

HA16820NT

Speech Network IC with Built-in Speaker Amp. for Telephone Sets (Speakerphone)

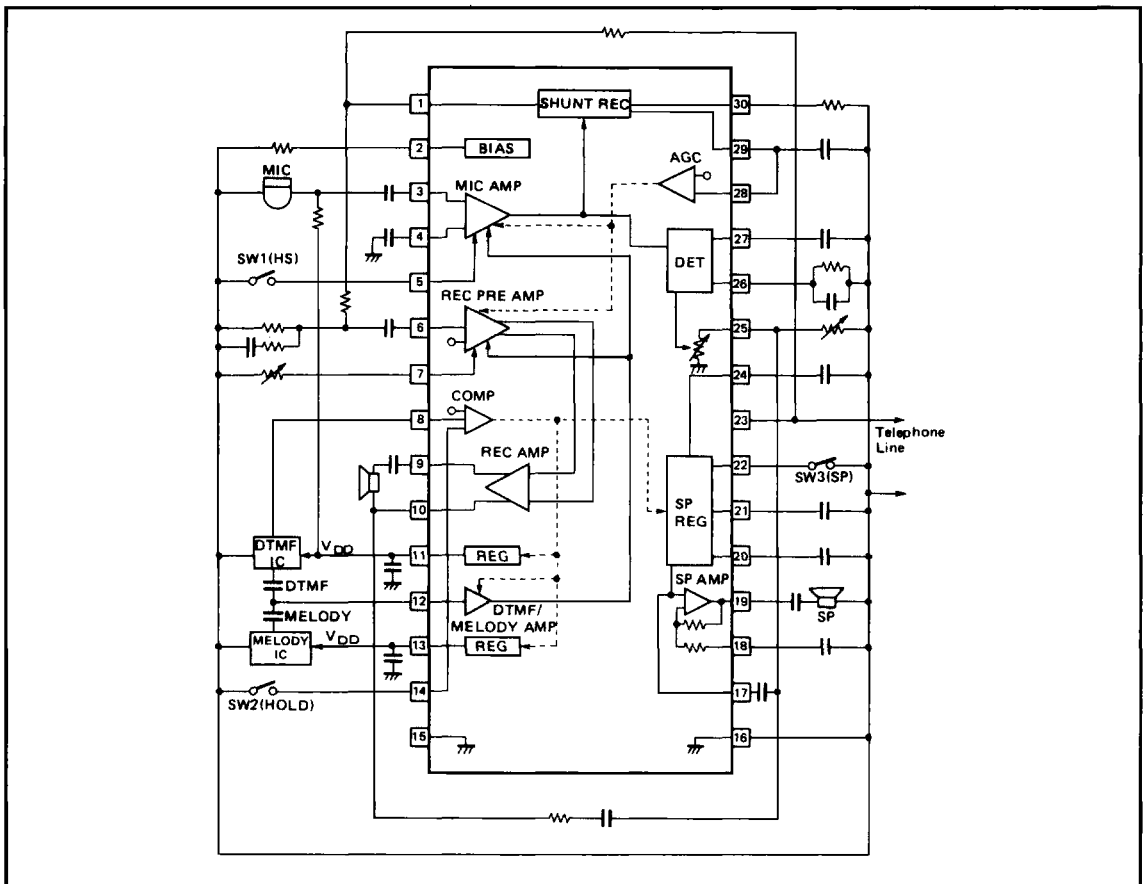
The HA16820NT realizes an excellent branching performance by incorporating a speech network and speaker amplifier on one chip while achieving low current dissipation and low voltage operation. This IC well suited telephones with speaker.

Features

- Low current dissipation, low voltage operation (5mA, 1.8V)
- Makes speaker amplified calls possible (Permits speech through handsets while receiving speaker amplified call)

- Prevents howling during speaker amplified call
- Directly drives 8Ω speaker
- Permits on-hook dialing by incorporating speaker amp. on chip
- Line compensation on chip (sending, receiving, DTMF sending, melody sending gain)
- DTMF sending interface on chip (power supply, MUTE, DTMF sending amp.)
- Melody sending interface on chip (power supply, melody sending amp.)
- Backtone can be output through either the receiver or speaker amp. during DTMF or melody sending
- 30 pins shrink plastic DIP package (DP-30S)

Block Diagram



Pin Description

| Pin No. | Symbol | Pin description |
|---------|-------------------|-------------------------------------|
| 1 | BRG1 | Bridge pin 1 |
| 2 | R _B | IC bias current decision |
| 3 | MIC1 | Mike input |
| 4 | MIC2 | Mike input |
| 5 | HS | Hook switch |
| 6 | BRG2 | Receiver amp. input (bridge pin) |
| 7 | GRCT | Receiver gain variable |
| 8 | MUTE | MUTE |
| 9 | REC1 | Receiver output |
| 10 | REC2 | Receiver output |
| 11 | V _{DD 1} | Regulator for DTMF IC |
| 12 | VIN | DTMF/melody input |
| 13 | V _{DD 2} | Regulator for melody IC |
| 14 | HOLD | ON when melody is being sending. |
| 15 | L2 | Line (GND) |
| 16 | SP GND | GND (Speaker section) |
| 17 | SP IN1 | Speaker amp. signal input |
| 18 | SP IN2 | Speaker amp. input |
| 19 | SP OUT | Speaker amp. output |
| 20 | V _{SP} | Speaker regulator |
| 21 | BIPS1 | AC bypass |
| 22 | SP SW | ON during speaker amp. mode |
| 23 | L1 | Line |
| 24 | BIPS2 | AC bypass |
| 25 | ATT | ATT pad on speaker amp. mode |
| 26 | VS1 | Voice switch (on speaker amp. mode) |
| 27 | VS2 | |
| 28 | AGC | AGC |
| 29 | VLD ET | Line voltage detection |
| 30 | ILD ET | Line current detection |

HA16820NT

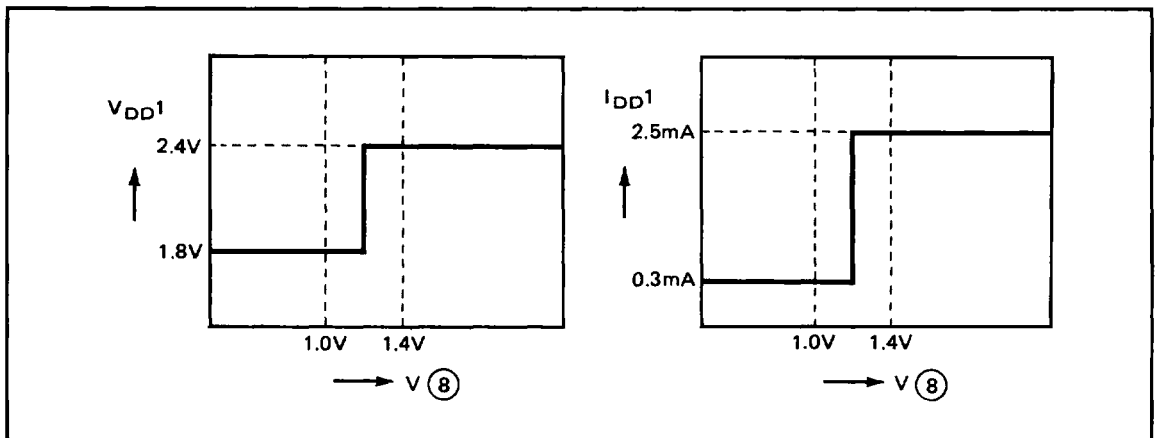
Functional Description

1. DTMF Interface

The DTMF sending mode is activated when pin ⑧ (MUTE) voltage ($V_{(8)}$) becomes 1.4V or more (threshold is 1.2V typ.). In this mode, the sending and receiver preamp. are off and the DTMF sending amp. is on. The DTMF signal is input to pin ⑫. However, since it has a bias of about 1V, and AC couple (Cex8) is required.

