

**SANYO**

No. 4276

**LA8517M****Audio Signal Processing Circuit for  
Cordless Telephone Base Set Applications****Overview**

The LA8517M, an audio signal processing IC for cordless telephone answering machine applications, incorporates speech network, audio signal processing and cross-point switching functions into a single chip.

**Applications****Speech Network**

- 2 to 4 wire conversion
- Impedance matching
- Line driver
- DTMF interfacing
- Transmitting amplifier
- Key tone interfacing
- Receiving amplifier

**Audio Signal Processing**

- Recorder preamplifier (with ALC)
- Playback equalizer amplifier
- Recorder amplifier
- Voice detection circuit (VOX)
- Power amplifier ( $P_O = 200 \text{ mW}$ ,  $R_L = 8\Omega$ ,  $V_{CC} = 5 \text{ V}$ )

**Cross-point Switching**

- 8 x 8 equivalent cross-point switching
- CPU interfacing (serial control)

**Features****Speech Network**

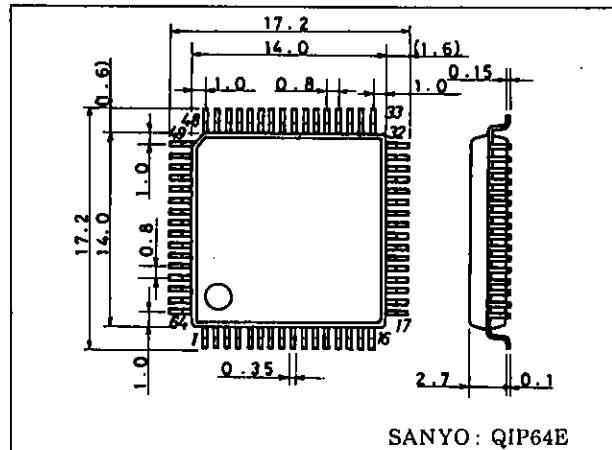
- Supports direct interfacing using low impedance telephone receiver.
- Using dialer IC mute signaling, supports output to circuit following changeover of telephone receiver and dial signal (DTMF).
- Transmit gain and receive gain are controlled automatically in response to loop current.
- Supports forced attenuation of transmit gain and receive gain from gain control pin.
- Equipped with dial confirmation tone (key tone) input pin (mute signal control).
- Variety of handsets supported using externally connected components for varying transmit gain and receive gain.
- Outstanding for branch performance with low operating current.

**Audio Signal Processing**

- Supports single mechanism system.
- All necessary answering machine functions built-in; microcontroller control permits unique system construction.
- Built-in power amplifier.
- Permits independent settings for recording amplifier gain and recording bias current using external resistors.

**Package Dimensions**

unit : mm

**3159-QIP64E****SANYO Electric Co., Ltd. Semiconductor Business Headquarters**

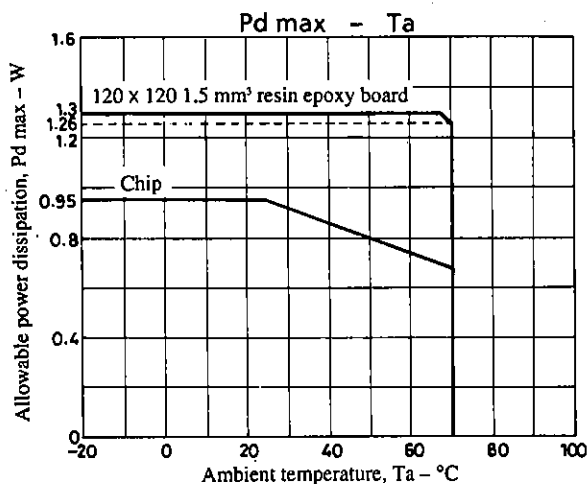
TOKYO OFFICE Tokyo Bldg., 1-10, 1 Chome, Ueno, Taito-ku, TOKYO JAPAN

## LA8517M

Continued from preceding page.

|   |           |  | min | typ  | max | unit             |
|---|-----------|--|-----|------|-----|------------------|
| <b>&lt;PB AMP&gt;</b>                                 |           |  |     |      |     |                  |
| Voltage gain  | $V_{GE}$  | -60dBV input between pins 23 – 25                                      | 47  | 49   | 51  | dB               |
| Total harmonic distortion                             | THD       | -60dBV input between pins 23 – 25                                      |     | 0.3  | 1.0 | %                |
| Equivalent input noise voltage                        | $V_{NI}$  | 23pin shorts (in terms of AC), 20Hz to 20kHz                           |     | 1.0  | 5   | $\mu\text{Vrms}$ |
| <b>&lt;OGM AMP&gt;</b>                                |           |  |     |      |     |                  |
| Voltage gain  | $V_{GC}$  | -20dBV input between pins 29 – 30                                      | 8   | 10   | 12  | dB               |
| Total harmonic distortion                             | THD       | -20dBV input between pins 29 – 30                                      |     | 0.1  | 1.0 | %                |
| <b>&lt;REC AMP&gt;</b>                                |           |  |     |      |     |                  |
| Voltage gain  | $V_{GR}$  | Pin 21 $Z_{AC} = 9\text{k}\Omega$ between pins 27 – 22                 | -6  | -4   | -2  | dB               |
| Output bias voltage (pin 22 voltage)                  | $V_B$     | Pin 21 $Z_{DC} = 15\text{k}\Omega$ , 6.8 $\text{k}\Omega$ pin 22 load, | 0.8 | 1.0  | 1.2 | V                |
| Total harmonic distortion                             | THD       | -30 dBV input pin 9 , pin 22 fixed                                     |     | 0.5  | 1.0 | %                |
| <b>&lt;MIC AMP&gt;</b>                                |           |  |     |      |     |                  |
| Voltage gain  | $V_{GM}$  | -40dBV input between pins 34 – 36                                      | 28  | 30   | 32  | dB               |
| Total harmonic distortion                             | THD       | -40dBV input between pins 34 – 36                                      |     | 0.1  | 1.0 | %                |
| Equivalent input noise voltage                        | $V_{NI}$  | 34 pin shorts (in terms of AC), 20Hz to 20kHz                          |     | 1.5  | 5   | $\mu\text{Vrms}$ |
| <b>&lt;POWER AMP : <math>R_L = 8\Omega</math>&gt;</b> |           |  |     |      |     |                  |
| Voltage gain  | $V_{GP}$  | -30dBV input between pins 45 – 42                                      | 28  | 30   | 32  | dB               |
| Output power  | $P_O$     | THD = 10%  | 200 | 250  |     | mW               |
| Total harmonic distortion                             | THD       | -30dBV input between pins 45 – 42                                      |     | 0.5  | 1.5 | %                |
| Input resistance                                      | $R_i$     |  |     | 60   |     | $\text{k}\Omega$ |
| Ripple rejection                                      | SVRR      | $R_g = 0$ , $f_r = 100\text{Hz}$ , $V_r = -20\text{dBV}$               | 50  | 60   |     | dB               |
| Output noise voltage                                  | $V_{NO}$  | 45 pin shorts (in terms of AC), 20Hz to 20kHz                          |     | 0.04 | 0.1 | mVrms            |
| <b>&lt;VOX&gt;</b>                                    |           |  |     |      |     |                  |
| Sensitivity 1   | $V_{OXL}$ | -24dBV input   |     |      | 0.3 | V                |
| Sensitivity 2   | $V_{OXH}$ | -28dBV input   | 4.5 |      |     | V                |
| <b>&lt;<math>V_{REF}</math>&gt;</b>                   |           |  |     |      |     |                  |
| Output voltage  | $V_{REF}$ |  | 2.1 | 2.3  | 2.5 | V                |
| <b>&lt;CONTROL&gt;</b>                                |           |  |     |      |     |                  |
| Clock frequency                                       | $F_{CK}$  |  |     |      | 500 | kHz              |
| Input signal "H" level                                | $V_H$     |  | 3   |      |     | V                |
| Input signal "L" level                                | $V_L$     |  |     |      | 1.5 | V                |

### Allowable power dissipation vs. ambient temperature



## Specifications

### Maximum Ratings at Ta = 25°C

|                             |                     |                          |             | unit |
|-----------------------------|---------------------|--------------------------|-------------|------|
| Maximum supply voltage      | V <sub>L</sub> max  | Speech network           | 15          | V    |
|                             | V <sub>CC</sub> max | Excluding speech network | 10          | V    |
| Loop current                | I <sub>L</sub> max  |                          | 130         | mA   |
| Allowable power dissipation | Pd max              |                          | 950         | mW   |
| Operating temperature       | Topr                |                          | -20 to +70  | °C   |
| Storage temperature         | Tstg                |                          | -40 to +150 | °C   |

### Operating Conditions at Ta = 25°C

|                                |                    |                          |            | unit |
|--------------------------------|--------------------|--------------------------|------------|------|
| Recommended supply voltage     | V <sub>CC</sub>    | Excluding speech network | 5          | V    |
| Supply voltage operating range | V <sub>CC</sub> op | Excluding speech network | 4.5 to 7.5 | V    |

