figure 11)  | Z <sub>AC</sub> | 500                  | 600                  | 700                   | n               |

## RECEIVE PATH

|   |                             |               |                    |               |                  |
|---|-----------------------------|---------------|--------------------|---------------|------------------|
| Gain ( $V_{CC}$ to RX01-RX02, Figures 14, 151)<br>I <sub>LOOP</sub> = 20 mA<br>I <sub>LOOP</sub> = 100 mA | G <sub>RX</sub>             | -7.2<br>-13.5 | -6.1<br>-1.1       | -5.0<br>-9.5  | dB               |
| AGain ( $G_{RX}$ @ 100 mA versus 20 mA)   | A <sub>G<sub>RX</sub></sub> | -7.5          | -6.0               | -4.5          | dB               |
| Muted Gain 前右路 = Log 0. I <sub>LOOP</sub> = 20 mA)  | G <sub>RX</sub> M           | -             | -22                | -20           | dB               |
| Distortion at RX01-RX02, $V_{CC} = 250mV$ rms<br>f = 300 Hz<br>f = 1.0 kHz<br>f = 3.4 kHz                 | THD <sub>R</sub>            | -<br>-<br>-   | 0.3<br>0.2<br>0.02 | -<br>2.0<br>- | %                |
| Output Noise across RX01-RX02 @ 10 kHz)   | N <sub>RX0</sub>            | -             | 40                 | -             | V <sub>rms</sub> |

## TRANSMIT PATH

|   |                                  |             |                  |               |                  |
|---|----------------------------------|-------------|------------------|---------------|------------------|
| Gain (MC1-MC2 to V <sub>CC</sub> , Figures 12, 13)<br>I <sub>LOOP</sub> = 20 mA<br>I <sub>LOOP</sub> = 100 mA | G <sub>TX</sub>                  | 36<br>29    | 38.5<br>32.5     | 40.5<br>35.5  | dB               |
| AGain ( $G_{TX}$ @ 100 mA versus 20 mA)   | A <sub>G<sub>TX</sub></sub>      | -7.5        | -6.0             | -4.5          | dB               |
| 8V <sub>CC</sub> Voltage Swing THD = 5% (Figure B)<br>I <sub>LOOP</sub> = 20 mA<br>I <sub>LOOP</sub> = 100 mA | V <sub>TX</sub> M <sub>A</sub> X | -<br>-      | 3.0<br>2.3       | -             | V <sub>p-p</sub> |
| Gain Reduction when muted (MC1-MC2 to V <sub>CC</sub> , 両右路 = 0V)   | G <sub>TX</sub> M                | -           | 68               | -             | dB               |
| Distortion @ dBm @ V <sub>CC</sub> I<br>f = 300 Hz<br>f = 1.0 kHz<br>f = 3.4 kHz                              | THD <sub>T</sub>                 | -<br>-<br>- | 0.5<br>1.5<br>13 | -<br>3.0<br>- | %                |
| Output Noise at V <sub>CC</sub> @ 10 kHz)   | N <sub>TX0</sub>                 | -           | 17               | -             | V <sub>rms</sub> |

## SIDETONE

Sidetone Gain (Gain from V<sub>CC</sub> to RX01-RX02 withSignal applied to MC1/MC2, I<sub>LOOP</sub> = 20 mA)

## PINDESCRIPTI0NS

|             | M n N I m b e r |         |   |
|-------------|-----------------|---------|---|
| S Y m h e l | t S O l c l     | t D 評 l | D e f i n i t i o n   |
| Vcc         | 1               | 1       | Power supply pin for the IC .Supply voltage is derived from loop current .Transmit amp output Operates On this pin .  |
| LR          | 2               | 2       | Resistors R2 +R3 at this pin set the DC characteristics of the circuit .The majority of the IOP Current flows through these resistors .Other components may be used to produce required DC Characteristics for individual regulatory agencies . * |
| V8          | 3               | 3       | A resistor Or appropriate network (n connected froh this pin to Vcc sets the AC terminating impedance (return loss spec ).  |
| VR          | 4               | 4       | A 17 volt regulated output which can be used to bias the microphone .Additionally ,this Voltage PowerS a Portion of the internal circuitry .Can nom inally supply 300 -500 pA .   |
| GND         | 5               | 5       | Ground pin for the entire IC .Nom ally this is not connected to ,nor to be confused w ith earth ground .  |
| MCI         | 6               | 6       | Inverting differential input to the n icrophone amplifier .Input impedance is typ ically 2Q kn .  |
| MC2         | 7               | 7       | Non-inverting differential input to the microphone amplifier .Input im bedance is typic3 y 20 kfl .   |
| MCO         | 8               | 8       | Microphone 8m P lifier output .Amplifiers gain is fixed at 30 dB .  |
| RAGC        | 10              | 9       | Ldop current sensing nPut .The voltage at this pin ,determined by the IOP current and R3 .OperateS the loop len9 the equ8 lization circuit .__  |
| TXI         | 11              | 10      | Input to the trImp it 8m P lifier from the microphone 8m P lifier ;DTM F Source ,and other soUrceS . Input impedance 是 10 kn .  |
| RXO2        | 12              | 11      | Receive am pHier non-inverting differential output .Current capability to the receiver is typically Set 8t ±30 mA peak .  |
| RXOI        | 14              | 12      | Receive am plifier inverting differential output .Current capabilty to the receiver is tyP ca y ±30 mA peak .Gain is set by R8 .  |
| RXI         | 15              | 13      | Summ ng input to the receive 8m P lifier .This pin is 8n AC virtualy grounded .   |
| RXA         | 16              | 14      | Summed outputs of the receive current amplifier ,Sidetone amplifier ,3nd an AGC point .Normally connected to the receive am plifier input (RXI )through a coupling capacitor .  |
| ZB          | 17              | 15      | Input to the receive current amplifier .A balance network (ZB )is Conn ected between this pin and Vcc .The network affects the receive level and sidetone performance .Input impedance is 是 500 gl in series w ith a diode .                      |
| MS          | 18              | 16      | Mode Select Input .A logic "1 "sets the IC for pulse dia n9 .A logic 0 Sets the C fortone .DTMF dialing .Effective on Y 肝 誌 is at 8 logic 0 ". Input impedance is 是 60 kfl .  |
| 町 羅         | 19              | 17      | 慧 靈 品 靈 靈 靈 器 靈 靈 器 鵠 鑑 器 靈 靈 忠 靈 靈 。<br><br>VDD .An internaH xed delay of 11 m Sec minim izes click\$ in the receiver when returnin9 to the Speech mode .  |
| VDD         | 20              | 18      | A regulated 33 volt output for an external dialer .Output source current Capabilty is 10 mA in SpeeCh mode .25 mA in tone dialling mode .   |