An input level of from 50 to 70mVrms is appropriate since the sending gain is a little over 20dB. As soon as the DTMF signal is sent out the line, a backtone is generated from receiver, and during a speaker amp. call, it is also generated from speaker.

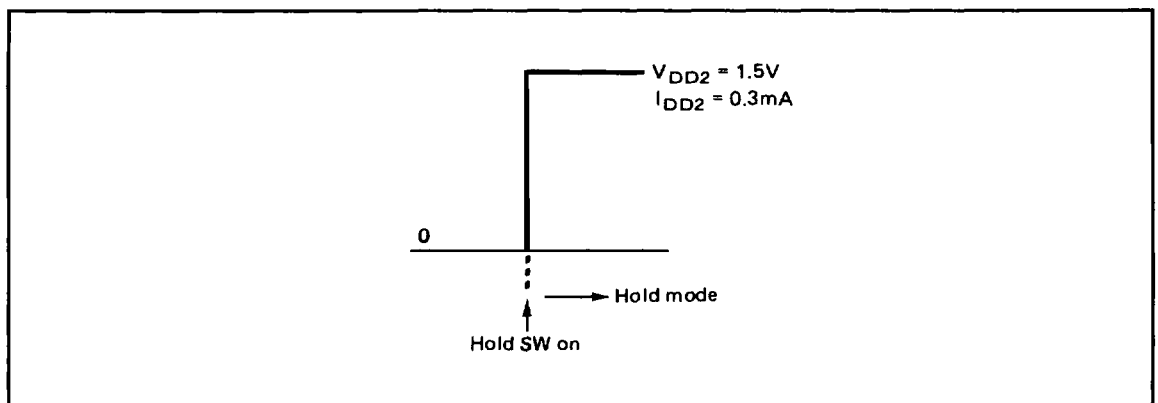
This IC is provided with a flexible power supply which changes the supply voltage and current (pin ⑪) according to whether the device is in waiting or operating status.



2. Holding Interface

The holding interface mode is activated when pin ⑭ (HOLD) is connected to GND. In this mode, the sending and receiving amps. are off and the melody sending amp. is on. The melody is input to pin ⑫. However, since it has a bias of about 1V, an AC couple (Cex9) is required.

An input level of from 10 to 30mVrms is appropriate since the sending gain is a little over 20dB. As soon as the melody is sent to the line, backtone is generated from the speaker. At this time, the melody IC power supply is on for the first time.

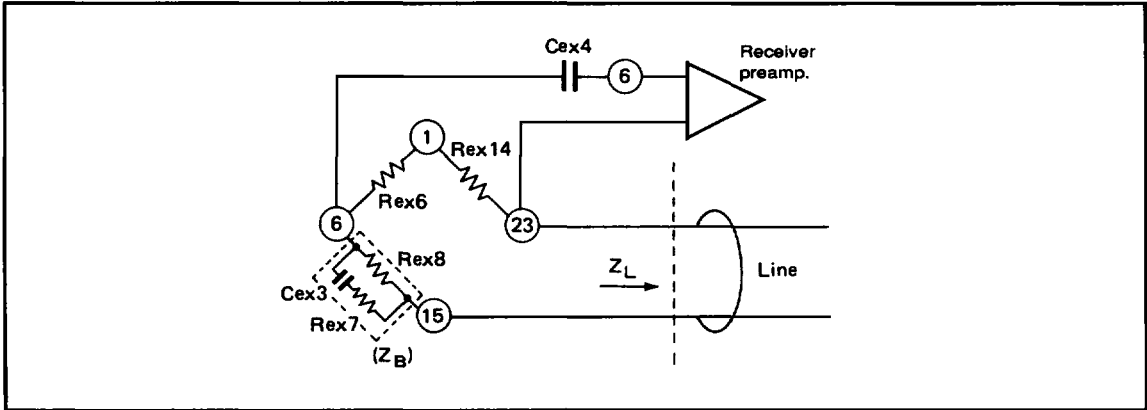


3. Sidetone Suppression Circuit

Sidetone suppression circuit is constructed with bridge-type resistance. To suppress sidetone, Z_B is adjusted by the following equation in response to line impedance Z_L .

$$\frac{R_{ex6}}{R_{ex14}} = \frac{Z_B}{Z_L}$$

Cex4 is for AC couple. Receiver gain is increased by increasing resistance while maintaining a R_{ex6}/R_{ex14} ratio. For example, when $R_{ex6}/R_{ex14} = 330\Omega/30\Omega$, receiver gain is increased by about 6dB over that when $R_{ex6}/R_{ex14} = 110\Omega/10\Omega$.

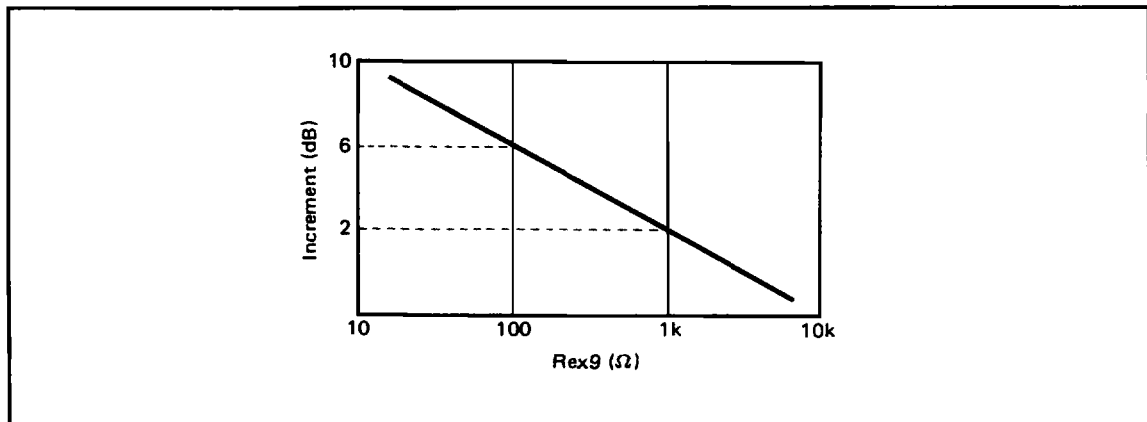


4. Receiving Gain Variable

Receiving gain is increased by lowering Rex9. For example, when $R_{ex9} = 100\Omega$, receiving gain is increased by about 6dB over that when pin (7) is open.

In some modes, receiving gain adjust function is automatically set to off.

| Mode | Speech | | Dialing | |
|------------------|---------|---------|----------------|---------|
| | Handset | Speaker | (DTMF Sending) | Holding |
| Receiver Preamp. | On | Off | Off | Off |



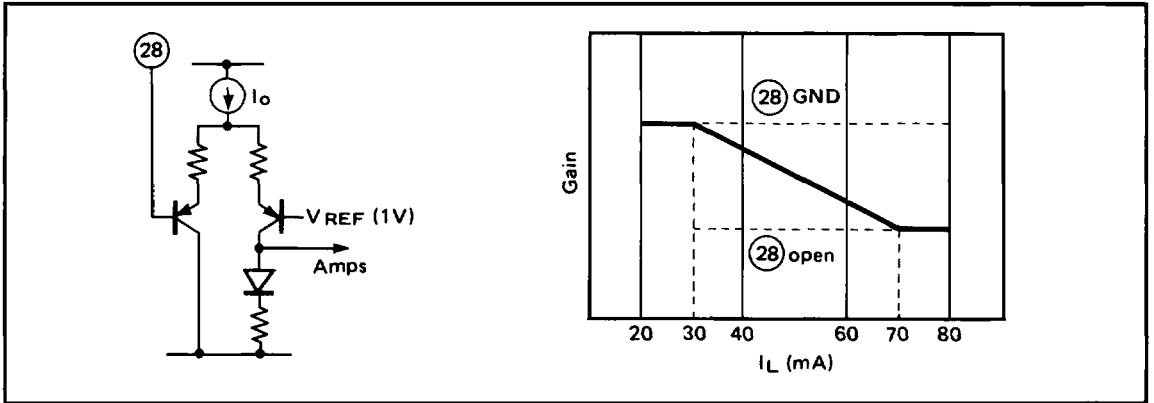
HA16820NT

5. AGC Characteristics (Line Compensation)

By connecting pins (28) and (29), sending and receiving gain, DTMF and melody sending gain are automatically adjust to coincide with line current.

