HA16820NT

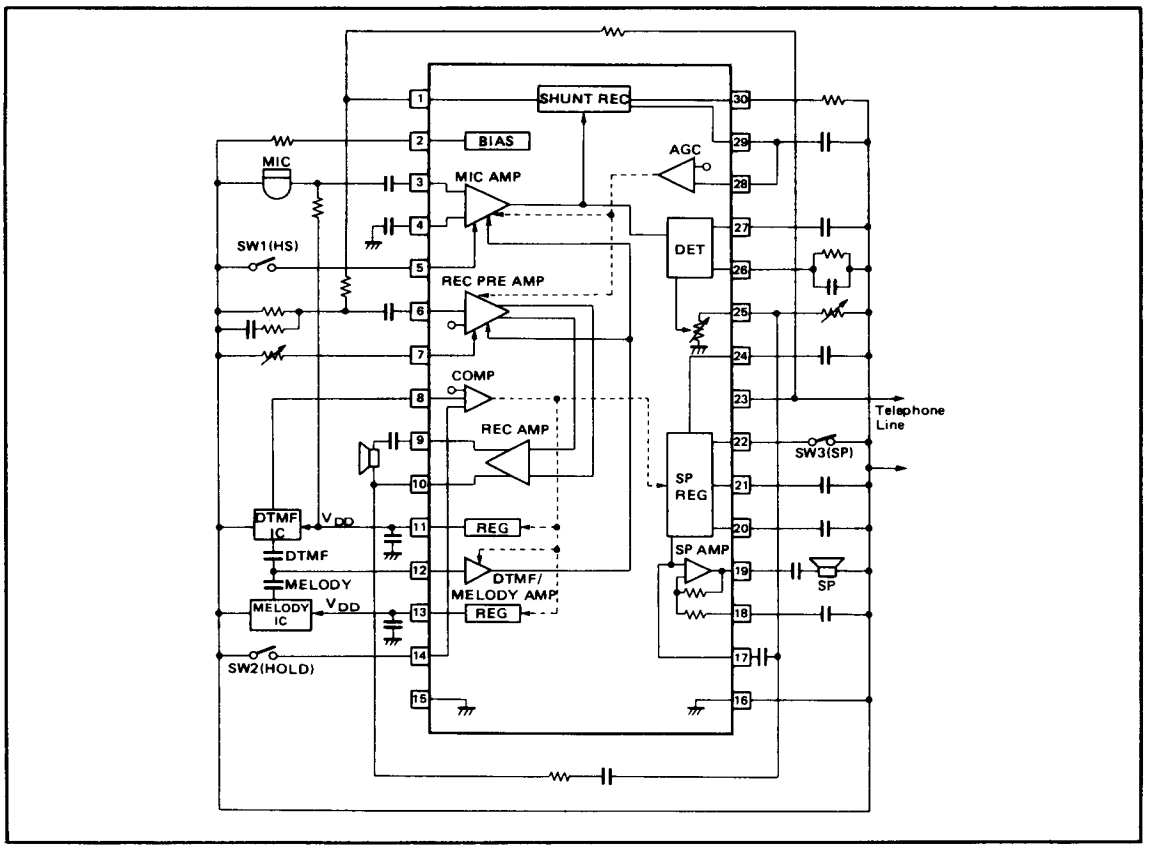
Speech Network IC with Built-in Speaker Amp. for Telephone Sets (Speakerphone)

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 howing 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	VLDET	Line voltage detection
30	ILDET	Line current detection

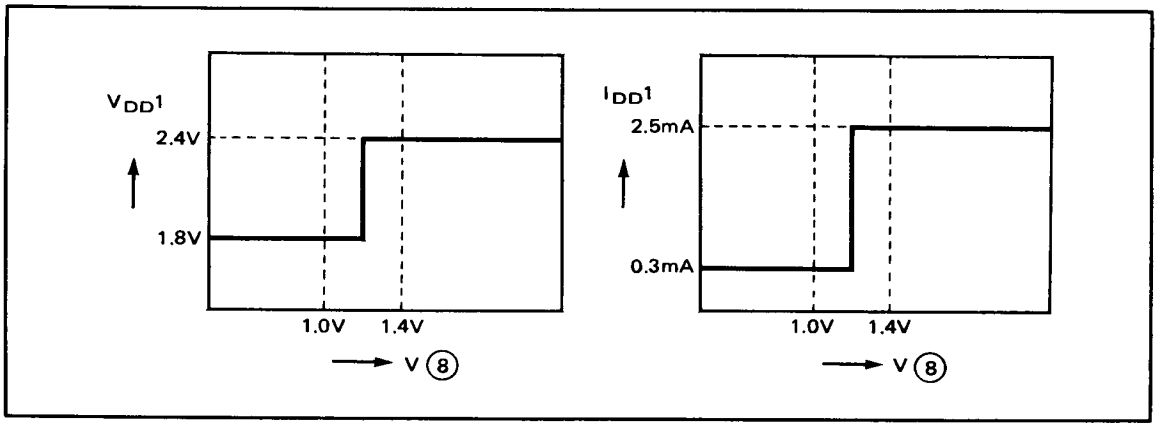
Functional Description

1. DTMF Interface

The DTMF sending mode is activated when pin (8). (MUTE) voltage (V (8)) becomes 1.6V 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.