### Operating Characteristics at Ta = 25°C, f = 1kHz

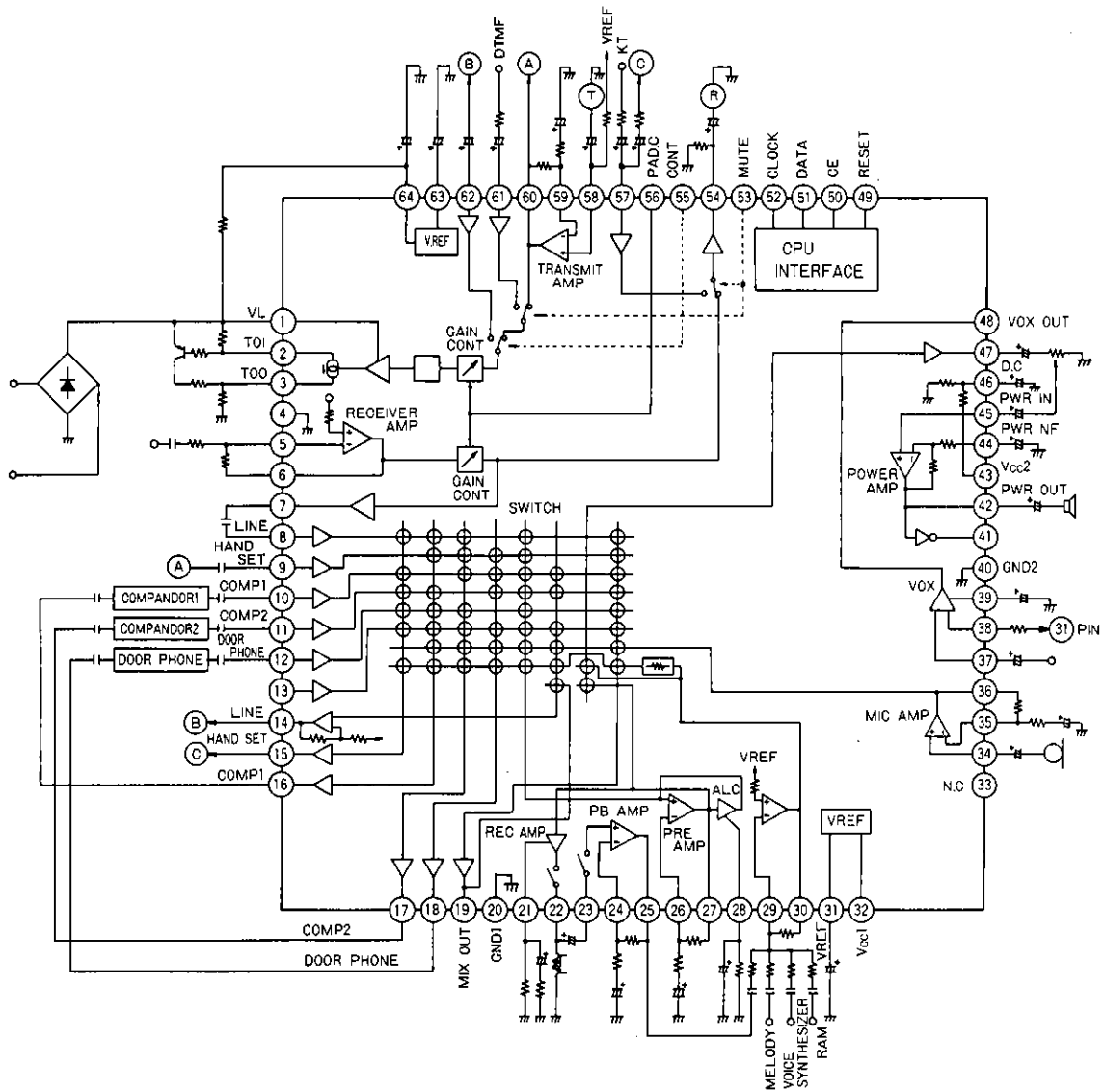
| [Speech network]              |                  |  | min                | typ  | max             | unit             |
|-------------------------------|------------------|--|--------------------|------|-----------------|------------------|
| Line voltage                  | V <sub>L</sub>   | I <sub>L</sub> = 20mA                            | 3.3                | 3.8  | 4.3             | V                |
|                               |                  | I <sub>L</sub> = 50mA                            | 5.5                | 6.3  | 7.1             | V                |
|                               |                  | I <sub>L</sub> = 120mA                           | 10.2               | 12.2 | 14.2            | V                |
| Internal supply voltage       | V <sub>CC</sub>  | I <sub>L</sub> = 20mA                            | 1.9                | 2.1  | 2.3             | V                |
|                               |                  | I <sub>L</sub> = 50mA                            | 3.3                | 3.6  | 3.9             | V                |
|                               |                  | I <sub>L</sub> = 120mA                           | 6.8                | 7.1  | 7.4             | V                |
| Transmitting gain             | G <sub>T</sub>   | I <sub>L</sub> = 20mA, V <sub>IN</sub> = -55dBV  | 34                 | 36   | 38              | dB               |
|                               |                  | I <sub>L</sub> = 120mA, V <sub>IN</sub> = -55dBV | 32                 | 34   | 36              | dB               |
| Receiving gain                | G <sub>R</sub>   | I <sub>L</sub> = 20mA, V <sub>IN</sub> = -20dBV  | -5                 | -3   | -1              | dB               |
|                               |                  | I <sub>L</sub> = 120mA, V <sub>IN</sub> = -20dBV | -9.5               | -7.5 | -5.5            | dB               |
| DTMF gain                     | G <sub>MF</sub>  | I <sub>L</sub> = 20mA, V <sub>IN</sub> = -30dBV  | 19.5               | 21.5 | 23.5            | dB               |
|                               |                  | I <sub>L</sub> = 120mA, V <sub>IN</sub> = -30dBV | 17                 | 19   | 21              | dB               |
| KTI gain                      | G <sub>KT</sub>  | I <sub>L</sub> = 20mA, V <sub>IN</sub> = -40dBV  | 12                 | 14   | 16              | dB               |
|                               |                  | I <sub>L</sub> = 120mA, V <sub>IN</sub> = -40dBV | 14                 | 16   | 18              | dB               |
| Transmitting dynamic range    | DR <sub>T</sub>  | I <sub>L</sub> = 20mA, THD = 4%                  | 2.5                |      |                 | V <sub>P,P</sub> |
|                               |                  | I <sub>L</sub> = 120mA, THD = 4%                 | 4.5                |      |                 | V <sub>P,P</sub> |
| Receiving dynamic range       | DR <sub>R</sub>  | I <sub>L</sub> = 20mA, THD = 10%                 | 0.3                |      |                 | V <sub>P,P</sub> |
|                               |                  | I <sub>L</sub> = 120mA, THD = 10%                | 0.5                |      |                 | V <sub>P,P</sub> |
| DTMF input impedance          | Z <sub>MF</sub>  |  | 20                 |      | kΩ              |                  |
| KTI input impedance           | Z <sub>KT</sub>  |  | 24                 |      | kΩ              |                  |
| Mute input "H" level voltage  | V <sub>IH</sub>  | I <sub>L</sub> = 20mA to 120mA                   | V <sub>CC</sub> /2 |      | V <sub>CC</sub> | V                |
| Mute input "L" level voltage  | V <sub>IL</sub>  | I <sub>L</sub> = 20mA to 120mA                   | 0                  |      | 0.2             | V                |
| Transmitting PADC attenuation | Δ G <sub>T</sub> | I <sub>L</sub> = 30mA, 24kΩ ground               |                    | 3    |                 | dB               |
| Receiving PADC attenuation    | Δ G <sub>R</sub> | I <sub>L</sub> = 30mA, 24kΩ ground               |                    | 6    |                 | dB               |
| Internal reference voltage    | V <sub>REF</sub> | I <sub>L</sub> = 20mA                            |                    | 0.65 |                 | V                |
|                               |                  | I <sub>L</sub> = 50mA                            |                    | 1.13 |                 | V                |
|                               |                  | I <sub>L</sub> = 120mA                           |                    | 2.25 |                 | V                |

### [Audio signal processing]

|                                |                  |  |     |      |     |       |
|--------------------------------|------------------|--|-----|------|-----|-------|
| Quiescent current              | I <sub>CCO</sub> |  | 10  | 21   | 30  | mA    |
| <PRE AMP>                      |                  |  |     |      |     |       |
| Voltage gain                   | V <sub>GC</sub>  | -48dBV input between pins 8 - 27                     | 37  | 39   | 41  | dB    |
| Total harmonic distortion      | THD              | -30dBV input between pins 8 - 27                     |     | 0.25 | 1.0 | %     |
| ALC saturation output level    | V <sub>OS</sub>  | -30dBV input between pins 8 - 27                     | 430 | 530  | 630 | mVrms |
| ALC range                      | ALCW             | After ALC is on and until THD becomes 1%             | 35  | 40   |     | dB    |
| Equivalent input noise voltage | V <sub>NI</sub>  | Number 8 pin shorts (in terms of AC), 20 Hz - 20 kHz |     | 2.0  | 5   | μVrms |

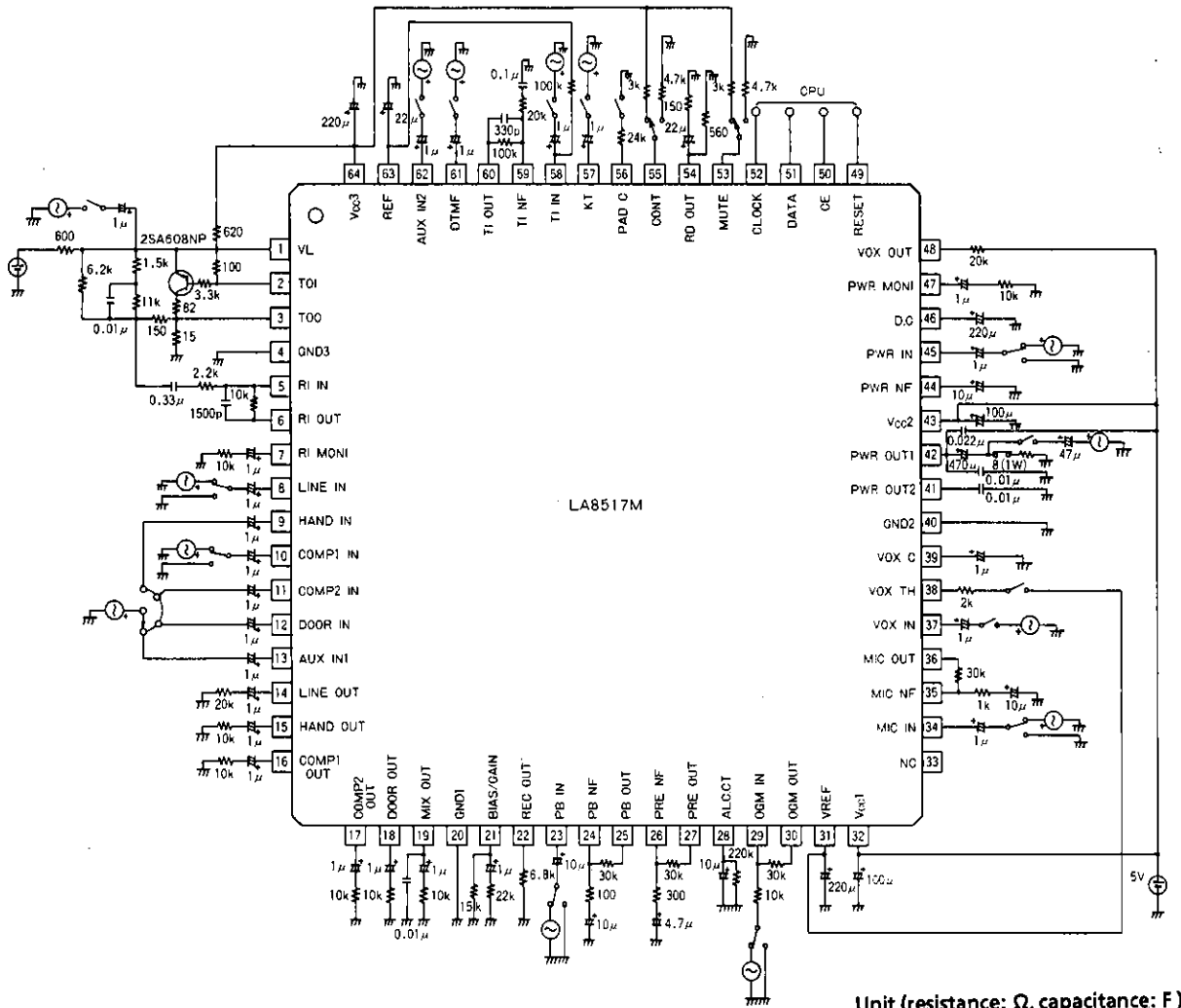
Continued on next page.