The gain fixed mode is set by disconnecting pin (29) and applying a constant voltage to pin (28).

High gain fixed when $0V \leq V_{(28)} \leq 0.3V$,
 Low gain fixed when $V_{(28)} = V_{(23)}$ or open.
 However, gain changes when I_L is from 30mA to 70mA.

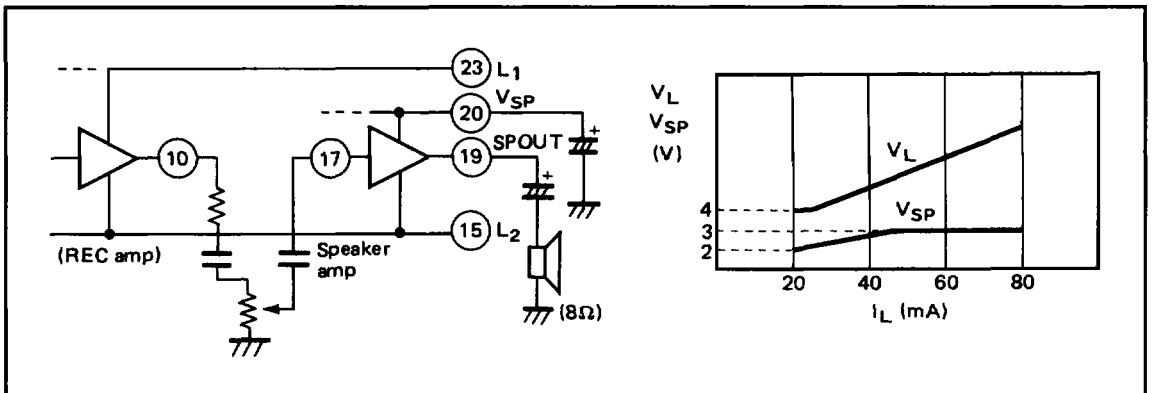


6. Speaker Amp.

The speaker amp. mode is activated when pin (22) (SPSW) is connected to GND. In this mode, the speaker amp. and speaker regulator (V_{SP}) comes on for the first time. Speaker output volume is adjusted by volume insertion.

The dynamic range of line L1 is assured by adjusting voltage V_{SP} to coincide with line current I_L .

V_{SP} changes from 2V to 3V, when $20mA \leq I_L \leq 50mA$, and V_{SP} is constant to 3V when $I_L \geq 50mA$.



7. Speech in Speaker Amp. Mode (Handset Speaker Amp.)

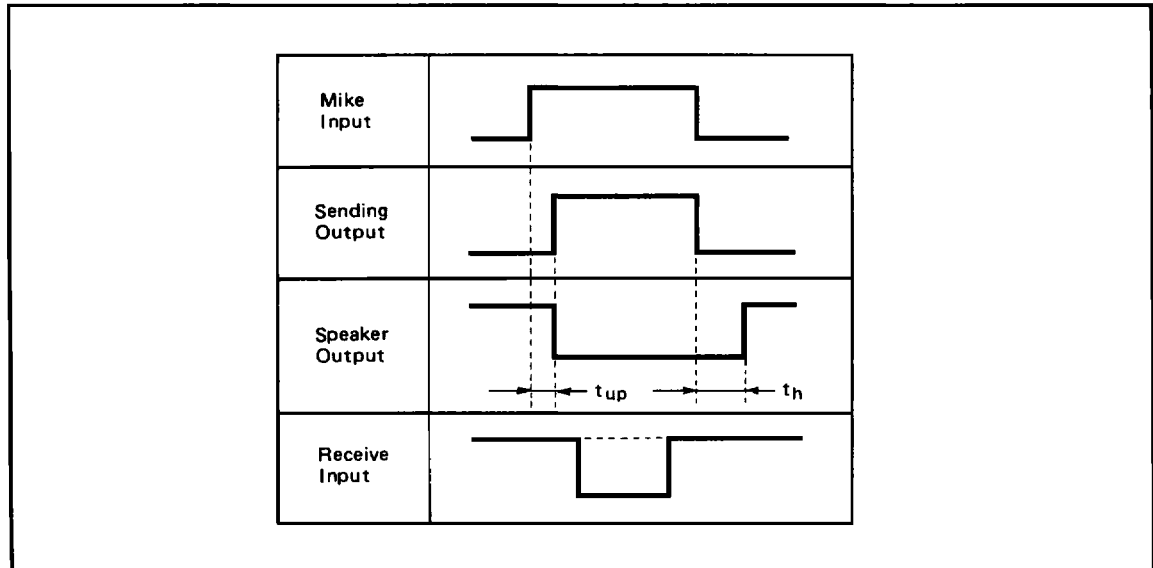
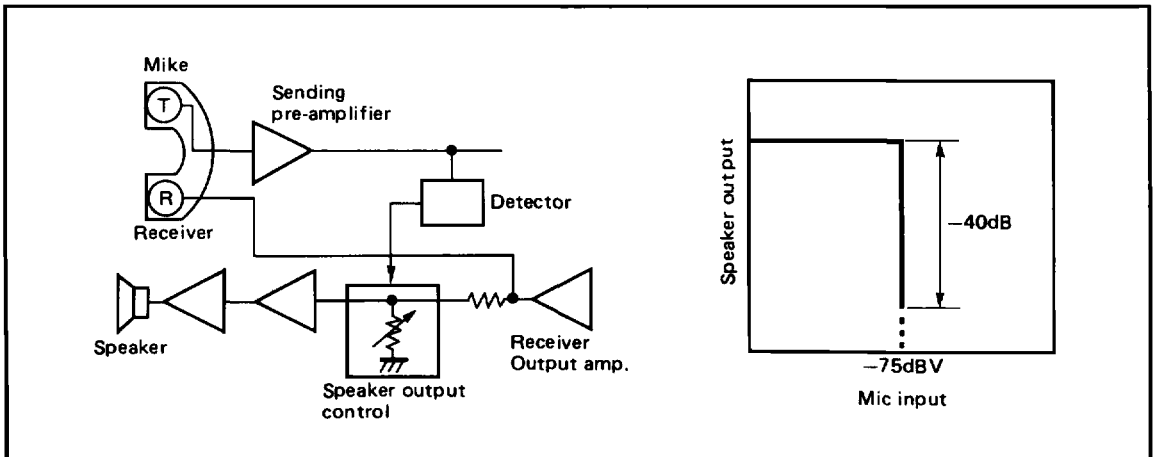
It's possible to talk holding handset in the speaker amp. mode. However, in order to prevent howling (that is resonance between the speaker and handset mike), a speaker output loss of about -40dB is provided in cases when signals are input into the mike.

As a result, handset receiver output is heard normally while speaker output is eliminated. The mike input threshold is adjustable with Cex20.