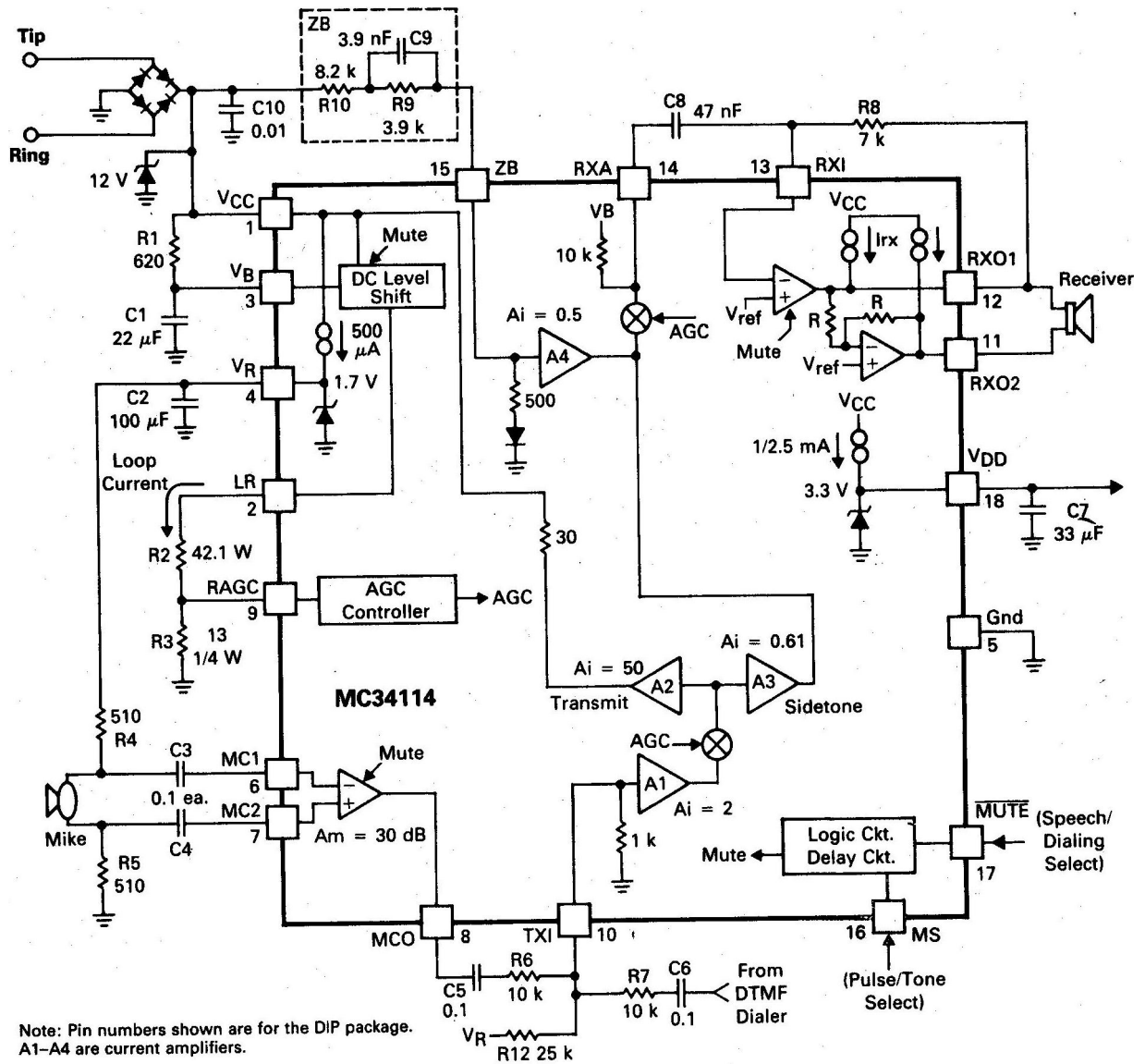
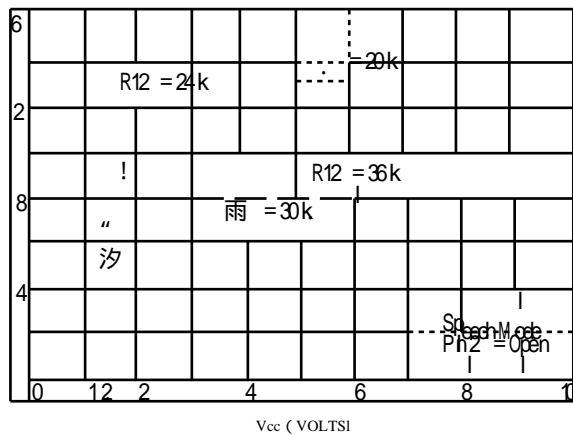
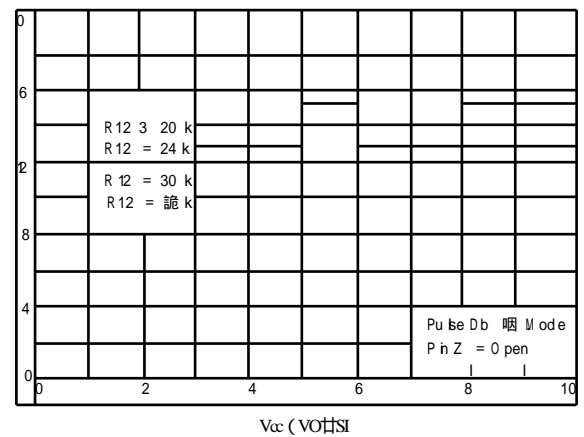
FIGURE 2 -  $I_{cc}$  versus  $V_{cc}$  (SPEECH MODE)FIGURE 3 -  $I_{cc}$  versus  $V_{cc}$  (PULSE DIALING MODE)

FIGURE 4 - Icc versus Vcc (TONE/DIAL/NG MODE)

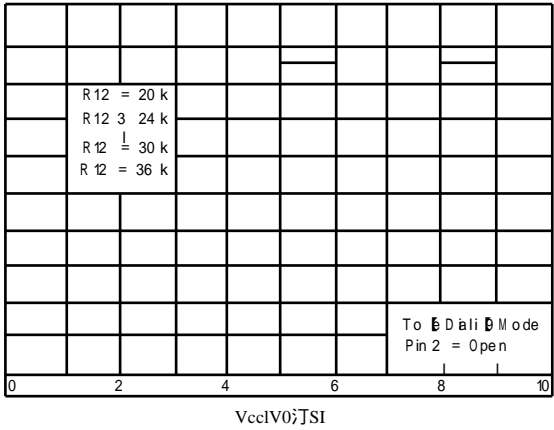


FIGURE 5 - Vcc versus Icc (TONE/DIAL/NG MODE)

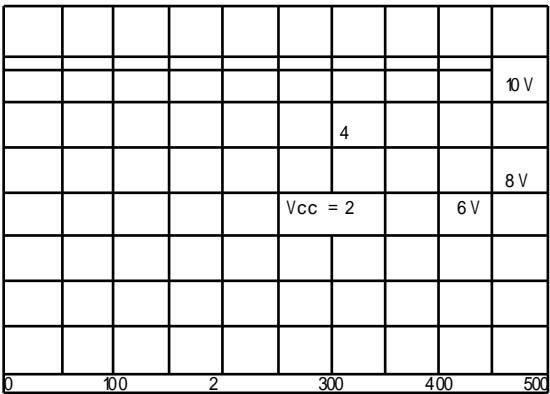


FIGURE 6 - VDD versus Idd (SIDD)

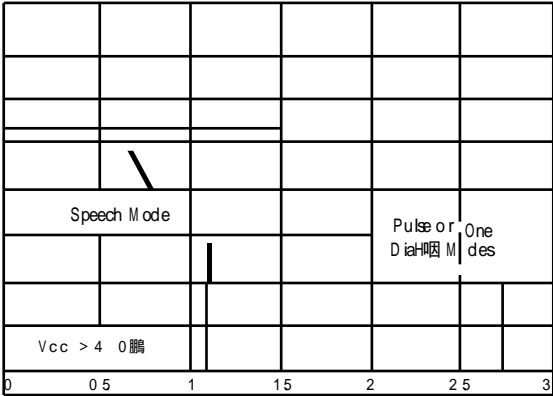


FIGURE 7 - AGC versus Vcc (VOLTAGE AT PIN 9)