Equivalent Circuit Block Diagram and Peripheral Circuits



- |               |               |              |             |
|---------------|---------------|--------------|-------------|
| 1. VL         | 17. COMP2 OUT | 33. NC       | 49. RESET   |
| 2. TOI        | 18. DOOR OUT  | 34. MIC IN   | 50. CE      |
| 3. T00        | 19. MIX OUT   | 35. MIC NF   | 51. DATA    |
| 4. GND3       | 20. GND1      | 36. MIC OUT  | 52. CLOCK   |
| 5. RI IN      | 21. BIAS/GAIN | 37. VOX IN   | 53. MUTE    |
| 6. RI OUT     | 22. REC OUT   | 38. VOX TH   | 54. RD OUT  |
| 7. RI MONI    | 23. PB IN     | 39. VOX C    | 55. CONT    |
| 8. LINE IN    | 24. PB NF     | 40. GND2     | 56. PAD C   |
| 9. HAND IN    | 25. PB OUT    | 41. PWR OUT2 | 57. KT      |
| 10. COMP1 IN  | 26. PRE NF    | 42. PWR OUT1 | 58. TI IN   |
| 11. COMP2 IN  | 27. PRE OUT   | 43. Vcc2     | 59. TI NF   |
| 12. DOOR IN   | 28. ALC CT    | 44. PWR NF   | 60. TI OUT  |
| 13. AUX IN1   | 29. OGM IN    | 45. PWR IN   | 61. DTMF    |
| 14. LINE OUT  | 30. OGM OUT   | 46. D.C      | 62. AUX IN2 |
| 15. HAND OUT  | 31. VREF      | 47. PWR MONI | 63. REF     |
| 16. COMP1 OUT | 32. Vcc1      | 48. VOX OUT  | 64. Vcc3    |

Test Circuit



Unit (resistance: Ω, capacitance: F)

Description of Pin Functions

Unit (resistance: Ω)

| Pin Number | Pin Name       | Internal Equivalent Circuit | Pin Description  |
|------------|----------------|-----------------------------|--|
| 1          | V <sub>L</sub> |                             | Input pin for Loop current and Line voltage.   |
| 2          | TOI            |                             | Inlet pin for transmitting output current.   |
| 3          | TOO            |                             | Transmitting output current output pin   |
| 4          | GND3           |                             | Speech network system ground (GND) pin.  |
| 5          | RI IN          |                             | Receiving input amplifier negative (-) input pin. Permits adjustments of gain and frequency performance using externally connected components. |
| 6          | RI OUT         |                             | Receiving input amplifier output pin.  |

Continued on next page.

LA8517M

Continued from preceding page.

Unit (resistance:  $\Omega$ )

| Pin Number | Pin Name  | Internal Equivalent Circuit | Pin Description  |
|------------|-----------|-----------------------------|--|
| 7          | RI MONI   |                             | Receiving input monitor amplifier output pin.  |
| 8          | LINE IN   |                             | Line input pin.  |
| 9          | HAND IN   |                             | Handset input pin.   |
| 10         | COMP1 IN  |                             | Compandor 1 input pin.   |
| 11         | COMP2 IN  |                             | Compandor 2 input pin.   |
| 12         | DOOR IN   |                             | Door phone input pin.  |
| 13         | AUX IN1   |                             | Auxiliary input pin.   |
| 14         | LINE OUT  |                             | Line output pin.   |
| 15         | HAND OUT  |                             | Handset output pin.  |
| 16         | COMP1 OUT |                             | Compandor 1 output pin.  |
| 17         | COMP2 OUT |                             | Compandor 2 output pin.  |
| 18         | DOOR OUT  |                             | Door phone output pin.   |
| 19         | MIX OUT   |                             | Mixing output pin.   |
| 20         | GND1      |                             | Signal processing ground (GND) pin.  |
| 21         | BIAS/GAIN |                             | Bias pin. Supports control of recording amplifier gain and recording bias using external resistor. |
| 22         | REC OUT   |                             | Recording amplifier output pin.  |

Continued on next page.

LA8517M

Continued from preceding page.

Unit (resistance:  $\Omega$ )

| Pin Number | Pin Name  | Internal Equivalent Circuit | Pin Description                                       |
|------------|-----------|-----------------------------|---|
| 23         | PB IN     |                             | PB amplifier positive (+) input pin.                  |
| 24         | PB NF     |                             | PB amplifier negative (-) input pin.                  |
| 26         | PRE NF    |                             | Preamplifier negative (-) input pin.                  |
| 34         | MIC IN    |                             | Microphone amplifier positive (+) input pin.          |
| 35         | MIC NF    |                             | Microphone amplifier negative (-) input pin.          |
| 25         | PB OUT    |                             | PB amplifier output pin.                              |
| 27         | PRE OUT   |                             | Preamplifier output pin.                              |
| 36         | MIC OUT   |                             | Microphone amplifier output pin.                      |
| 28         | ALC. CT   |                             | ALC time constant connection pin.                     |
| 29         | OGM IN    |                             | Outgoing message (OGM) signal negative (-) input pin. |
| 30         | OGM OUT   |                             | Outgoing message (OGM) signal output pin.             |
| 31         | $V_{REF}$ |                             | Internal reference voltage output pin.                |
| 32         | $V_{CC1}$ |                             | Signal processing power supply pin.                   |
| 33         | N. C.     |                             | No connection (NC).                                   |

Continued on next page.

LA8517M

Continued from preceding page.

Unit (resistance:  $\Omega$ )

| Pin Number | Pin Name  | Internal Equivalent Circuit | Pin Description   |
|------------|-----------|-----------------------------|---|
| 37         | VOX IN    |                             | Voice detection (VOX) positive (+) input pin.   |
| 38         | VOX TH    |                             | Voice detection (VOX) sensitivity adjustment pin. Adjusts VOX sensitivity using connection to $V_{REF}$ (pin 31) with resistor located between. |
| 39         | VOX. C    |                             | Voice detection (VOX) output pin.   |
| 40         | GND2      |                             | Power system ground (GND) pin.  |
| 41         | PWR OUT2  |                             | Power amplifier 2 output pin (inverted).  |
| 42         | PWR OUT1  |                             | Power amplifier 1 output pin (non-inverted).  |
| 44         | PWR NF    |                             | Power amplifier negative (-) input pin.   |
| 45         | PWR IN    |                             | Power amplifier positive (+) input pin.   |
| 46         | D. C      |                             | Power amplifier reference voltage output pin (approximately $4/9 \times V_{CC2}$ ).   |
| 43         | $V_{CC2}$ |                             | Power system power supply pin.  |
| 47         | PWR MONI  |                             | Power amplifier output pin.   |
| 48         | VOX       |                             | Voice detection (VOX) output pin, open-collector (O/C).   |
| 49         | RESET     |                             | Reset pin. Resets with "L".   |
| 50         | CE        |                             | Chip enable input pin.  |
| 51         | DATA      |                             | Data input pin.   |
| 52         | CLOCK     |                             | Clock Input pin.  |

Continued on next page.



Continued from preceding page.

Unit (resistance:  $\Omega$ )

| Pin Number | Pin Name | Internal Equivalent Circuit | Pin Description  |
|------------|----------|-----------------------------|--|
| 53         | MUTE     |                             | <p>Mute pin. Changes receiving signal, KT signal of receiving system and transmitting signal as well as DTMF signal of transmitting system.</p> <p>"H": Call settings<br/>                     "L": DTMF transmitting, KT receiving output</p> |
| 55         | CONT     |                             | <p>Control pin. When set to "L", signal input from AUX IN2 (pin 62) becomes transmitting output.</p>   |
| 54         | RD OUT   |                             | <p>Receiving output pin. Connected to low impedance telephone receiver (approximately <math>150\Omega</math>) through capacitor.</p>   |
| 56         | PADC     |                             | <p>PAD control pin. The value of the resistor between this pin and either the <math>V_{CC3}</math> (pin 64) or <math>GND3</math> (pin 4) determines the shape of the Loop-current vs. gain control (auto PAD) characteristics.</p>             |
| 57         | KT       |                             | <p>Key tone input. The input signal switches to receiving output when the MUTE pin (pin 53) is set to "L" for low.</p>   |
| 58         | TI IN    |                             | <p>Transmitting input amplifier positive (+) input pin.</p>  |
| 59         | TI NF    |                             | <p>Transmitting input amplifier negative (-) input pin.</p>  |
| 60         | TI OUT   |                             | <p>Transmitting input amplifier output pin.</p>  |
| 61         | DTMF     |                             | <p>DTMF input pin. The input signal becomes transmitting output when the MUTE pin (pin 53) is set to "L" for low.</p>  |

Continued on next page.