Rise time t_{up} and hang-over time t_h are determined by Rex12 and Cex19 of pin (26).

$$t_{up} \approx 13 \text{ Cex19 (ms)}$$

$$t_h \approx \text{Cex19} \cdot \text{Rex12 (ms)}$$



8. Hook Switch (HS)

Pin ⑤ is linked to the hook switch. The sending pre-amplifier is on when the pin is connected to GND, and off when it is open and the signal from the mike is not amplified.

| ⑤ | Pre-Amplifier |
|------|---------------|
| GND | ON |
| OPEN | OFF |

9. Line Current Detection

Line current is detected by Rex13 of pin ③①

The voltage of pin ②⑨ is,

$$V_{29} = V_{30} + 0.3V$$

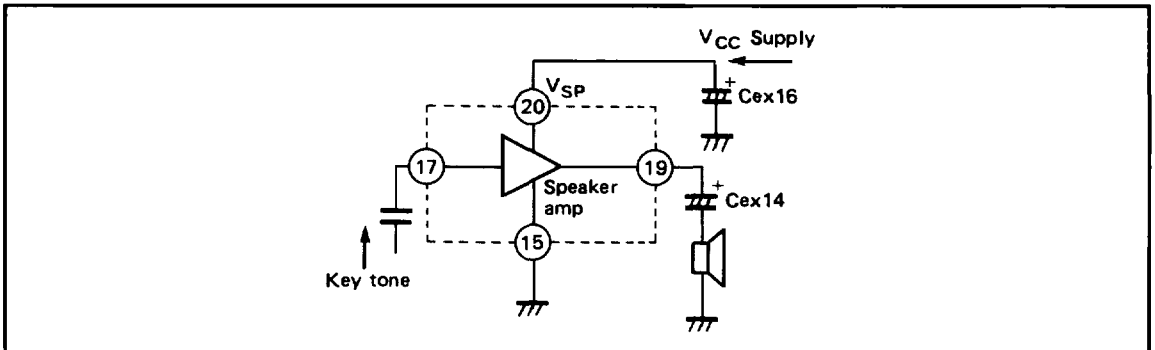
The line matching impedance is proportionate to the Rex13.

$$Z_{IN} \propto \text{Rex13}$$

10. Key Tone Amplifier

The key tone is generated as the backtone when dialing with a pulse dialer. The speaker amp. can also be used as the key tone amp.

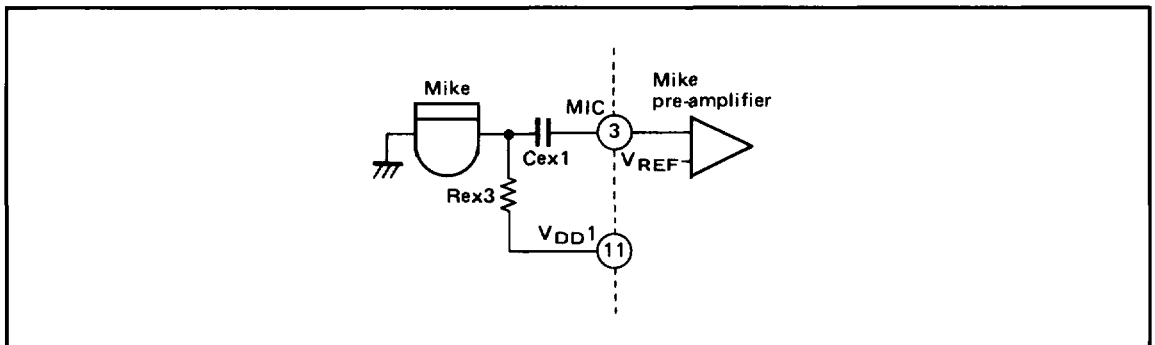
Voltage is applied to V_{SP} (pin ②①), using a zener diode. The speaker amp. is activated when a voltage of 1.5V or more is applied. Generation of the key tone from the speaker can be verified by inputting the key tone in pin ①⑦.



11. Mike Bias

Mike bias is provided for capacitor mike. Pin ①① V_{DD1} is used for mike bias source. This V_{DD1} is 1.8V typ, and the Rex3 of which is determined

by the type of mike used. The signal from the mike is input to mike pre-amplifier through Cex1.



Absolute Maximum Ratings (Ta=25°C)

| Item | Symbol | Ratings | Unit |
|-----------------------------|----------------|------------|------|
| Supply Voltage*1 | V _L | 15 | V |
| Supply Current | I _L | 120 | mA |
| Operating Temperature Range | Topr | -20 ~ +70 | °C |
| Storage Temperature Range | Tstg | -55 ~ +125 | °C |
| Power Dissipation | P _T | 850 | mW |

Note) 1: 3ms Pulse duration (Keep the duration to be more than 3 sec.)

Electrical Characteristics (Ta=25°C)

On Handset Mode:

| Item | Symbol | Min | Typ | Max | Unit | I _L mA | Test Conditions |
|---------------------------|------------------|-----|-----|------|------|-------------------|----------------------------------|
| Supply Voltage | V _L | 2.5 | 2.8 | 3.1 | V | 20 | f=1kHz |
| | | 5.0 | 6.5 | 8.0 | V | 80 | |
| | | 3.6 | 4.0 | 4.4 | V | 20 | |
| | | 6.5 | 8.0 | 9.5 | V | 80 | |
| Receiver Gain | G _R | -6 | -4 | -2 | dB | 30 | f=1kHz |
| | | -11 | -9 | -7 | dB | 80 | |
| Up Mode | | 2.5 | 6.5 | 10.5 | dB | 30 | Rex 9=0Ω |
| Sending Gain | G _T | 39 | 41 | 43 | dB | 30 | f=1kHz |
| | | 34 | 36 | 38 | dB | 80 | |
| DTMF Sending Gain | G _{MF} | 22 | 24 | 26 | dB | 30 | f=1kHz |
| | | 19 | 21 | 23 | dB | 80 | |
| Sending Dynamic Range | DR _T | 2.5 | 3.5 | - | Vp-p | 30 | f=1kHz, Distortion=6% |
| | | 3.5 | 4.5 | - | Vp-p | 80 | |
| Receiving Dynamic Range | DR _R | 0.7 | 1.0 | - | Vp-p | 30 | f=1kHz, Distortion=5% |
| | | 0.8 | 1.1 | - | Vp-p | 80 | |
| On Dialing Dynamic Range | DR _{MF} | 2.5 | 4.0 | - | Vp-p | 30 | f=1kHz, Distortion=5% |
| | | 2.5 | 4.0 | - | Vp-p | 80 | |
| DTMF Supply Voltage | V _{DD1} | 1.6 | 1.8 | 2.0 | V | 20 | |
| | | 2.2 | 2.4 | 2.6 | V | 20 | |
| DTMF Supply | I _{DD1} | 220 | - | - | μA | 20 | V _{DD} ≥ 1.6V |
| | | 2 | - | - | mA | 20 | V _{DD} ≥ 2.2V |
| DTMF Backtone | BT _{MF} | -13 | -8 | -4 | dB | 30 | V _{IN} =50mV, f=1kHz |
| Characteristics Impedance | Z _{IN} | 480 | 600 | 720 | Ω | 30, 80 | f=1kHz |