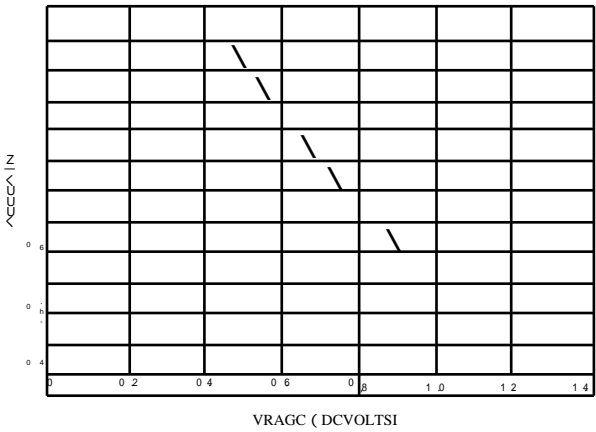


FIGURE 8 - MAXIMUM TRANSMIT SIGNAL AT Vcc

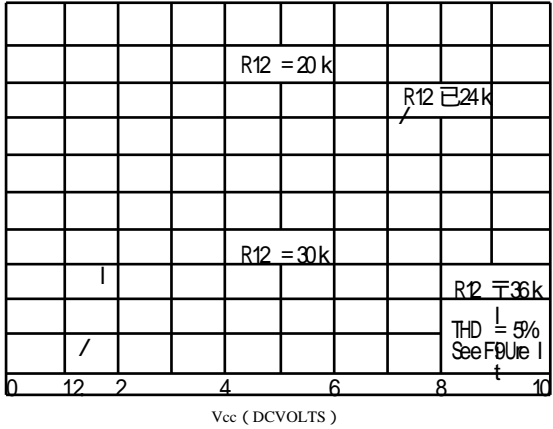
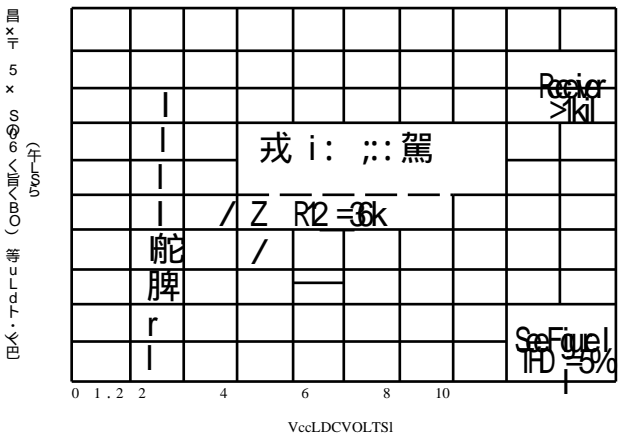


FIGURE 9 - MAXIMUM RECEIVE SIGNAL AT Vcc



1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20. 21. 22. 23. 24. 25. 26. 27. 28. 29. 30. 31. 32. 33. 34. 35. 36. 37. 38. 39. 40. 41. 42. 43. 44. 45. 46. 47. 48. 49. 50. 51. 52. 53. 54. 55. 56. 57. 58. 59. 60. 61. 62. 63. 64. 65. 66. 67. 68. 69. 70. 71. 72. 73. 74. 75. 76. 77. 78. 79. 80. 81. 82. 83. 84. 85. 86. 87. 88. 89. 90. 91. 92. 93. 94. 95. 96. 97. 98. 99. 100. 101. 102. 103. 104. 105. 106. 107. 108. 109. 110. 111. 112. 113. 114. 115. 116. 117. 118. 119. 120. 121. 122. 123. 124. 125. 126. 127. 128. 129. 130. 131. 132. 133. 134. 135. 136. 137. 138. 139. 140. 141. 142. 143. 144. 145. 146. 147. 148. 149. 150. 151. 152. 153. 154. 155. 156. 157. 158. 159. 160. 161. 162. 163. 164. 165. 166. 167. 168. 169. 170. 171. 172. 173. 174. 175. 176. 177. 178. 179. 180. 181. 182. 183. 184. 185. 186. 187. 188. 189. 190. 191. 192. 193. 194. 195. 196. 197. 198. 199. 200. 201. 202. 203. 204. 205. 206. 207. 208. 209. 210. 211. 212. 213. 214. 215. 216. 217. 218. 219. 220. 221. 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1018. 1019. 1020. 1021. 1022. 1023. 1024. 1025. 1026. 1027. 1028. 1029. 1030. 1031. 1032. 1033. 1034. 1035. 1036. 1037. 1038. 1039. 1040. 1041. 1042. 1043. 1044. 1045. 1046. 1047. 1048. 1049. 1050. 1051. 1052. 1053. 1054. 1055. 1056. 1057. 1058. 1059. 1060. 1061. 1062. 1063. 1064. 1065. 1066. 1067. 1068. 1069. 1070. 1071. 1072. 1073. 1074. 1075. 1076. 1077. 1078. 1079. 1080. 1081. 1082. 1083. 1084. 1085. 1086. 1087. 1088. 1089. 1090. 1091. 1092. 1093. 1094. 1095. 1096. 1097. 1098. 1099. 1100. 1101. 1102. 1103. 1104. 1105. 1106. 1107. 1108. 1109. 1110. 1111. 1112. 1113. 1114. 1115. 1116. 1117. 1118. 1119. 1120. 1121. 1122. 1123. 1124. 1125. 1126. 1127. 1128. 1129. 1130. 1131. 1132. 1133. 1134. 1135. 1136. 1137. 1138. 1139. 1140. 1141. 1142. 1143. 1144. 1145. 1146. 1147. 1148. 1149. 1150. 1151. 1152. 1153. 1154. 1155. 1156. 1157. 1158. 1159. 1160. 1161. 1162. 1163. 1164. 1165. 1166. 1167. 1168. 1169. 1170. 1171. 1172. 1173. 1174. 1175. 1176. 1177. 1178. 1179. 1180. 1181. 1182. 1183. 1184. 1185. 1186. 1187. 1188. 1189. 1190. 1191. 1192. 1193. 1194. 1195. 1196. 1197. 1198. 1199. 1200. 1201. 1202. 1203. 1204. 1205. 1206. 1207. 1208. 1209. 1210. 1211. 1212. 1213. 1214. 1215. 1216. 1217. 1218. 1219. 1220. 1221. 1222. 1223. 1224. 1225. 1226. 1227. 1228. 1229. 1230. 1231. 1232. 1233. 1234. 1235. 1236. 1237. 1238. 1239. 1240. 1241. 1242. 1243. 1244. 1245. 1246. 1247. 1248. 1249. 1250. 1251. 1252. 1253. 1254. 1255. 1256. 1257. 1258. 1259. 1260. 1261. 1262. 1263. 1264. 1265. 1266. 1267. 1268. 1269. 1270. 1271. 1272. 1273. 1274. 1275. 1276. 1277. 1278. 1279. 1280. 1281. 1282. 1283. 1284. 1285. 1286. 1287. 1288. 1289. 1290. 1291. 1292. 1293. 1294. 1295. 1296. 1297. 1298. 1299. 1300. 1301. 1302. 1303. 1304. 1305. 1306. 1307. 1308. 1309. 1310. 1311. 1312. 1313. 1314. 1315. 1316. 1317. 1318. 1319. 1320. 1321. 1322. 1323. 1324. 1325. 1326. 1327. 1328. 1329. 1330. 1331. 1332. 1333. 1334. 1335. 1336. 1337. 1338. 1339. 1340. 1341. 1342. 1343. 1344. 1345. 1346. 1347. 1348. 1349. 1350. 1351. 1352. 1353. 1354. 1355. 1356. 1357. 1358. 1359. 1360. 1361. 1362. 1363. 1364. 1365. 1366. 1367. 1368. 1369. 1370. 1371. 1372. 1373. 1374. 1375. 1376. 1377. 1378. 1379. 1380. 1381. 1382. 1383. 1384. 1385. 1386. 1387. 1388. 1389. 1390. 1391. 1392. 1393. 1394. 1395. 1396. 1397. 1398. 1399. 1400. 1401. 1402. 1403. 1404. 1405. 1406. 1407. 1408. 1409. 1410. 1411. 1412. 1413. 1414. 1415. 1416. 1417. 1418. 1419. 1420. 1421. 1422. 1423. 1424. 1425. 1426. 1427. 1428. 1429. 1430. 1431. 1432. 1433. 1434. 1435. 1436. 1437. 1438. 1439. 1440. 1441. 1442. 1443. 1444. 1445. 1446. 1447. 1448. 1449. 1450. 1451. 1452. 1453. 1454. 1455. 1456. 1457. 1458. 1459. 1460. 1461. 1462. 1463. 1464. 1465. 1466. 1467. 1468. 1469. 1470. 1471. 1472. 1473. 1474. 1475. 1476. 1477. 1478. 1479. 1480. 1481. 1482. 1483. 1484. 1485. 1486. 1487. 1488. 1489. 1490. 1491. 1492. 1493. 1494. 1495. 1496. 1497. 1498. 1499. 1500. 1501. 1502. 1503. 1504. 1505. 1506. 1507. 1508. 1509. 1510. 1511. 1512. 1513. 1514. 1515. 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1848. 1849. 1850. 1851. 1852. 1853. 1854. 1855. 1856. 1857. 1858. 1859. 1860. 1861. 1862. 1863. 1864. 1865. 1866. 1867. 1868. 1869. 1870. 1871. 1872. 1873. 1874. 1875. 1876. 1877. 1878. 1879. 1880. 1881. 1882. 1883. 1884. 1885. 1886. 1887. 1888. 1889. 1890. 1891. 1892. 1893. 1894. 1895. 1896. 1897. 1898. 1899. 1900. 1901. 1902. 1903. 1904. 1905. 1906. 1907. 1908. 1909. 1910. 1911. 1912. 1913. 1914. 1915. 1916. 1917. 1918. 1919. 1920. 1921. 1922. 1923. 1924. 1925. 1926. 1927. 1928. 1929. 1930. 1931. 1932. 1933. 1934. 1935. 1936. 1937. 1938. 1939. 1940. 1941. 1942. 1943. 1944. 1945. 1946. 1947. 1948. 1949. 1950. 1951. 1952. 1953. 1954. 1955. 1956. 1957. 1958. 1959. 1960. 1961. 1962. 1963. 1964. 1965. 1966. 1967. 1968. 1969. 1970. 1971. 1972. 1973. 1974. 1975. 1976. 1977. 1978. 1979. 1980. 1981. 1982. 1983. 1984. 1985. 1986. 1987. 1988. 1989. 1990. 1991. 1992. 1993. 1994. 1995. 1996. 1997. 1998. 1999. 2000. 2001. 2002. 2003. 2004. 2005. 2006. 2007.