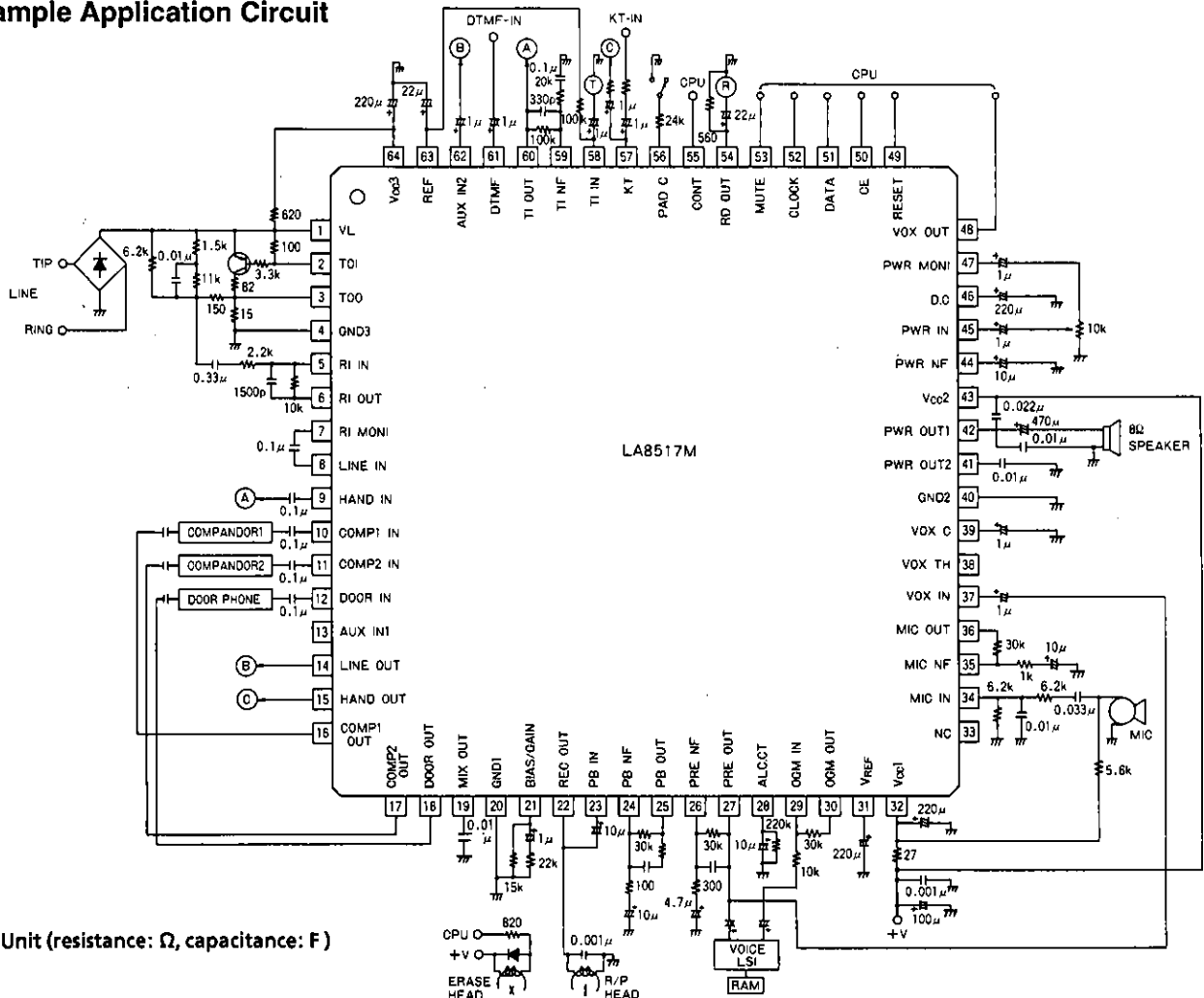
# LA8517M

Continued from preceding page.

Unit (resistance:  $\Omega$ )

| Pin Number | Pin Name | Internal Equivalent Circuit | Pin Description  |
|------------|----------|-----------------------------|--|
| 62         | AUX IN2  |                             | Auxiliary input pin. The input signal switches to transmitting output when the CONT pin (pin 55) is set to "L" for low.  |
| 63         | REF      |                             | Internal reference voltage output pin. Should not be used as an external power supply source.  |
| 64         | Vcc3     |                             | Internal power supply pin. Internal circuit power supply voltage. Should not be used as an external power supply source other than for MUTE pin and CONT pin "H" (high) level voltage. |

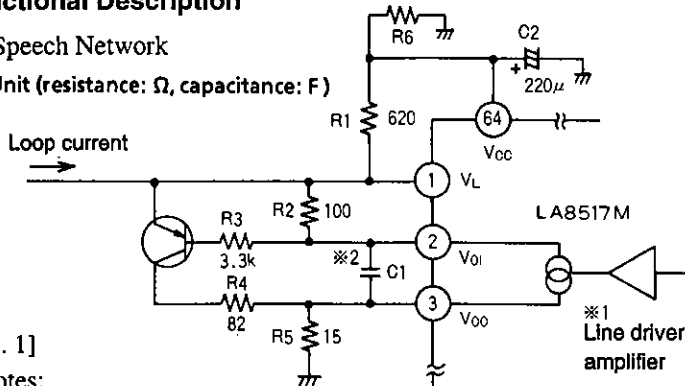
## Sample Application Circuit



**Functional Description**

1) Speech Network

Unit (resistance:  $\Omega$ , capacitance: F)



[Fig. 1]

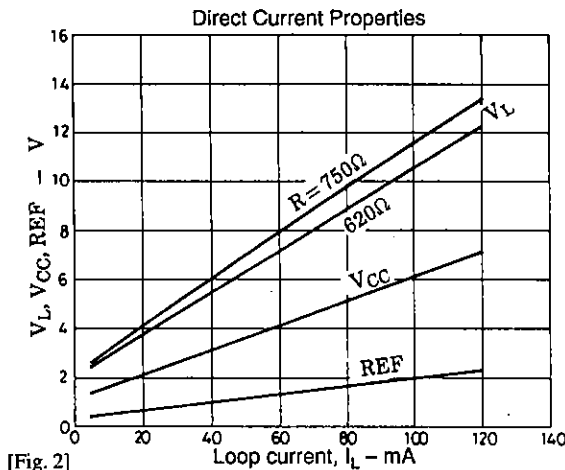
Notes:

- \*1. The line driver amplifier absorbs transmitting signal delivery and direct current.
- \*2. In cases of oscillation caused by load conditions existing between  $V_L$  and GND, a 0.1  $\mu$ F rated capacitor should be installed.

Since the LA8517 is equipped with a built-in power amplifier, a surface mount transistor for the allowable demand should be attached as shown in figure 1 so that loop current is consumed outside the IC. Loop current flowing to the transistor can be controlled by varying the R3 base resistor. R4 and R5 allowable electrical power setting reflects the maximum current requirements of the expected loop current.

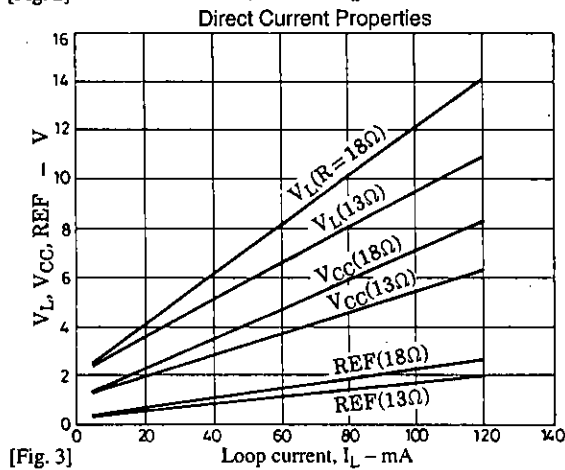
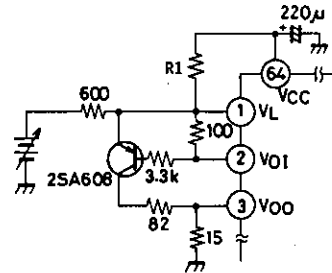
• **Modifying Direct Current Resistance**

Unit (resistance:  $\Omega$ , capacitance: F)



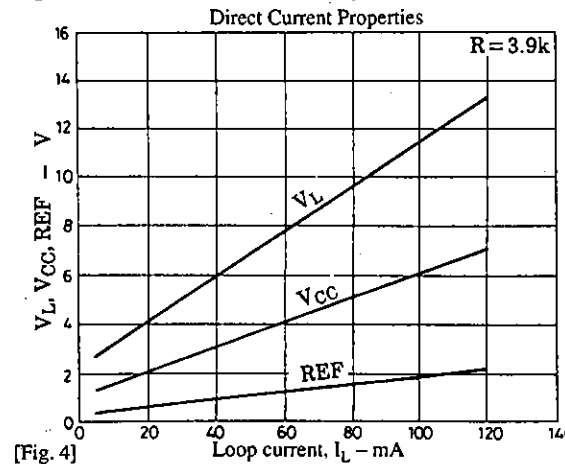
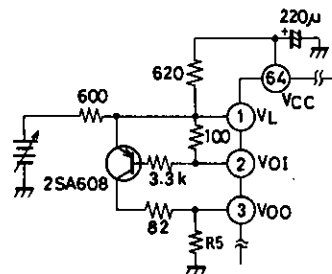
[Fig. 2]

- ① By varying R1 (620 $\Omega$ ), direct current resistance can be modified as shown in figure 2. Under such circumstances, the alternating current impedance is also changed.



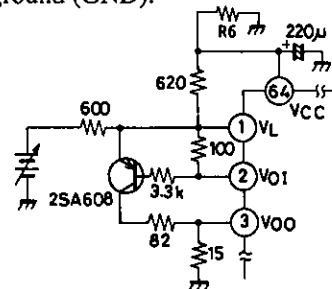
[Fig. 3]

- ② By varying R5 (15 $\Omega$ ), direct current resistance can be modified as shown in figure 3. Under such circumstances, BN (balancing network) conditions and transmitting gain are also changed.

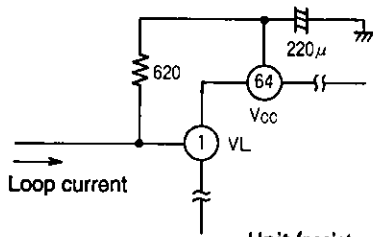


[Fig. 4]

- ③ Direct current resistance can also be altered, as shown in figure 4, by establishing a connection from the  $V_{CC}$  pin (pin 64) through an R6 to the ground (GND).



• Setting Alternating Current Impedance

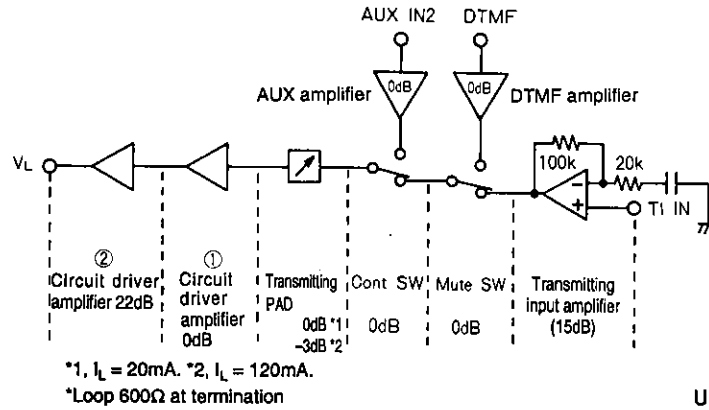


Alternating current impedance is fundamentally decided according to  $620\Omega$   $220\mu\text{F}$ . In practice, because current loads, other than those of the speech network, enter from the line, alternating current impedance is synthetically adjusted to match the impedance of the speech network.

Unit (resistance:  $\Omega$ , capacitance: F)

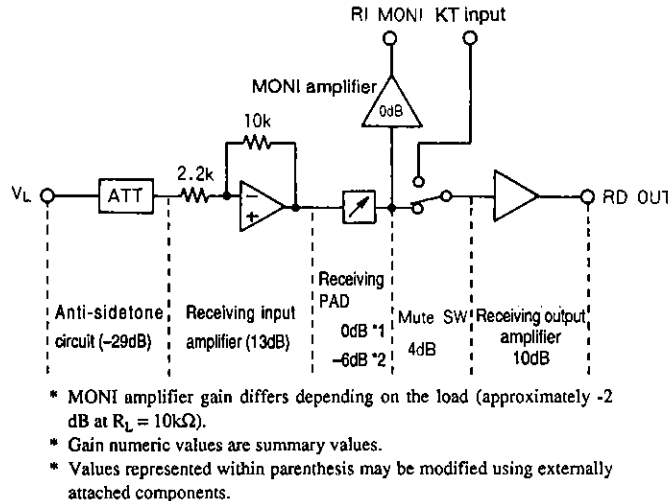
Gain Allocation

① Transmitting Gain Allocation



Unit (resistance:  $\Omega$ )

② Receiving Gain Allocation



Unit (resistance:  $\Omega$ )

• Gain Control Circuit (PADC pin)

① PADC pin open (auto PAD)

Loop current capacity which supports transmitting and receiving gain is automatically adjusted. When transmitting is approximately  $-3\text{dB}$  and when receiving is approximately  $-6\text{dB}$ , attenuation follows the increase of loop current.