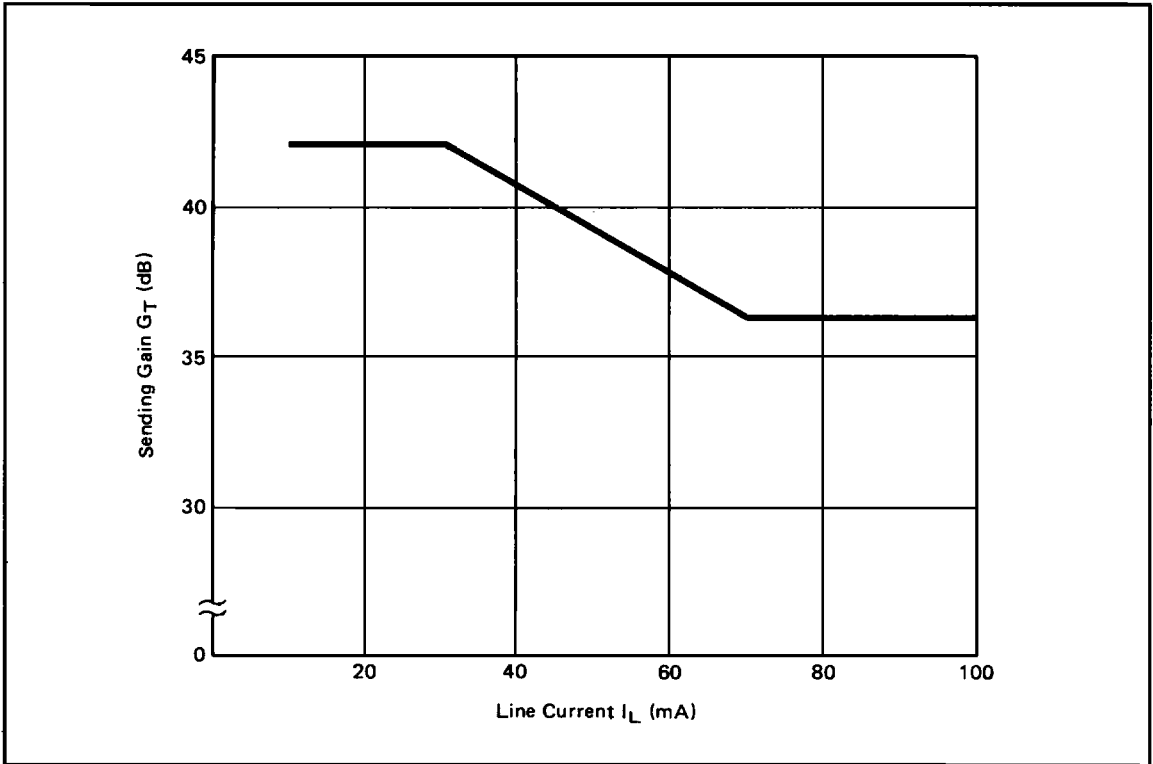
HA16820NT

On Speaker Amp. Mode:

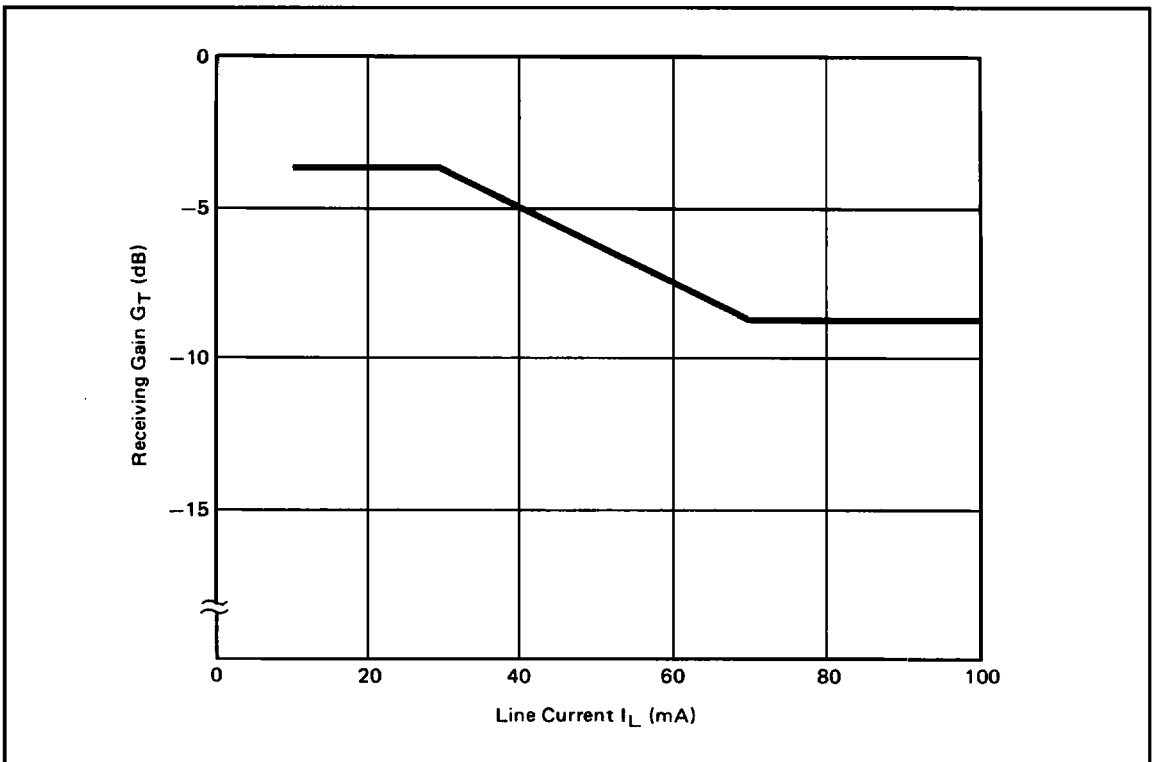
| Item | Symbol | Min | Typ | Max | Unit | I _L mA | Test Conditions | |
|------------------------------|---------------------|---------------------|------|------|------------------|-------------------|--|----------------------------------|
| Supply Voltage | Speaking | 3.6 | 4.0 | 4.4 | V | 20 | | |
| | | 6.6 | 7.8 | 9.0 | V | 80 | | |
| | Dialing | 3.5 | 3.9 | 4.3 | V | 20 | | |
| | | 6.6 | 7.8 | 9.0 | V | 80 | | |
| Receiving Gain | G _{RS} P | -6.5 | -4.0 | -1.5 | dB | 30 | f=1kHz | |
| | | -12.0 | -9.5 | -7.0 | dB | 80 | | |
| Sending Gain | G _{TS} P | 38.5 | 41 | 43.5 | dB | 30 | f=1kHz | |
| | | 33 | 35.5 | 38 | dB | 80 | | |
| DTMF Sending Gain | G _{MF} SP | 21.5 | 24 | 26.5 | dB | 30 | f=1kHz | |
| | | 18.5 | 21 | 23.5 | dB | 80 | | |
| Sending Dynamic Range | DR _{TS} P | 2.5 | 3.8 | - | V _{p-p} | 50 | f=1kHz Distortion=5% | |
| Receiving (SP) Dynamic Range | DR _{SP} | 0.7 | 1.0 | - | V _{p-p} | 50 | SP Output, f=1kHz, Distortion=5% | |
| On Dialing Dynamic Range | DR _{MF} SP | 2.5 | 3.5 | - | V _{p-p} | 50 | f=1kHz, Distortion=5% | |
| DTMF Backtone | Speaker | BT _{MF} SP | 7 | 10 | 13 | dB | 50 | V _{in} =50mV, f=1kHz |
| Line Matching Impedance | Z _{IN} SP | 450 | 600 | 750 | Ω | 30, 80 | f=1kHz | |
| Speaker Amp. Gain | G _{SP} | 8 | 12 | 16 | dB | 30 | f=1kHz | |

On Holding Mode :