# SYSTEM PERFORMANCE

FIGURE 10 - TIP / Firing Voltage vs. Loop Current

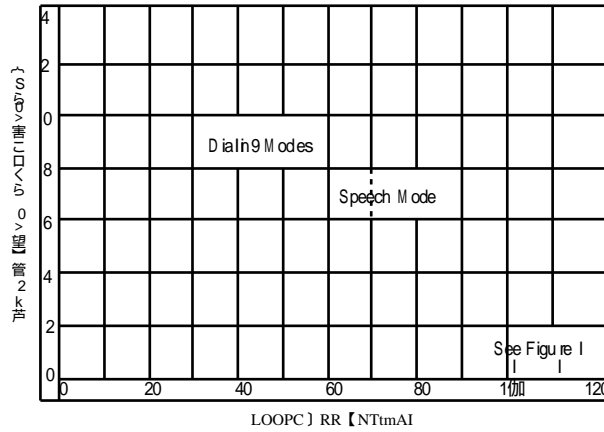


FIGURE 11 - Acoustic Impedance vs. Loop Current

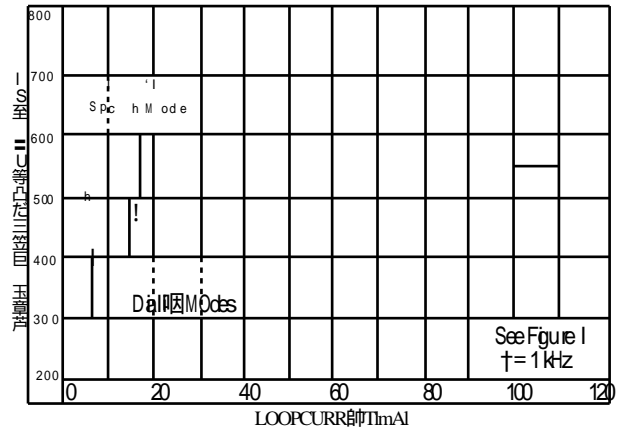


FIGURE 12 - Transmit Gain vs. Loop Current

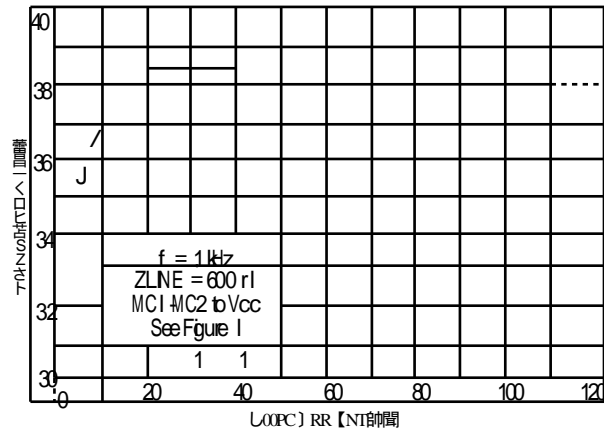


FIGURE 13 - Transmit Gain vs. Frequency

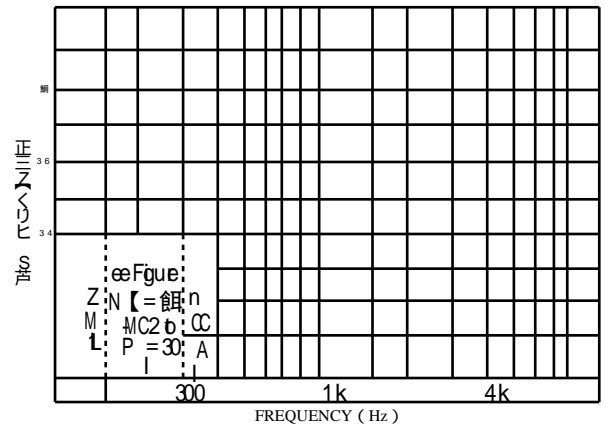


FIGURE 14 - Receive Gain vs. Loop Current

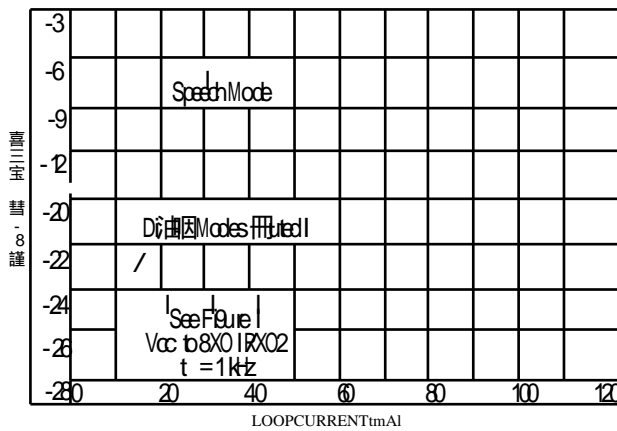
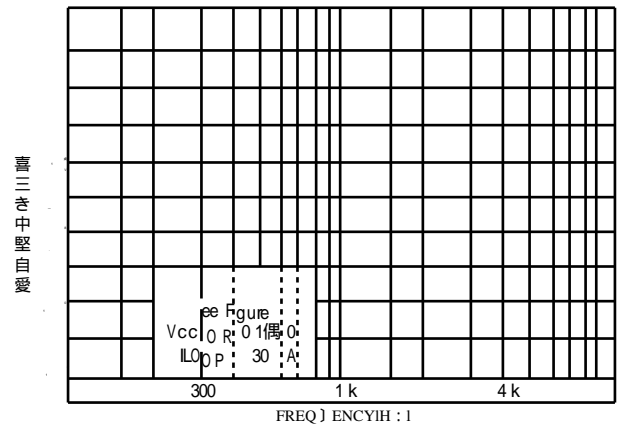