② PADC pin connected to ground (GND) using resistor

Gain attenuation begins using a loop current capacity which is lesser than when the PADC pin is open.

③ PADC pin connected to  $V_{CC}$  using resistor

Gain attenuation begins using a loop current capacity which is greater than when the PADC pin is open.

• Receiving Amplifier

Uses a dynamic receiver.

2) Signal Processing

• ALC

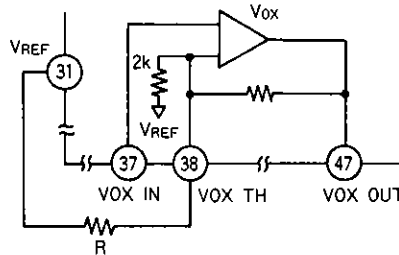
ALC operates with input ranging between approximately  $-45\text{dBV}$  to  $-5\text{dBV}$ . ALC saturation power level is approximately  $500\text{ mVrms}$ .

• V/I Conversion

V/I conversion is made to draw the recording current for DC bias. The conversion gain and bias current can be controlled using an external resistor connected to pin 21. DC equalling pin 21 DC output is output from pin 22.

• VOX

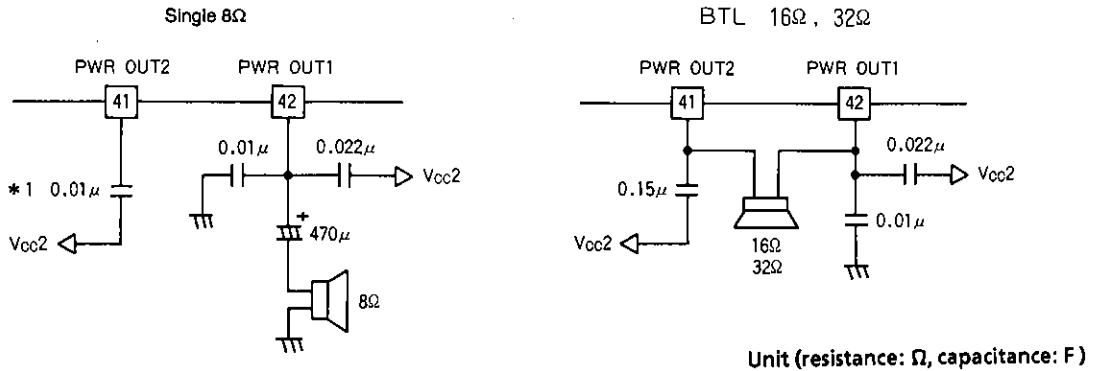
Detects the presence or absence of a call. When the VOX input pin (pin 37) signal is  $-24\text{dB}$  or greater, the VOX output pin (pin 47) switches to "L" for low. Detection level adjustments may be performed by installing an R resistor between VOX TH (pin 38) and  $V_{\text{REF}}$  (pin 31) as shown in the following figure.



Unit (resistance:  $\Omega$ )

3) Power Amplifier

• Oscillation prevention Capacitor



Unit (resistance:  $\Omega$ , capacitance: F)

Note: A Mylar capacitor is recommended as a damping capacitor. ( A ceramic capacitor may be use in \* 1.)

• Mute

Under mute conditions, power amplifier output impedance switches to high impedance.

4) Cross-point

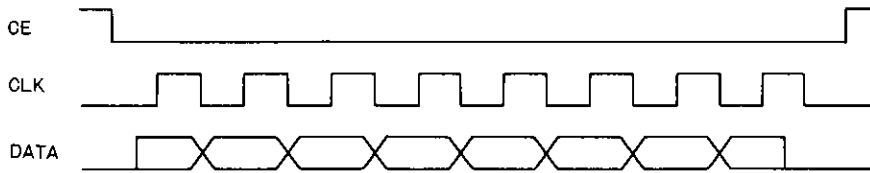
• Mixing

Mixing is possible with MIX OUT only (pin 19).

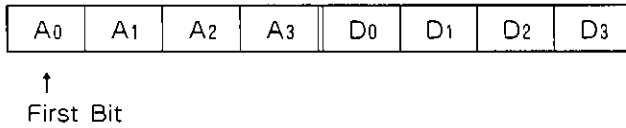
• Line Output Amplifier

Line output amplifier gain becomes approximately  $16\text{dB}$ . When set to  $-6\text{dB}$  using serial control, line output amplifier gain is established at approximately  $10\text{dB}$ .

**Serial Control Input Data Format**



**Serial Data Contents**



- A<sub>3</sub> = 0 ⇒ Displays control data for cross-point switching. At such a time, A<sub>2</sub> through A<sub>0</sub> indicate cross-point switching output addresses.
  - A<sub>3</sub> = 1, A<sub>2</sub> = 0 ⇒ Indicates mixing output control data.
  - A<sub>3</sub> = 1, A<sub>2</sub> = 1 ⇒ Indicates audio signal processing control data.
- Table 1 indicates contents.

| A <sub>3</sub> | A <sub>2</sub> | A <sub>1</sub> | A <sub>0</sub> | Contents          |            |
|----------------|----------------|----------------|----------------|-------------------|------------|
| 0              | 0              | 0              | 0              | Output address 0  | HANDSET    |
| 0              | 0              | 0              | 1              | Output address 1  | COMP 1     |
| 0              | 0              | 1              | 0              | Output address 2  | COMP 2     |
| 0              | 0              | 1              | 1              | Output address 3  | DOOR PHONE |
| 0              | 1              | 0              | 0              | Output address 4  | PRE AMP    |
| 0              | 1              | 0              | 1              | Output address 5  | LINE       |
| 0              | 1              | 1              | 0              | Output address 6  | POWER      |
| 1              | 0              | 0              | 0              | Output address 7A | MIXING OUT |
| 1              | 0              | 0              | 1              | Output address 7B | MIXING OUT |
| 1              | 1              | *              | *              | CONTROL DATA      |            |

\* : don't care

[Table 1]

D<sub>3</sub>toD<sub>0</sub>: Input addresses for cross-point switching control data are shown in table 2. Table 3 shows address assignments for mixing output control data. On/off settings for all controls are indicated in table 4 for audio signal processing control data.

| D <sub>3</sub> | D <sub>2</sub> | D <sub>1</sub> | D <sub>0</sub> | Contents         |                                       |
|----------------|----------------|----------------|----------------|------------------|---------------------------------------|
| 0              | 0              | 0              | 0              | ALL OFF          |                                       |
| 0              | 0              | 0              | 1              | Input address 1  | LINE                                  |
| 0              | 0              | 1              | 0              | Input address 2  | HANDSET                               |
| 0              | 0              | 1              | 1              | Input address 3  | COMP 1                                |
| 0              | 1              | 0              | 0              | Input address 4  | COMP 2                                |
| 0              | 1              | 0              | 1              | Input address 5  | DOOR PHONE                            |
| 0              | 1              | 1              | 0              | Input address 6  | AUX                                   |
| 0              | 1              | 1              | 1              | Input address 7  | MIC                                   |
| 1              | 0              | 0              | 0              | Input address 8  | OGM                                   |
| *              | 0              | 0              | 1              | Input address 9  | PRE (Used only with output address 6) |
| *              | 0              | 1              | 0              | Input address 10 | MIX (Used only with output address 5) |

\* : don't care

[Table 2]

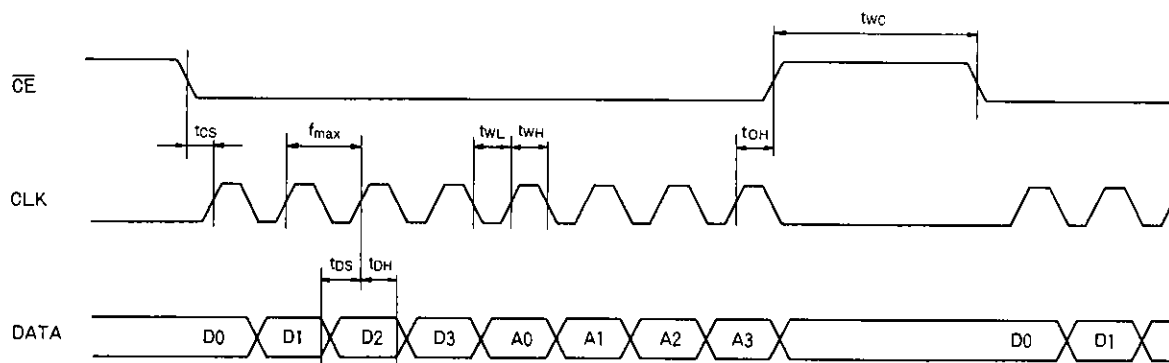
| Item           | Contents                |                            |
|----------------|-------------------------|----------------------------|
|                | Output Address 7-A      | Output Address 7-B         |
| D <sub>0</sub> | Input address 1 LINE    | Input address 5 DOOR PHONE |
| D <sub>1</sub> | Input address 2 HANDSET | Input address 6 AUX        |
| D <sub>2</sub> | Input address 3 COMP 1  | Input address 7 MIC        |
| D <sub>3</sub> | Input address 4 COMP 2  | Input address 8 OGM        |

[Table 3]

| Item           | Contents       |           |            |
|----------------|----------------|-----------|------------|
|                | A <sub>1</sub> | LINE -6dB | 1: On      |
| D <sub>0</sub> | ALC            | 1: On     | 0: Off     |
| D <sub>1</sub> | PB             | 1: On     | 0: Off     |
| D <sub>2</sub> | REC            | 1: On     | 0: Off     |
| D <sub>3</sub> | POWER AMP MUTE | 1: Mute   | 0: Release |

[Table 4]

### Input Address Port Timing



- f<sub>max</sub> (Maximum clock frequency) 500kHz
- t<sub>WL</sub> (Clock pulse width "L") 250ns or more
- t<sub>WH</sub> (Clock pulse width "H") 250ns or more
- t<sub>CS</sub> (Chip enable setup time) 200ns or more
- t<sub>CH</sub> (Chip enable hold time) 400ns or more
- t<sub>DS</sub> (Data setup time) 250ns or more
- t<sub>DH</sub> (Data hold time) 250ns or more
- t<sub>WC</sub> (Chip enable pulse width) 400ns or more

### Proper Care for IC Applications

#### 1) PCB

During PCB manufacturing, the ground (GND) line of pin 20 becomes thicker and shorter. When common impedance is applied, problems may occur due to distorted coefficients.