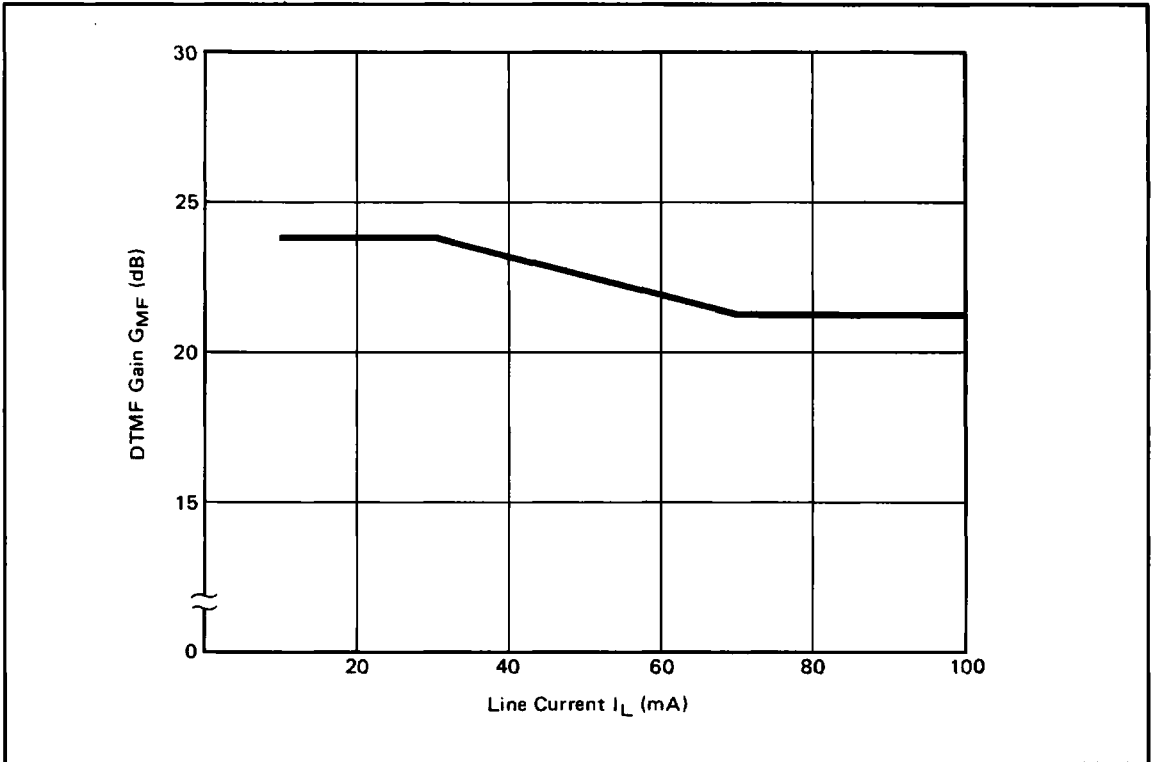
| Item | Symbol | Min | Typ | Max | Unit | I _L mA | Test Conditions | |
|------------------------------|------------------|------------------|-----|------|------------------|-------------------|------------------------------|----------|
| Supply Voltage | V _{LHD} | 3.6 | 4.0 | 4.4 | V | 20 | | |
| | | 6.5 | 7.7 | 8.9 | V | 80 | | |
| Melody IC | Voltage | V _{DD2} | 1.2 | 1.5 | 1.8 | V | 20 | |
| Supply | Current | I _{DD2} | 200 | 300 | - | μA | 20 | |
| Melody Sending Gain | G _{HD} | 21.5 | 24 | 26.5 | dB | 30 | f = 1kHz | |
| | | 18.5 | 21 | 23.5 | dB | 80 | | |
| Melody Sending Dynamic Range | DR _{HD} | 2.5 | 4.5 | - | V _{p-p} | 50 | f = 1kHz, Distortion = 5% | |
| Melody Backtone | Speaker | BT _{HD} | 19 | 22 | 25 | dB | 50 | f = 1kHz |