FIGURE 15 - Receive Gain vs. Frequency





# SYSTEM PERFORMANCE

FIGURE 16 - TRANSMITTER NOISE SPECTRUM

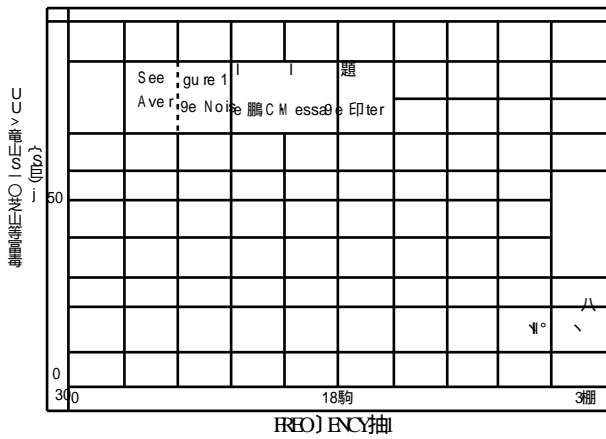


FIGURE 17 - RECEIVER NOISE SPECTRUM

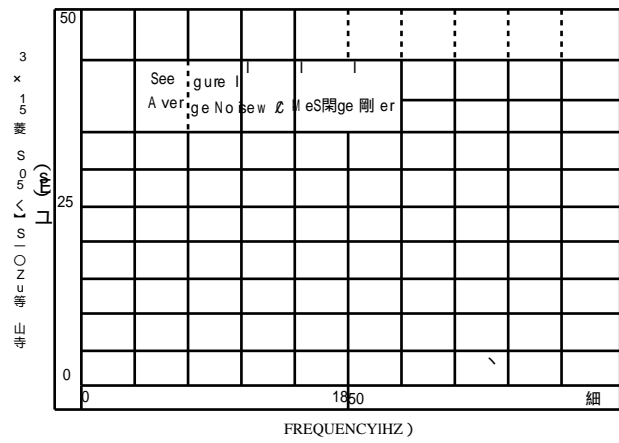


FIGURE 18 - Vcc vs TEMPERATURE

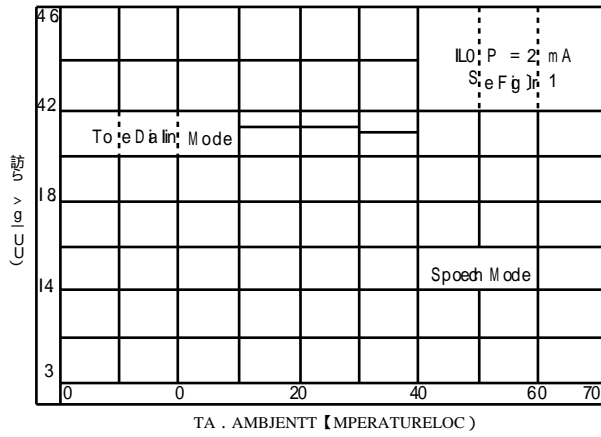


FIGURE 19 - Transmitter Gain vs TEMPERATURE

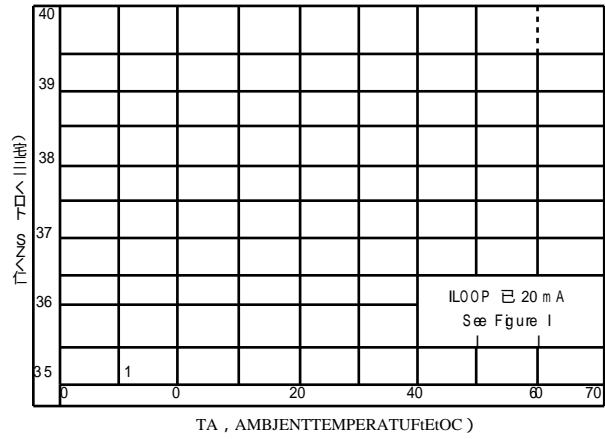


FIGURE 20 - Receiver Gain vs TEMPERATURE

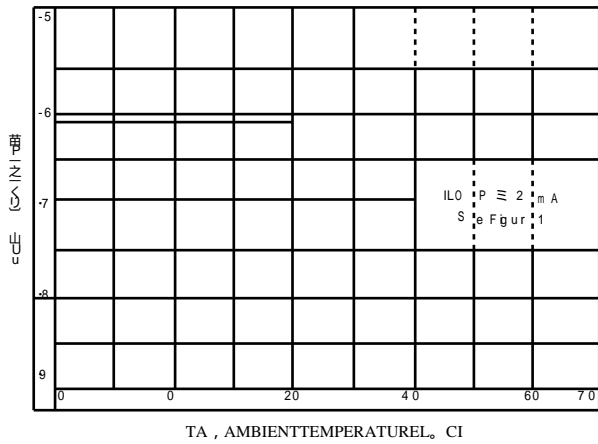
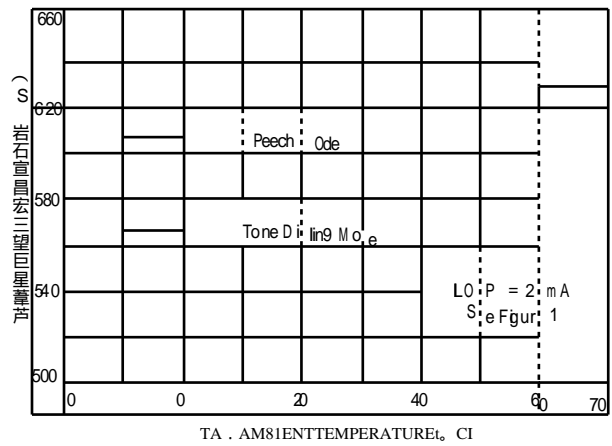


FIGURE 21 - Characterizing Impedance vs TEMPERATURE



## INTRODUCTION

The MC34114 is a SPC network which provides the hybrid function and the DC - 00 PCU current in the case of

throughap0l8rityguardbridge • Thetran8mit • reCeive •  
andsidetone9aInSareeXterna "Yadjustable • andaddi-  
tionally , ine - engthcompens3tionvariesethe931nSWith  
variationSinloopcurrenT • ThomicprovieneamPlifier  
emp - oYSadiffer6ntiaIinputtomimizeR 卩  
SuScePtibil叫 •

The loop current interface portion determines the dc voltage  $V_{rs}$  current characteristics and provides the required regulated voltages for internal and external use.