- 2) If the IC is used in the vicinity of the maximum rating, even a slight variation in conditions may cause the maximum rating to be exceeded, thereby leading to a breakdown. Allow an ample margin of variation in such areas as supply voltage and use the IC in a range where the maximum rating will not be exceeded.

#### 3) Shorting Between Pins

If the power supply is applied when the space between pins is shorted, a breakdown or deterioration may occur. When installing the IC on the board or applying the supply voltage, make sure that the space between pins is not shorted with solder or by other means.

#### 4) Load Shorting

If the IC is used with the load shorted for a long time, a breakdown or deterioration may occur. Be sure not to short the load.

## Serial Control Mode

The following table indicate basic modes.

| Mode   | Serial Data    |                |                |                |                |                |                |                | Notes  |
|--|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--|
|  | A <sub>0</sub> | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | D <sub>0</sub> | D <sub>1</sub> | D <sub>2</sub> | D <sub>3</sub> |  |
| ICM REC  | 0              | 0              | 1              | 0              | 1              | 0              | 0              | 0              | Input is set to LINE while output sets to PRE.   |
|  | 0              | 1              | 1              | 0              | 1              | 0              | 0              | *              | Input is set to PRE while output sets to PWR.    |
|  | *              | *              | 1              | 1              | 1              | 0              | 1              | 0              | ALC and REC are on.                              |
| 2 WAY REC  | 0              | 0              | 1              | 0              | 1              | 0              | 0              | 0              | Input is set to LINE while output sets to PRE.   |
|  | *              | *              | 1              | 1              | 1              | 0              | 1              | 0              | ALC and REC are on.                              |
| DECT REC   | 0              | 0              | 1              | 0              | 1              | 1              | 1              | 0              | Input is set to MIC while output sets to PRE.    |
|  | *              | *              | 1              | 1              | 1              | 0              | 1              | 0              | ALC and REC are on.                              |
| 2 WAY BEEP   | 0              | 1              | 1              | 0              | 0              | 0              | 0              | 1              | Input is set to OGM while output sets to PWR.    |
|  | 0              | 0              | 1              | 0              | 0              | 0              | 0              | 1              | Input is set to OGM while output sets to PRE.    |
|  | 1              | 0              | 1              | 0              | 0              | 0              | 0              | 1              | Input is set to OGM while output sets to LINE.   |
|  | *              | *              | 1              | 1              | 1              | 0              | 1              | 0              | ALC and REC are on.                              |
| ICM OUT  | *              | 1              | 1              | 1              | 0              | 0              | 0              | 0              | LINE Amp -6dB                                    |
|  | 0              | 1              | 1              | 0              | 0              | 0              | 0              | 1              | Input is set to OGM while output sets to PWR.    |
|  | 1              | 0              | 1              | 0              | 0              | 0              | 0              | 1              | Input is set to OGM while output sets to LINE.   |
|  | *              | *              | 1              | 1              | 0              | 1              | 0              | 0              | PB ON  |
| ICM PLAY   | 0              | 1              | 1              | 0              | 0              | 0              | 0              | 1              | Input is set to OGM while output sets to PWR.    |
|  | *              | *              | 1              | 1              | 0              | 1              | 0              | 0              | PB ON  |
| OGM REC  | 0              | 0              | 1              | 0              | 1              | 1              | 1              | 0              | Input is sets to MIC while output sets to PRE.   |
|  | *              | *              | 1              | 1              | 1              | 0              | 0              | 0              | ALC ON   |
| OGM CHANGE   | 0              | 0              | 1              | 0              | 1              | 0              | 0              | 0              | Input is set to LINE while output sets to PRE.   |
|  | 0              | 1              | 1              | 0              | 1              | 0              | 0              | *              | Input is set to PRE while output sets to PWR.    |
|  | *              | *              | 1              | 1              | 1              | 0              | 0              | 0              | ALC ON   |
| OGM OUT  | 0              | 1              | 1              | 0              | 0              | 0              | 0              | 1              | Input is set to OGM while output sets to PWR.    |
|  | 1              | 0              | 1              | 0              | 0              | 0              | 0              | 1              | Input is set to OGM while output sets to LINE.   |
| OGM PLAY   | 0              | 1              | 1              | 0              | 0              | 0              | 0              | 1              | Input is set to OGM while output sets to PWR.    |
| ROOM MONI  | 1              | 0              | 1              | 0              | 1              | 1              | 1              | 0              | Input is set to MIC while output sets to LINE.   |
| ROOM OUT   | 0              | 0              | 1              | 0              | 1              | 0              | 0              | 0              | Input is set to LINE while output sets to PRE.   |
|  | 0              | 1              | 1              | 0              | 1              | 0              | 0              | *              | Input is set to PRE while output sets to PWR.    |
| VOICE SELE   | 1              | 0              | 1              | 0              | 0              | 0              | 0              | 1              | Input is set to OGM while output sets to LINE.   |
|  | 0              | 0              | 1              | 0              | 1              | 0              | 0              | 0              | Input is set to LINE while output sets to PRE.   |
|  | 0              | 1              | 1              | 0              | 1              | 0              | 0              | *              | Input is set to PRE while output sets to PWR.    |
| Dialogue REC   | 1              | 0              | 1              | 0              | 0              | 0              | 0              | 1              | Input is set to OGM while output sets to LINE.   |
|  | 0              | 0              | 1              | 0              | 1              | 0              | 0              | 0              | Input is set to LINE while output sets to PRE.   |
|  | *              | *              | 1              | 1              | 1              | 0              | 1              | 0              | ALC and REC are on                               |
| Extension calling<br>(main phone ← →<br>extension phone)                       | 1              | 0              | 0              | 0              | 0              | 1              | 0              | 0              | Input is set to HAND while output sets to COMP1. |
|  | 0              | 0              | 0              | 0              | 1              | 1              | 0              | 0              | Input is set to COMP1 while output sets to HAND. |
| Extension phone →<br>external line (used<br>for accessing an<br>external line) | 1              | 0              | 1              | 0              | 1              | 1              | 0              | 0              | Input is set to COMP1 while output sets to LINE. |
|  | 1              | 0              | 0              | 0              | 1              | 0              | 0              | 0              | Input is set to LINE while output set to COMP1.  |

"1" = High, "0" = Low

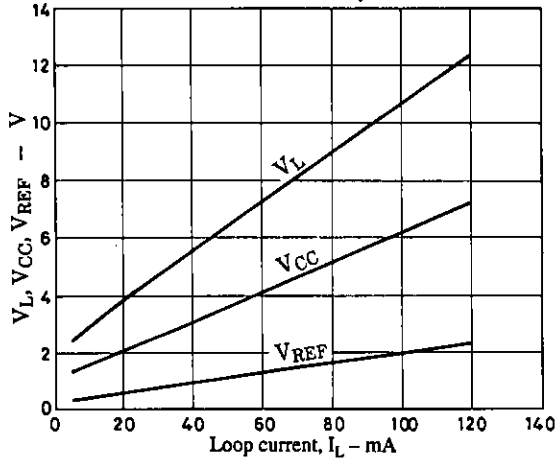
\* : don't care



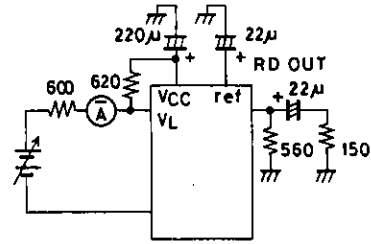
## Mode Description

- 1) ICM REC (Incoming Message Rec.)
  - Incoming message recording.
  - Recording of dictation from distant location (remote-controlled at separate location).
- 2) 2-way REC
  - Recording of both conversations while talking over the telephone.
  - Incoming message recording.
- 3) DICT REC
  - Dictation recording using microphone (records family messages or other messages with limited contents).
- 4) 2-way BEEP
  - Outputs alarm sound to speaker and if recording incoming message (ICM), simultaneously activates line output to also inform caller.
  - Informs caller of recording activity.
  - Line output sets to 6dB for line output of other modes.
- 5) ICM OUT
  - Incoming message playback.
  - Listening to the incoming message using telephone from distant location.
  - Incoming message transfer.
  - Recorded dictation playback.
- 6) ICM PLAY
  - Incoming message playback.
  - Recorded dictation playback.
- 7) OGM REC (Outgoing Message Rec.)
  - Outgoing message recording.
- 8) OGM CHANGE
  - Changing outgoing message from distant location using remote control operations.
- 9) OGM OUT
  - Outgoing message playback.
  - Outgoing message transmitting (with remote control operations, etc.).
- 10) OGM PLAY
  - Outgoing message playback and confirmation.
- 11) ROOM MONI
  - Listening to microphone input using remote control operations from distant location.
- 12) ROOM OUT
  - Generating speaker output such as messages using remote control operations from distant location.
- 13) VOICE SELE
  - Confirming speaker output of other person's voice along with outgoing message transmission.
- 14) Dialog REC
  - Recording incoming message while transmitting outgoing message.