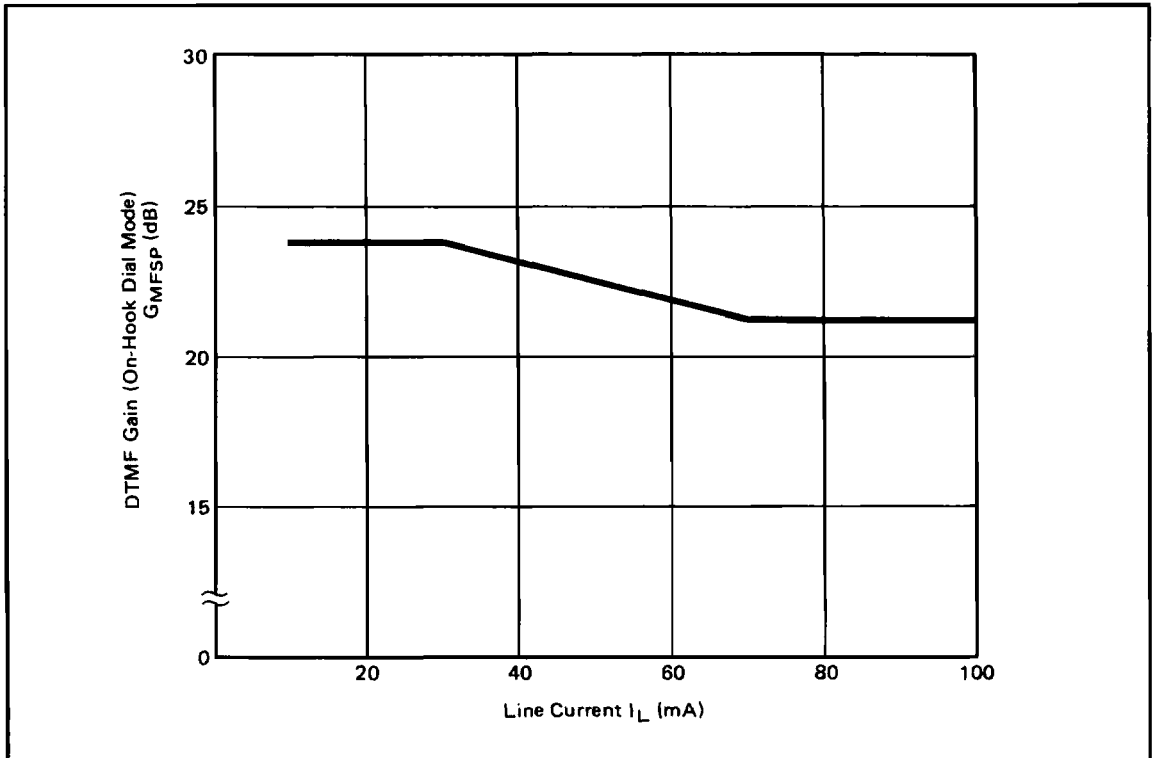
SENDING GAIN vs. LINE CURRENT



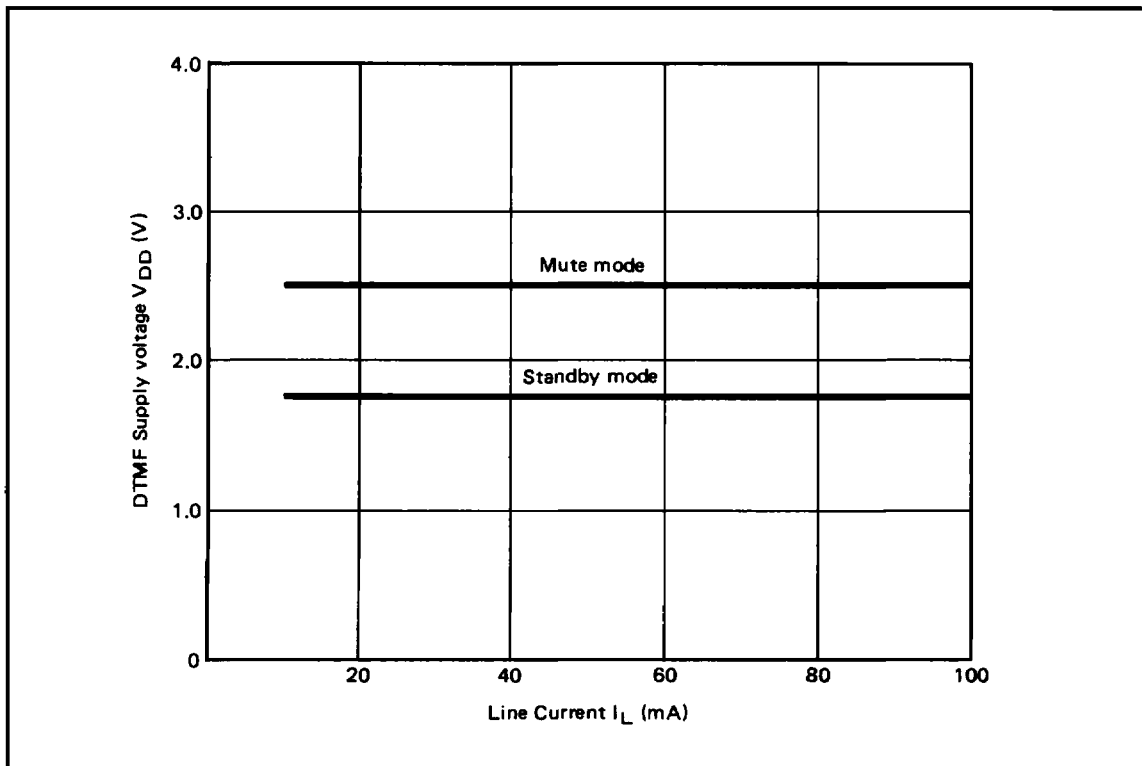
RECEIVING GAIN vs. LINE CURRENT



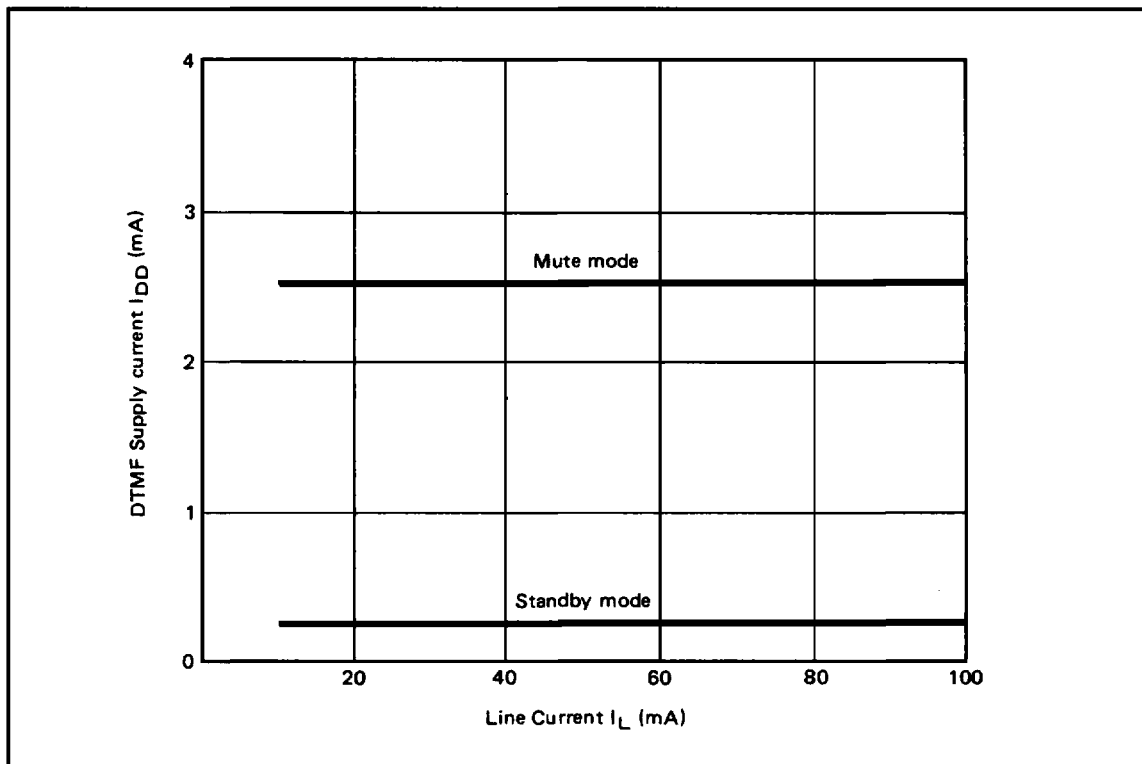
DTMF GAIN vs. LINE CURRENT



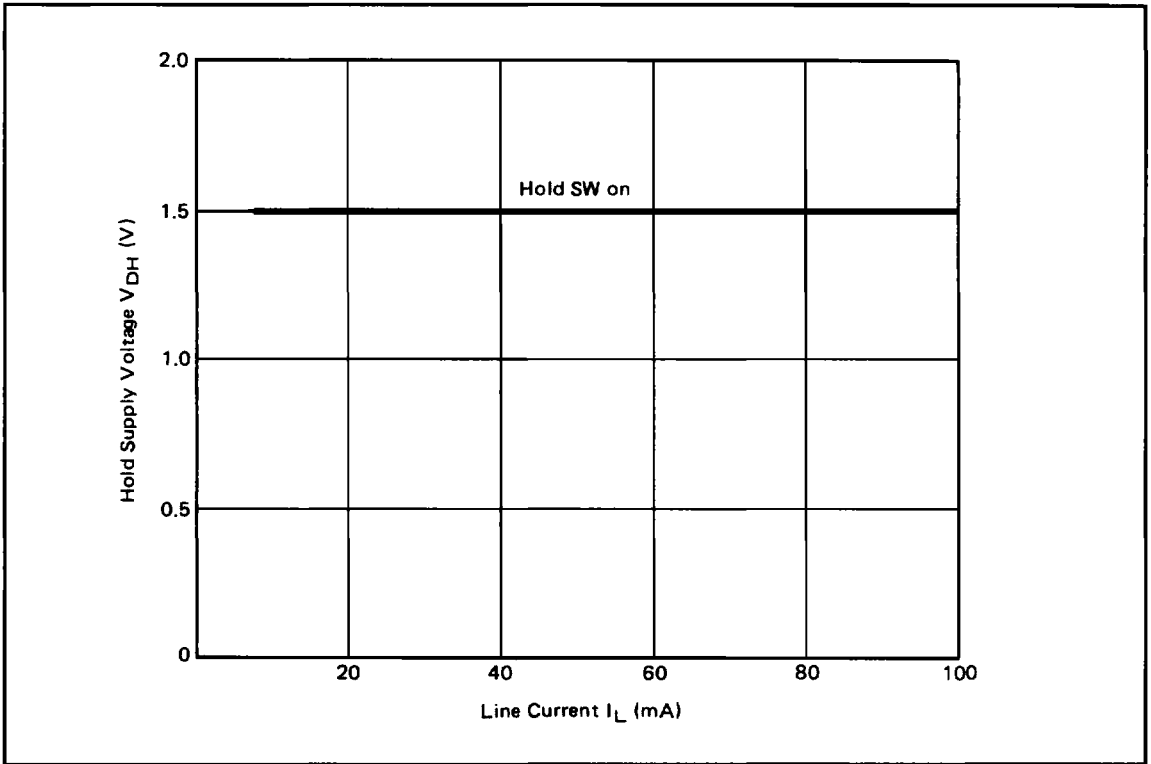
DTMF SENDING GAIN (ON-HOOK DIAL MODE) vs. LINE CURRENT