The dialer interface provides three modes of operation : SPeech tnon - dial in 9LPulsed dial in 9 and tone

some parameter has changed in order to optimize the circuit operation for that mode • The following table summarizes those changes :

TABLE1\_\_OPER,, r1NQPAftAMETeftSYerStJ8  
OPERATINQMODE

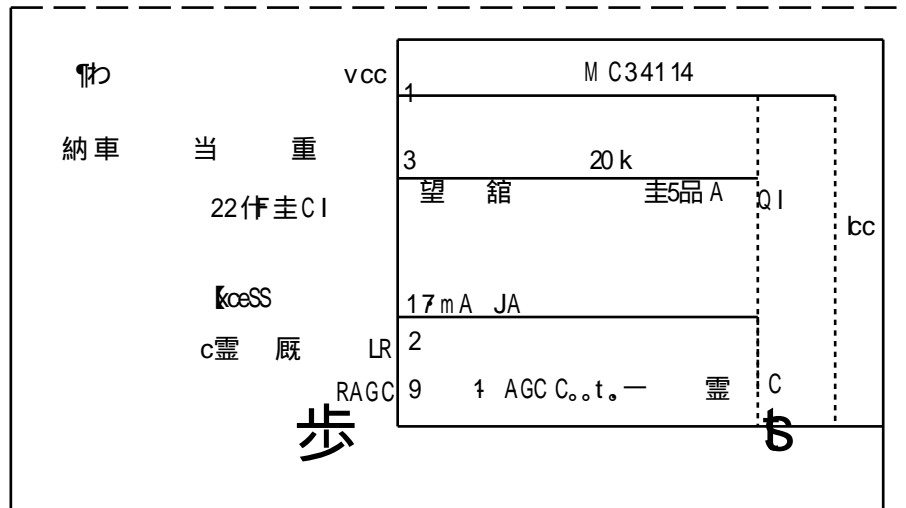
| Function                                      | Speech          | __Pul\$        | Tone           |
|---|-----------------|----------------|----------------|
| LR Level Shift<br>Vcc - VLEP                  | 2.8 V           | 2.8 V          | 3.8 V          |
| VDD Current<br>Cap8b ty                       | 10 mA           | 2.5 mA         | 2.5 mA         |
| Microphone<br>Amplifier                       | Functional      | Muted          | Muted          |
| Receive Amp.<br>Internal Feedback<br>Resistor | Switched<br>Out | Switched<br>In | Switched<br>In |

# DCuNEINTERFACEANDLINELENGTH

## cOMPENSAnON

The DC line interface circuit ( Pins 1, 2, 3 ) Set the DC voltage characteristics with respect to loop current • See Figure 22 •

FIGUFtE22 - DCuNEINTEFtFAcEEQUIVALENT



The DC voltage at  $V_{CC}$  is determined by the level shift

from VcctoLR . p . usthevo . tage8crO \$ SR23ndR3 . lcc  
is the intern3 lbiacurrent required by the MC34114  
nominally in the range Of lOmA . lccc3nbereduced .

ifnecess8rY,byincreasingR12 cOnSi\$tentWiththe  
tr8nSmit8ndreceivesignalrequirementStSeethe  
Tr8nSrnitPath \$eCtion) . SeeFigureS2 - 4 . 88nd9 .

In the \$Peech3ndpulsediaHngmodescurrent\$ Ource  
lli\$ Off , andthelevel\$ hiftisduetoQ1 sbase · emitter  
drop ( 軸1.4V ) , 1 · Ovoltacross \$ the20kresiSt. r · 8ndthe  
volt8geaCrOSS R1 Whichv8rieswithVccfrom0 · 15volt5  
to 角 · 1. Ovolt . Whenthe loopcurrentcOm · nginfromTip  
8ndRin9eXceedstheIccrequ . rement · theexces \$ cUr ·  
rentf · WSthr · UghQ1 . R28ndR3 · tOSetthesthe10PeOf  
theV · lchar8teristicfortheircuitQlhasanequivalent  
resistanceOf 菊10印 . SeeFigure1O ·

IsthethomediHs9nOde currentSourceIiisen+draw-  
 ing8s3dditional1-7mAthroughR1 increasingthellevel  
 shiftBY 1.OvoItS (forR1=600fl) • Thi\$ featureensureS  
 that,atlowloopcurrents SufficientvoltageIspreSent  
 atvccfortheDTMFsign3-8 8adth8ttheVDRegulator  
 suppliessufficientvto -t89etO8neXtemaldi3ler • TheIcc  
 currentincreasesby1.3mAinthis\$ mode •

```
Rlmu $ tbekeptintherangeoflOOto1800n . lfitis
tool8rge in $ ufficientcurrentw川fl0WintoVBtObi8 $
upthecircuit . lfitiStOOSrTlaII . insufficientHteringat
vBW 川re $ ultun . eS $ Clisincres8 $ edaccord軸y . Speech
lgnal $ mu $ tbeue = filteredfromVB .
```

The voltage across  $R_3$  determines the operation of the AGC circuit. The length compensation is such that the voltage across  $R_3$  increases from  $0.4 \text{ volt}$  to  $1.2 \text{ volt}$  as the AGC control varies the current gain of the two AGC

PointstFigureIhroml . OtoO . 5 , therebYreducingthe  
galnOfhetransmitand receivepathsby6 . OdB . See

Figure7 • Pin9isahighimpedanceInPUt .

ThevaIuesofR2andR3canbevariedaSrequiredto  
COmPlYwithvariousregul8tOryagencies . tocompen -  
S3teforadditionalcircuitrypoweredbytheIoopcurrent  
( microprocessor . etc . ) . ortochange thestarting point  
OftheAGCfunction . IftheAGCisnotused , Pin9should  
beconnectedto groundforhighgains , OrtoOVRforlow  
gainS •

## V O m G E R E G U U 汀 O R S

The MC34114 . has twointernal voltage regulators  
Which are usedto powerexternalaswellasinternal  
Circuitry .

TheVR reguLatorprovides1 . 7voltsata maXimum  
CurrentOf500FAA ( seeFigure5 ) . Thisoutputisnormally  
USedto setthe DC biasintoTXI . andto bias

theelectretmicrophone • VRWi " typicallybe 欠 300mV  
LessthanVccwhenVccisbelow2 . 0volts •

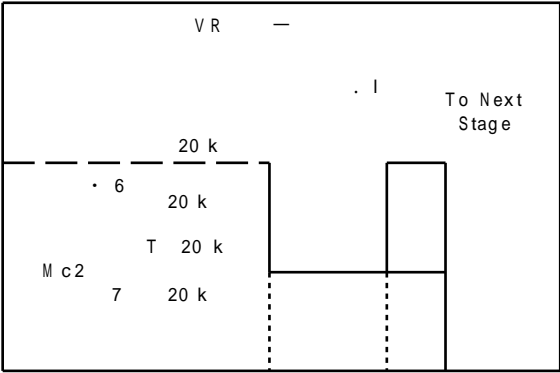
TheVDDregulatorprovides3 . 3voltsatamaximum  
Of1 . 0mAinthespeechmodeiand2 . 5mAinthePUse  
OrtOnedialingmOdes ( seeFigure6 日 tisnormallyYuSed  
to poweran eXternaldialer , and otherassociated cir -  
cuitry . VDDisnormna " Y 等 0 . 5voltslessthanVccuntiI  
VDDregulates . Itisashunttyperegulatorwhichauto -  
matica " y switchesto a highimpedance mode when  
Vccfa " sbelow1 . 4volts . Thisfeaturepreventsexces -  
Sive battery drainin the event a memory sustaining  
batteryIS . uSedwiththeextemaLdialer . Leakagecurrent  
( with Vcc = 0istypicallyYO . 02FAAwith an applied  
VOLTageofupto6 • 0voltsatVDD , Withpin170PenOr  
at VDD . If Pin17is at9rOund . a current of several  
hundredmicroampswillftowintoVDDandoutofpin  
17 ( seeparagraphonLogicInterface ) .

## MiCROPHONEAMPLIFIER

ThemicrophoneampHfier ( Pins6 , 7 , 8 ) hasadiffer -  
entialLnPUt , Single ended output . and afixedinternal  
gainof + 30dB ( 31 . 1VN ) . Theoutputisinphasewith

MC2 , 8ndoutofphasewithMC1 . Theinputs ( seeFigure  
23 ) have a nominalimpedance of20kf1 . and are  
m8tChed to provide a high common mode rejection  
( tYPicalIy26dB ) .