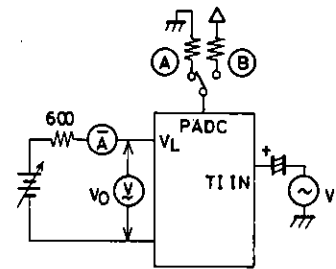
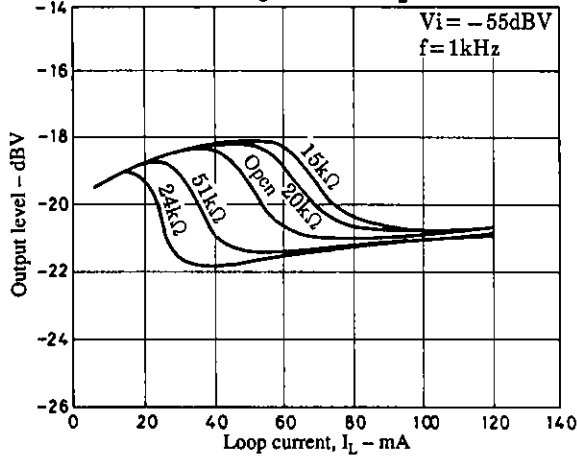
Direct Current Properties



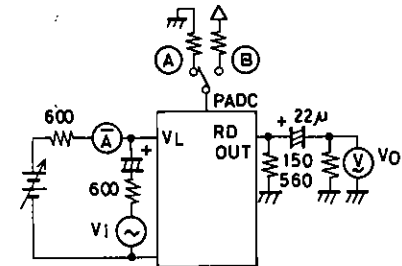
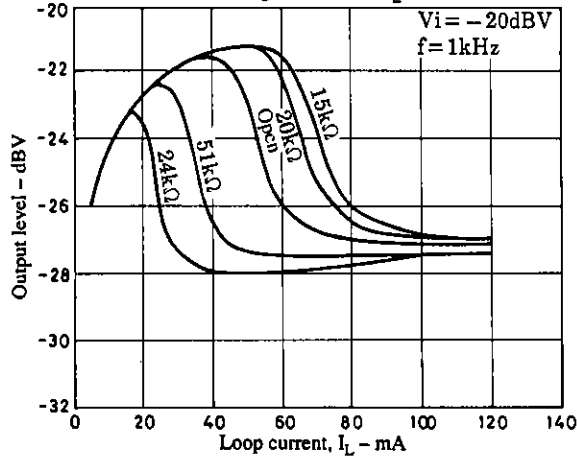
Unit (resistance:  $\Omega$ , capacitance: F)



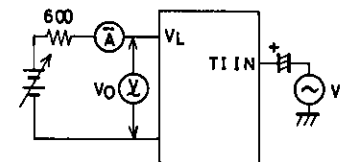
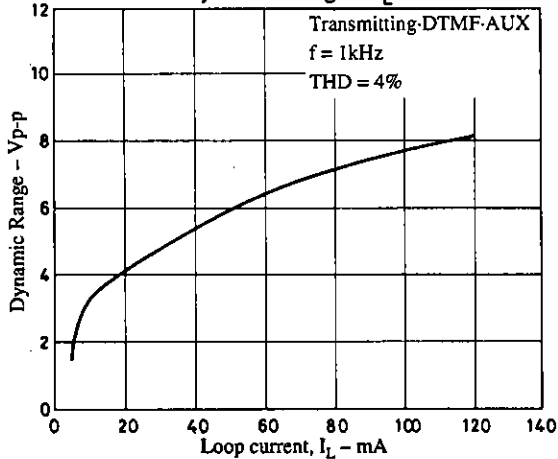
Transmitting Gain -  $I_L$



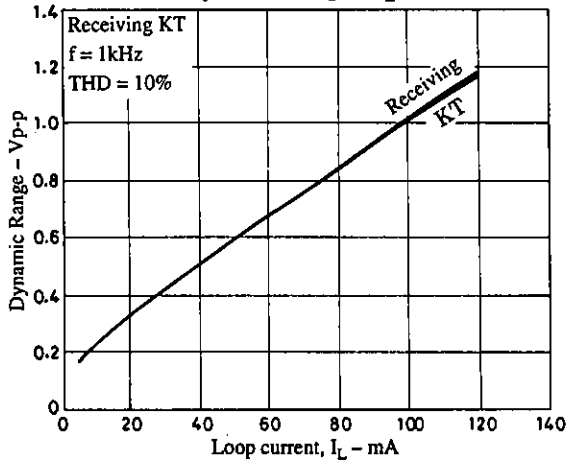
Receiving Gain -  $I_L$



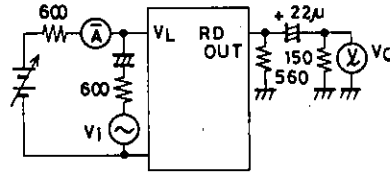
Dynamic Range -  $I_L$



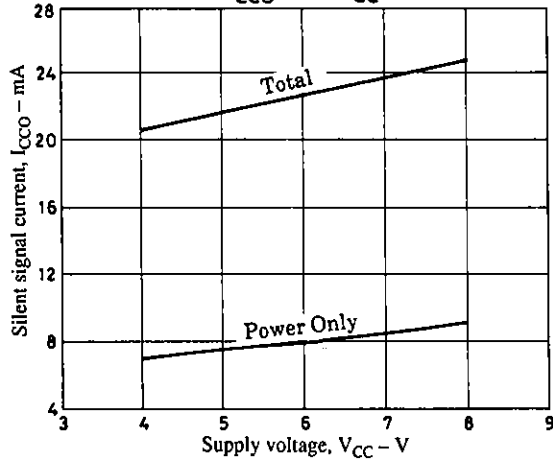
Dynamic Range -  $I_L$



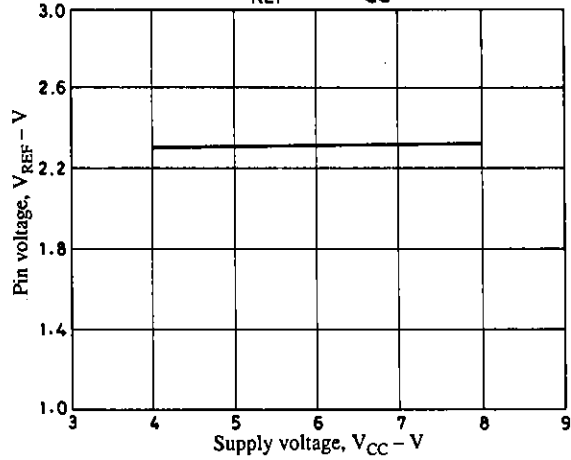
Unit (resistance:  $\Omega$ , capacitance: F)