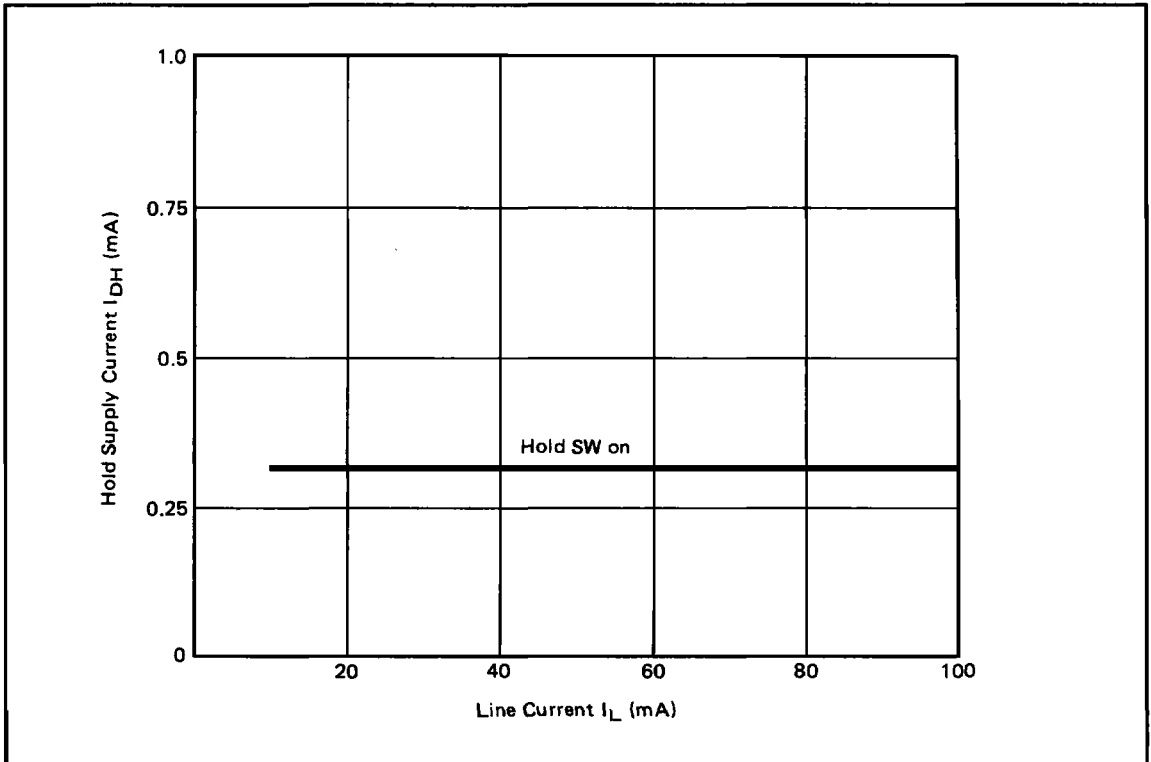
DTMF SUPPLY VOLTAGE vs. LINE CURRENT



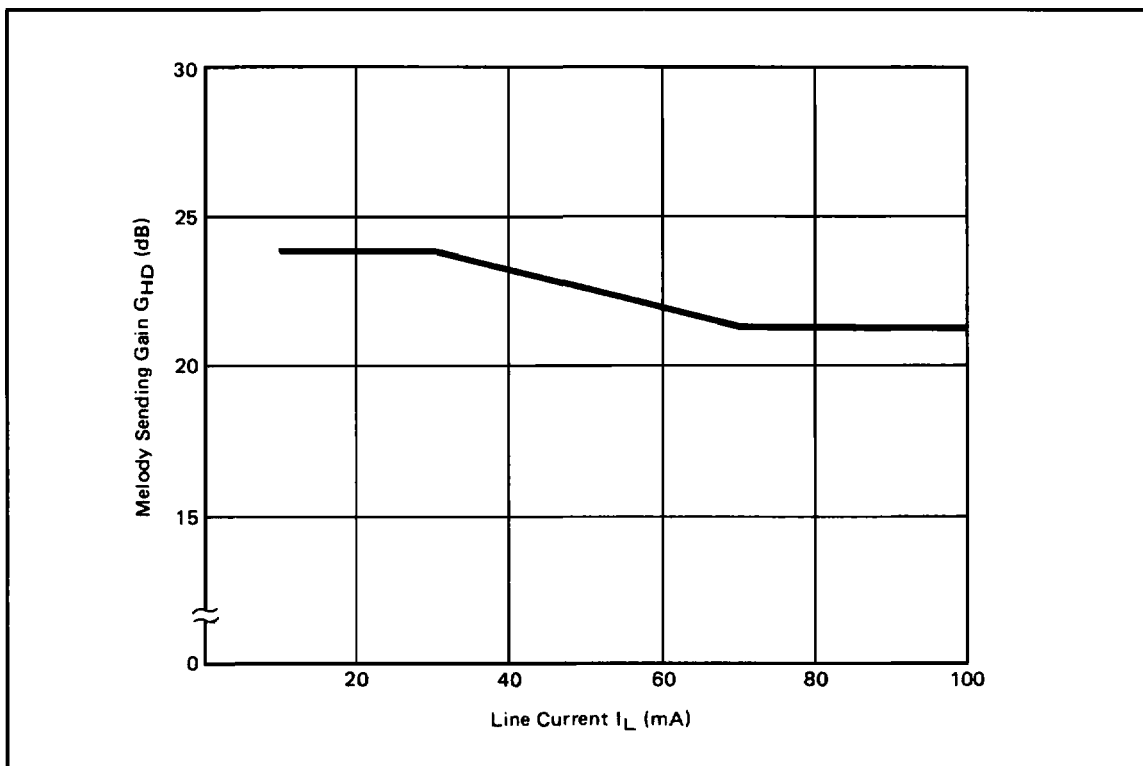
DTMF SUPPLY CURRENT vs. LINE CURRENT



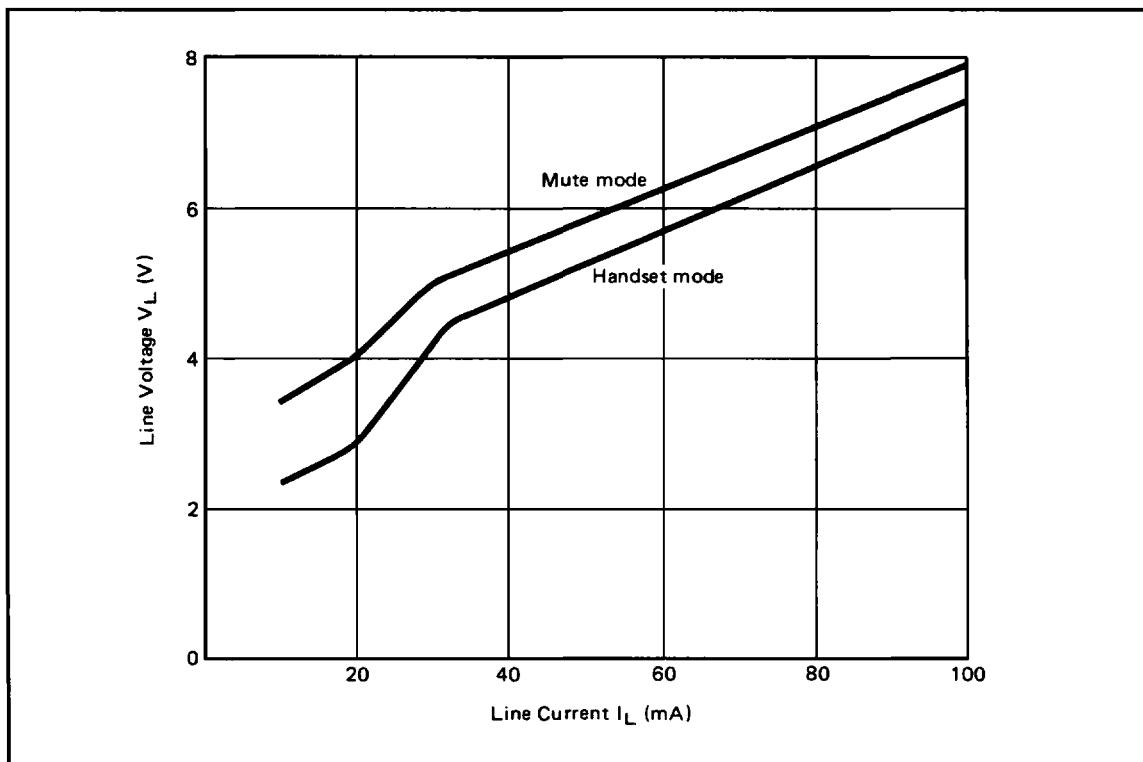
HOLD SUPPLY VOLTAGE vs. LINE CURRENT



HOLD SUPPLY CURRENT vs. LINE CURRENT



MELODY SENDING GAIN vs. LINE CURRENT



LINE VOLTAGE vs. LINE CURRENT

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Circuit Example