FIGUFE23 \_ tNPUTSTAGE



T ° PreSerVe a hi9h CMRR against unwanted signals  
inducedin the microphoneleads . tho microphone  
Should be biased with two equalvalue resistors as  
ShowninFigure1 .

The output ( MCO ) hasaDCbiasvoltageof 欠 1 . 1volts  
( Vcc > 3 . 0volts ) , andcannomina " yswing 含 2 . 0volts  
P - P ( 500mVp - P8tVcc = 1 • 2volts ) • Theoutputimpe -  
dancex 欠 27011 . and ' has a peakcurrentcapabilityof  
零160FLAfor5%THD .

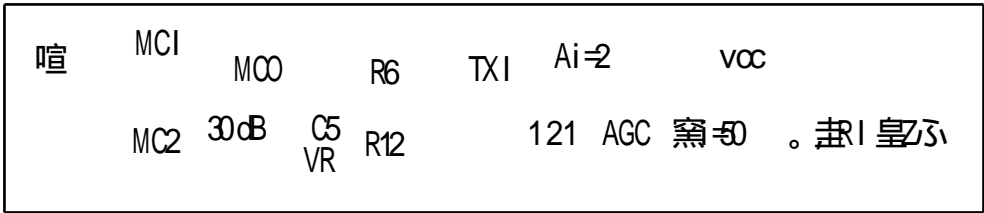
When the MC34114is switched to either dialing  
mode the microphoneamplifieris muted by 電 70dB  
( 300Hz - 4kHzI , effectivelydisabLingthe microphone .

TheDCvoltageatMCOis 欠 80mVwhenmuted .

## TRANSMITPATH

The AC - transmit path consists ofthe components  
Sh ° WninFigure24 ( takenfromFigure1 ) .

FIGUFE24 - TFrANSMITPATH



The voltage OutPUtat MCOis c ° nVertedto a current  
into TXIby C5 , R6 , andTXrsI . O kinputimpedance  
( WithaslighterrorduetoR12 ) . AlandA2arecurrent  
amplifierswithacombinedgainof100 . TheAGCpoint  
has a current gain Of1 . 03tlowloop currents . and

decreasestoO . 5as100PCurrentincreases . Therefore  
thecurrentgainfrqmTXItoVccvariesfrom100to50  
asLoopcurrentisincreased . Theresultingcurrentout -  
PutatVccactsonR18ndthelineimpedance ( nominally  
600neach , Clisan ACshort ) togenerateaVOLTage



## SIDETONE CANCELLATION

Sidetone cancellation is provided by a current amplifier A3 (see Figure 1) which generates a current proportional to the transmitted signal to cancel the reflected side tones. To achieve perfect cancellation (no AC current out of RXA), it is necessary that:

$$Z_B = (40 \times R_{L1} + Z_{LINE} - 500 \Omega) \quad (\text{Equation 5})$$

Where  $Z_B$  is the network composed of  $R_9$ ,  $R_{10}$ , and  $C_9$ , and  $Z_{LINE}$  is the AC impedance of the line. The reactive components of the line's impedance can be compensated for by making the  $Z_B$  network comparable in reactive. In Figure 1,  $C_9$  provides a phase shift to compensate for the phase shift created by the telephone.

## LOGIC INTERFACE (MS and MUTE)

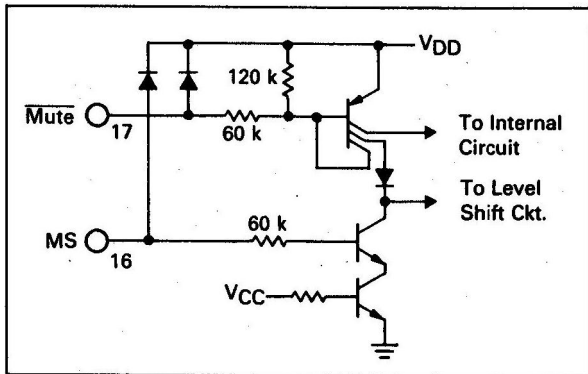
The two logic inputs (MS and MUTE) are used to switch the MC34114 between the speech and dialing modes according to the following table:

TABLE 2 - LOGIC INPUTS

| MUTE | MS   | Mode          |
|------|------|---------------|
| High | X    | Speech        |
| Low  | High | Pulse Dialing |
| Low  | Low  | Tone Dialing  |

Table 2, together with Table 1, describes the condition of the MC34114 in the various modes. Figure 26 shows the input configuration for the Mute and MS pins.

FIGURE 26 - LOGIC INPUTS



The Mute input has a nominal input impedance of 60

k $\Omega$ , referenced to VDD. This pin may be left open or connected to VDD. Logic '1' is defined as between VDD - 0.5 volts and VDD. Logic '0' is defined as between 0.9V and 1.0V. The switching threshold is 2.3V. When Mute is switched low (speech to dialing), the changes listed in Table 1 will occur within 10  $\mu$ s. Upon switching high (back to speech mode), however, the receive amplifier feedback resistor will be switched out after a delay of typically 711 ms. This feature prevents dialing transient (particularly during pulse dialing) from being heard as loud clicks in

the receiver. The other functions listed in Table 1 transfer within 10  $\mu$ s.

The MS pin is a function only when Mute is low and its only function is to provide an additional voltage level shift between Vcc and L in the tone dialing mode (see the section on DC Interface). The input impedance is 60 k $\Omega$  when Vcc > 1.5 volts. Logic '1' is between ground and 0.3 volts, and logic '0' is between 0.3 volts and VDD. The switching threshold is typically 0.75 V. If unused, this pin must be connected to ground or VDD, and not left open.

When Vcc = 0 (on-hook condition), and a voltage in the range of 0 to 0.6 volts is applied to Mute, a leakage current of (typical) 0.02  $\mu$ A will flow. If Mute is at a voltage different from VDD, current will flow through the internal resistors and/or diode. If memory sustaining battery is used in conjunction with an external dialer, and is configured so that its voltage is 8V or less at VDD, Mute must be allowed to float or be connected to VDD. Otherwise, current in the range of 100 - 200  $\mu$ A will flow through VDD and out of the Mute pin.

When Vcc = 0, and a voltage in the range of 0 to 0.6 volts is applied to MS, a leakage current of (typical) 0.01  $\mu$ A will flow. If Mute is open or at VDD, if Mute is at ground, a equivalent 3.5 k $\Omega$  parasitic resistance exists between MS and Mute.

When Vcc < 1.5 volts, the Mute function is non-existent and the MC34114 will be in the speech mode.