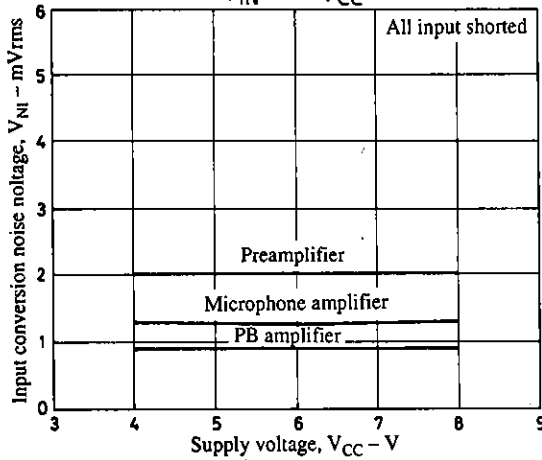
$I_{CCO} - V_{CC}$



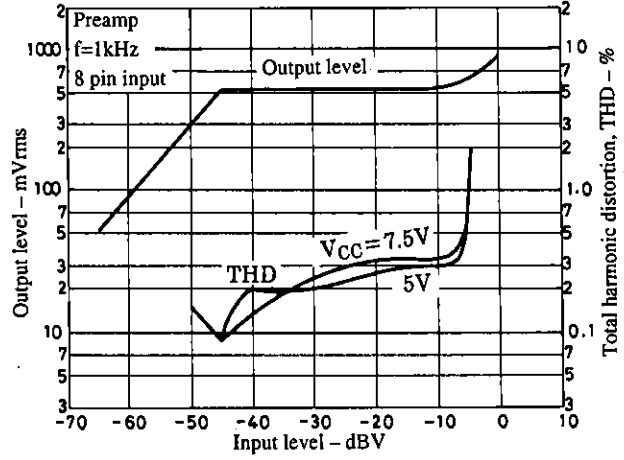
$V_{REF} - V_{CC}$



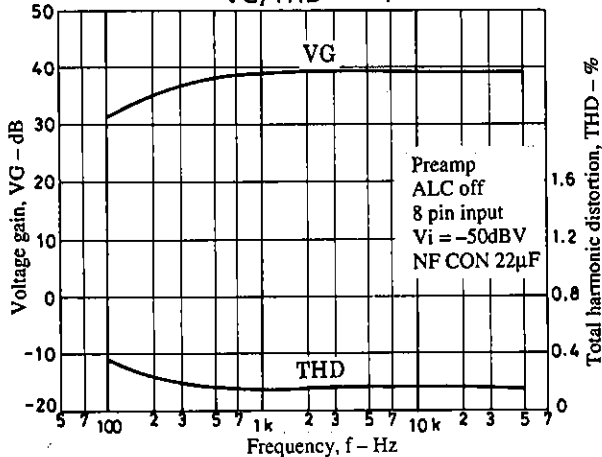
$V_{IN} - V_{CC}$



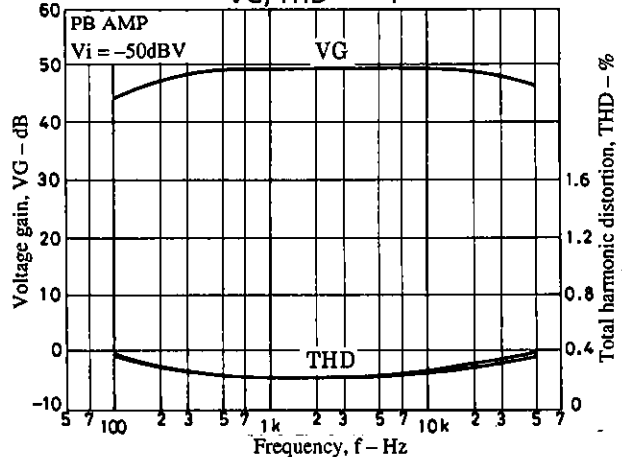
ALC Characteristics

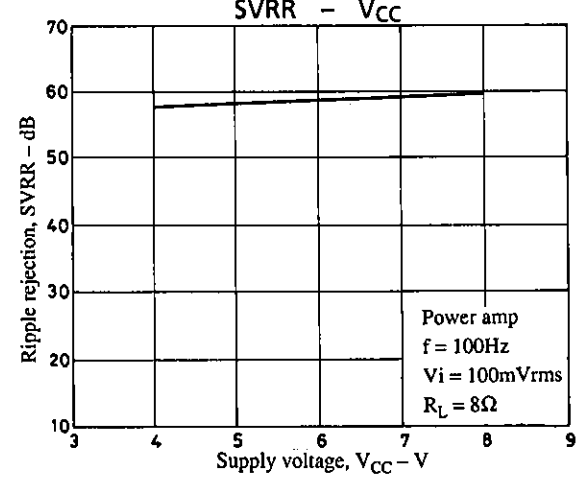
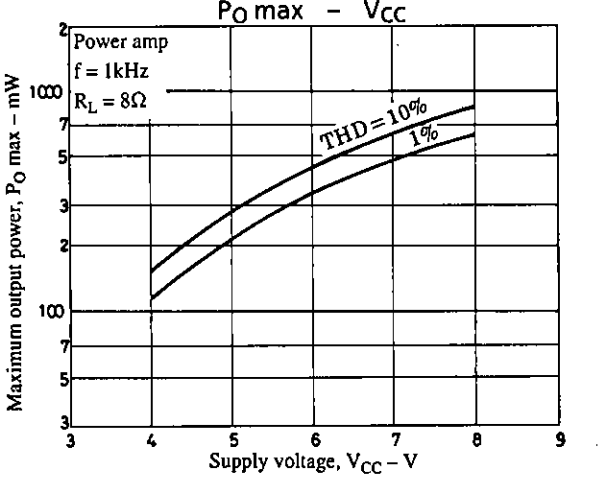
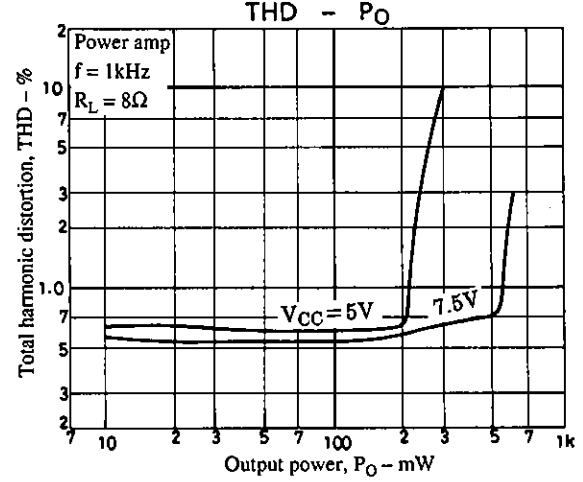
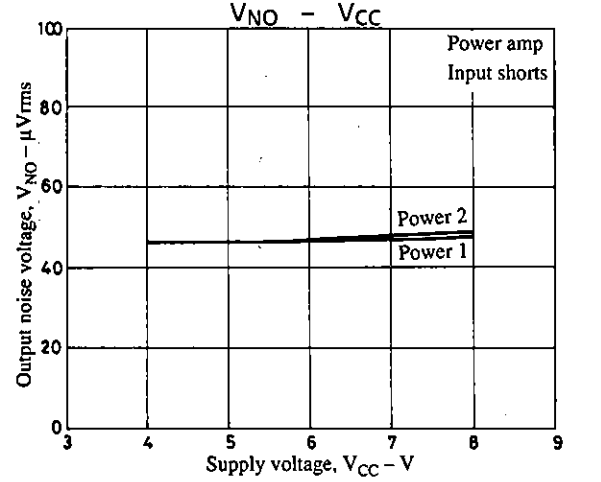
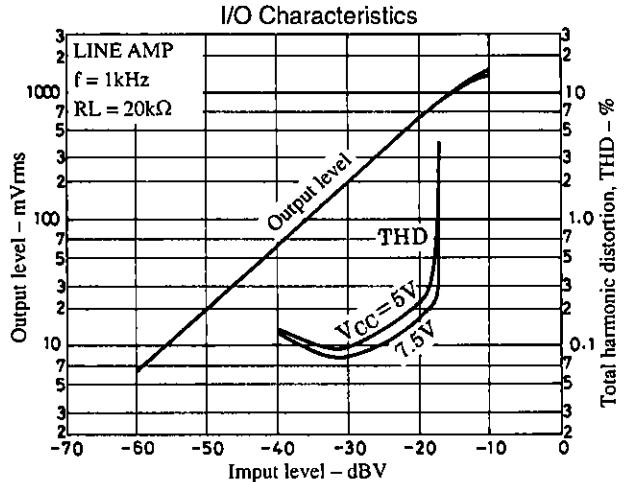
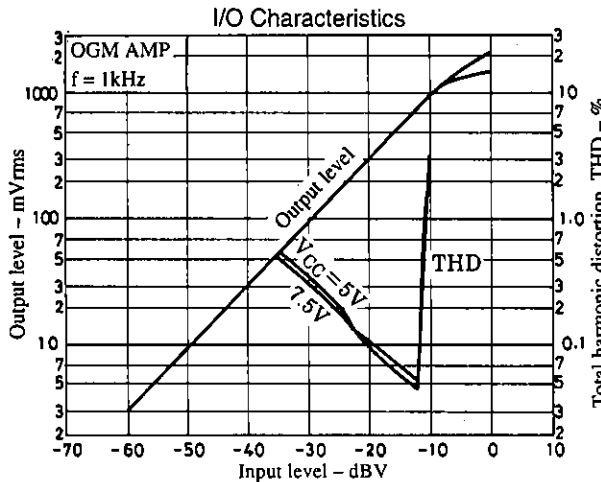
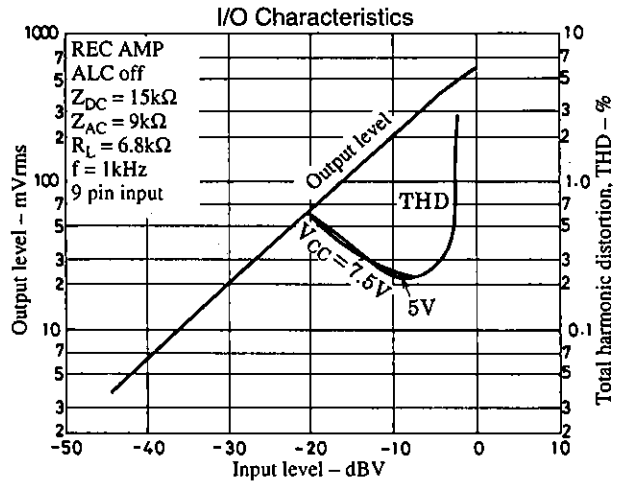
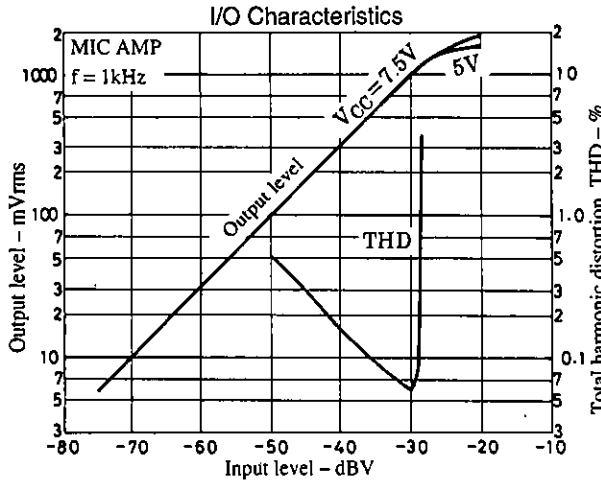


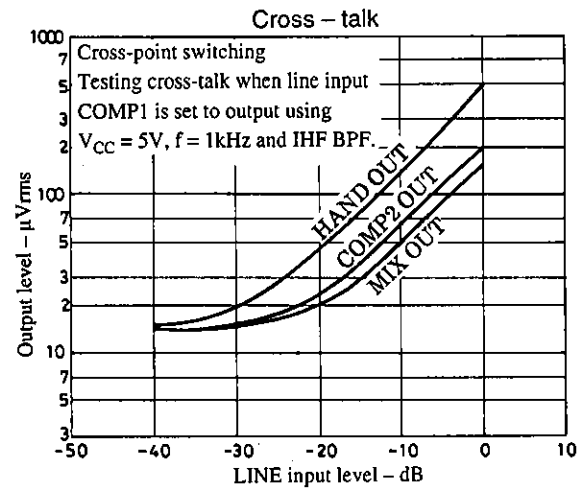
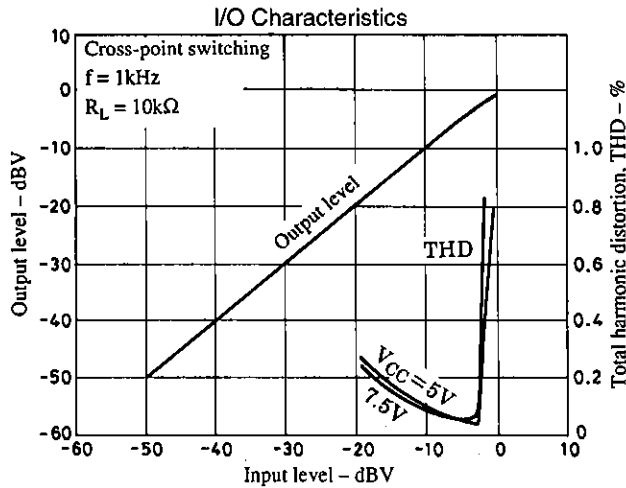
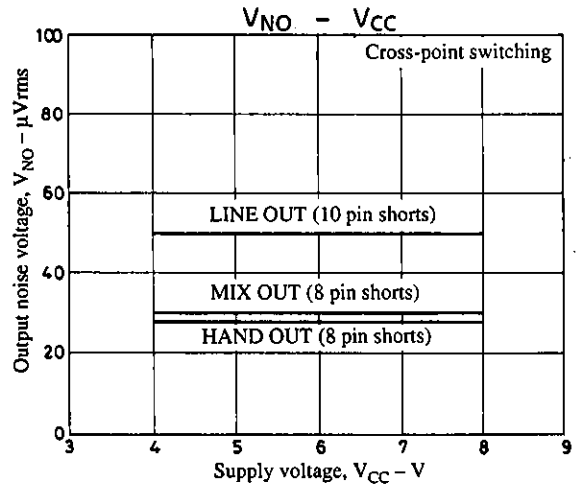
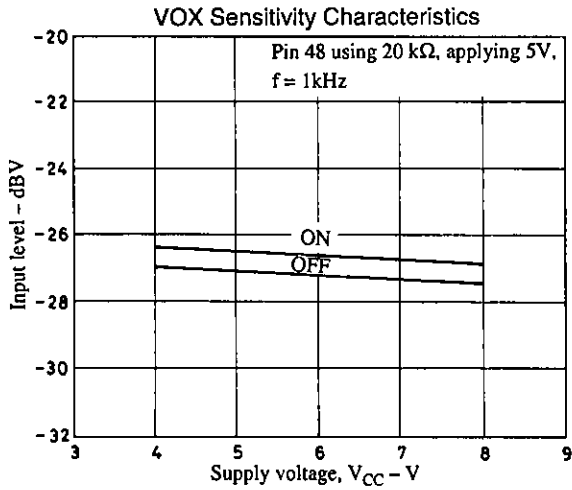
$V_{G, THD} - f$



$V_{G, THD} - f$







■ No products described or contained herein are intended for use in surgical implants, life-support systems, aerospace equipment, nuclear power control systems, vehicles, disaster/crime-prevention equipment and the like, the failure of which may directly or indirectly cause injury, death or property loss.

■ Anyone purchasing any products described or contained herein for an above-mentioned use shall:

- ① Accept full responsibility and indemnify and defend SANYO ELECTRIC CO., LTD., its affiliates, subsidiaries and distributors and all their officers and employees, jointly and severally, against any and all claims and litigation and all damages, cost and expenses associated with such use:
- ② Not impose any responsibility for any fault or negligence which may be cited in any such claim or litigation on SANYO ELECTRIC CO., LTD., its affiliates, subsidiaries and distributors or any of their officers and employees jointly or severally.

■ Information (including circuit diagrams and circuit parameters) herein is for example only; it is not guaranteed for volume production. SANYO believes information herein is accurate and reliable, but no guarantees are made or implied regarding its use or any infringements of intellectual property rights or other rights of third parties.