## APPLICATIONS INFORMATION

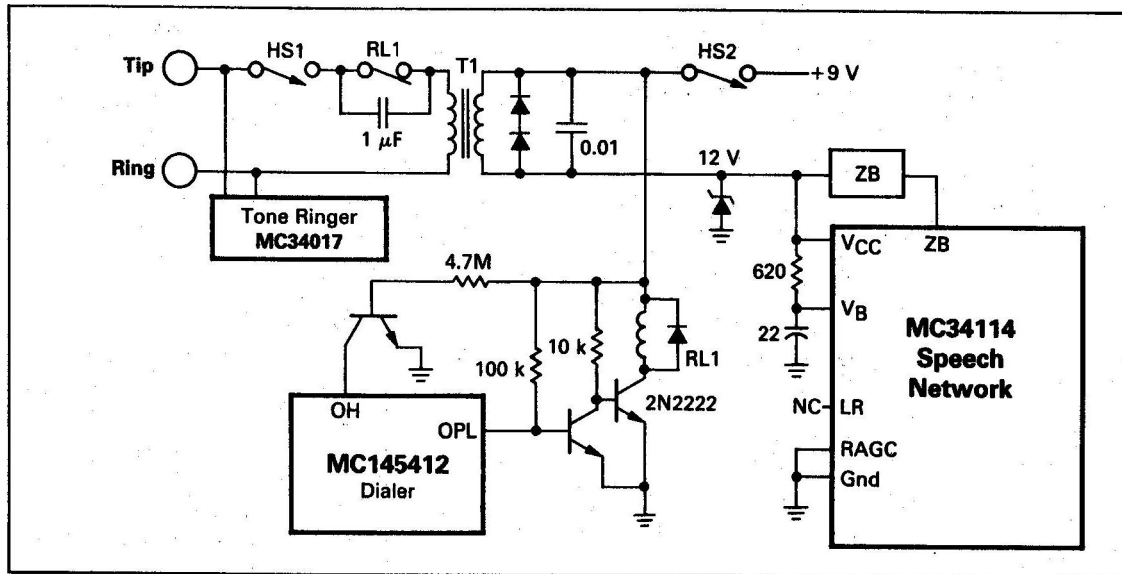
### DESIGN SEQUENCE

The design sequence for incorporating the MC34114 into most applications is as follows: refer to Figure 1:

- 1) Decide on the AC terminating impedance (return loss) and select R1 to that value (typically 600  $\Omega$ ). If there are other devices powered by the loop current which will be in parallel with R1 such as a pulse dialing circuit which lower the effective terminating impedance, R1 can be increased accordingly.
- 2) Select the maximum value of R12 which will provide the minimum required transmit and receive signals according to Figures 8 and 9.
- 3) Select the sum of R2 + R3 to provide the desired Tip and Ring DC voltage versus loop current characteristics. Then select R3 for the desired starting point of the loop length compensation. The compensation begins when the voltage across R3 is 0.4 volt.
- 4) Select R4 and R5 (they should be equal) to properly bias the microphone. The microphone manufacturer should be consulted for this information.
- 5) Select R6 for proper transmit gain. See equation 1. Then select C5 to provide low frequency rolloff. Adjust R6 as required.
- 6) Select the ZB network (R9, R10, C9) to provide side tone cancellation. See equation 5.
- 7) Select R8 for proper receive impedance depends on the specific receiver used. See equation 2. Then select C8 to provide low frequency rolloff. Adjust R8 as required.

Mc34114  
2 - 510

FIGURE 28 - USE WITH A POWER SUPPLY



A transformer (T1) is required at Tip and Ring to provide isolation required between the phone line and any AC power and earth ground. (The transformer must be rated to handle the loop current.) Since the loop current does not pass through the MC34114, loop length compensation is not possible in this circuit, and pin 2 (LR) is left open. The RAGC pin is grounded, setting the transmit and receive gain to their maximum.

The transformer provides a path for the power supply

MC34114. The two series diodes provide transient clamping, as does the 12V Zener diode. Although a +9.0V supply is shown, other voltages can be used as long as the MC34114 receives between 4.0 and 10.5V at VCC.

Because of the isolation requirement, the MC145412

dialer requires a relay (RL1) to break the loop current during pulse dialing. The relay is normally open and energized only during pulse dialing. The 0.01µF capacitor (rated 50V min., NPO) across the relay contacts helps absorb transient generated during pulse dialing.

#### ALTERNATE MICROPHONE CONFIGURATIONS

The MC34114 is designed for use with electret microphones, although dynamic microphones can be used. Carbon microphones are not recommended as they generally require considerable bias current which is not

available from the MC34114.

When using an electret microphone which requires more than 1.7V, but less than 10mA for bias, it can be biased from VDD instead.

A three-terminal electret microphone (containing an internal biasing resistor or equivalent) is used, it should be connected to the MC34114 as shown in Figure 29.

The common mode rejection of the balanced circuit shown in Figure 29 is not present however, and care should be taken to prevent unwanted signals (radio sta-

tions, noise, etc.) from being picked up by the microphone leads.

FIGURE 29 - 3-TERMINAL MICROPHONE

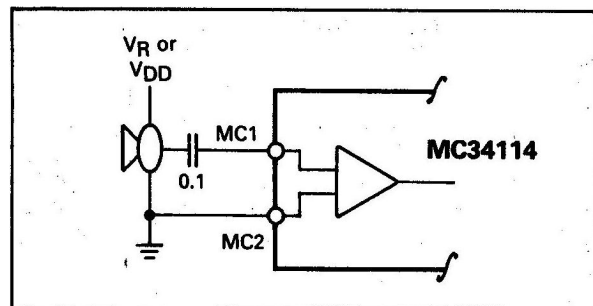
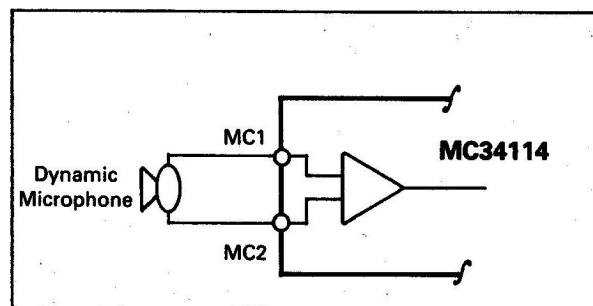


Figure 30 indicates use of the MC34114 with a dynamic microphone. The output level of dynamic microphones is generally lower than electret units, and so the gain of the transmit path will have to be adjusted accordingly.

FIGURE 30 - DYNAMIC MICROPHONE



## Frequency characteristics for both transmit and

Low frequency roll - Off for the  $\tau_{8n}$  Smits signal can be

( R6A + R6B + 1 . 0 kI

---



Low frequency roll - Off for there receives 19 nals can be  
Set by Adj. Setting C8, and high frequency roll - off can be  
Set by Placing a Capacitor across R8.

FEATURE PHONE DESIGN

Figure 32 and Figure 33 depict two feature phone circuits which include the following functions: Selectable  
handset and Speakerphone operation, ten number

memory, pulse / tone dialer, tone pager, 8 "Privacy" .

Q u e s t i o n s a n d a n s w e r s

MOTOROLA

the Mute Function, and line length compensation for  
both handset and speakerphone operation. Figure 32  
uses the MC34018 Speakerphone IC. While Figure 33  
uses the MC34118 Speakerphone IC. Application notes  
AN1002 and AN1004 (for Figure 32 and Figure 33  
respectively) should be consulted for design and per-  
formance details, as well as variations of these two  
circuits.

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formance details, as well as variations of these two  
circuits.

MC34118

MC34114

## EMISUSCEPTIBILITY

Physical proximity of the pins • TX1, RX1 • and ZB should also be considered sensitive to EMI signals •

The microphone wires within the handset cord can act as an antenna, and pick up nearby radio stations • If this is a problem in the final design • adding RF filters (consisting of ferrite beads and small capacitors) to the PCB where the wires attach to the board can generally reduce the problem •

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## SUGGESTED VENDORS

Microphones

Primo Microphones Inc.  
Bensenville, IL 60106  
312 - 595 - 1022  
Model IEM - 60

MURACORP.  
Weaterville, N.Y. 11590  
516 - 935 - 3640  
Model EC - 983 - 7

Hosiden America Corp.  
Evanston, IL 60007  
312 - 981 - 1144  
Model KUC2123

Telephone modems

Microtron Co., Inc.  
Village Stream, N.Y. 11528  
516 - 561 - 6050  
Ask for Applications  
Bulletin F232

Stancor Products  
Logansport, IN 46947  
219 - 722 - 2244

PREMAGNETICS, INC.  
McHenry, IL 60050  
815 - 385 - 2700

Onan Power / Electronics  
Minneapolis, MN 55437  
612 - 921 - 5600

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