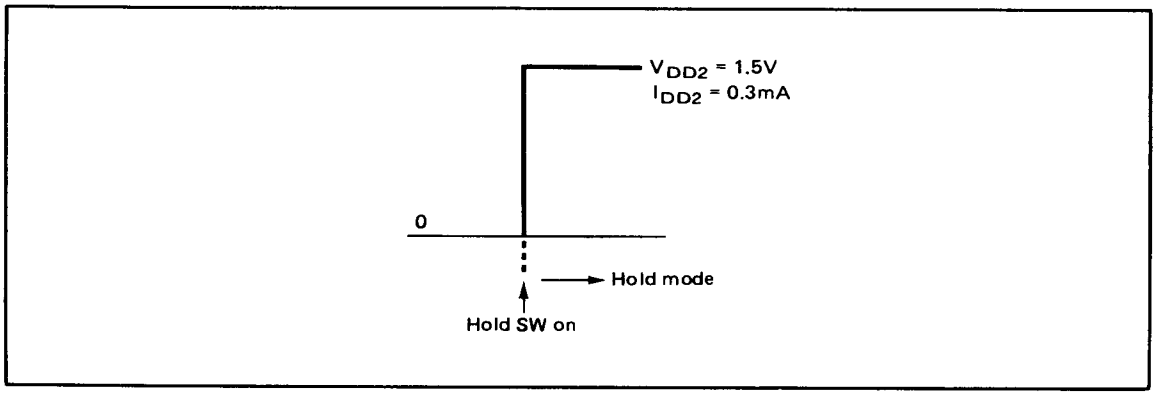
This IC is provided with a flexible power supply which changes the supply voltage and current (pin (11)) according to whether the device is in waiting or operating status.



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.

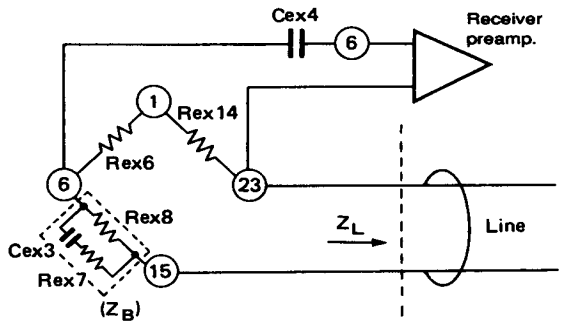


3. Sidetone Suppression Circuit

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.

$$\frac{Rex6}{Rex14} = \frac{Z_B}{Z_L}$$

Cex4 is for AC couple. Receiver gain is increased by increasing resistance while maintaining a Rex6/Rex14 ratio. For example, when Rex6/Rex14 = 330Ω/30Ω, receiver gain is increased by about 6dB over that when Rex6/Rex14 = 110Ω/10Ω.



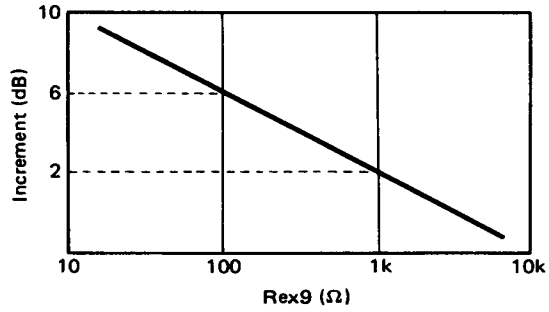
4. Receiving Gain Variable

Receiving gain is increased by lowering Rex9.

For example, when Rex9 = 100Ω, 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	Holding
	Handset	Speaker	(DTMF Sending)	
Receiver Preamp.	On	Off	Off	Off

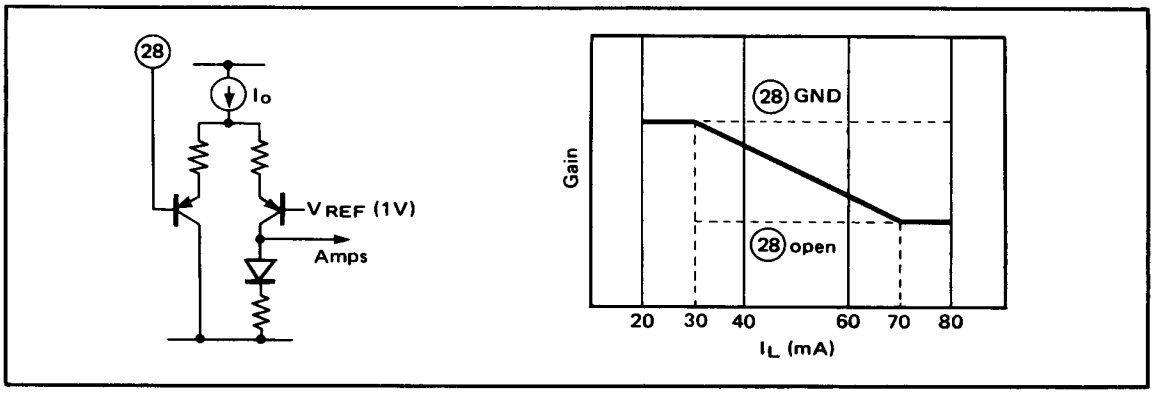


5. AGC Characteristics (Line Compensation)

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

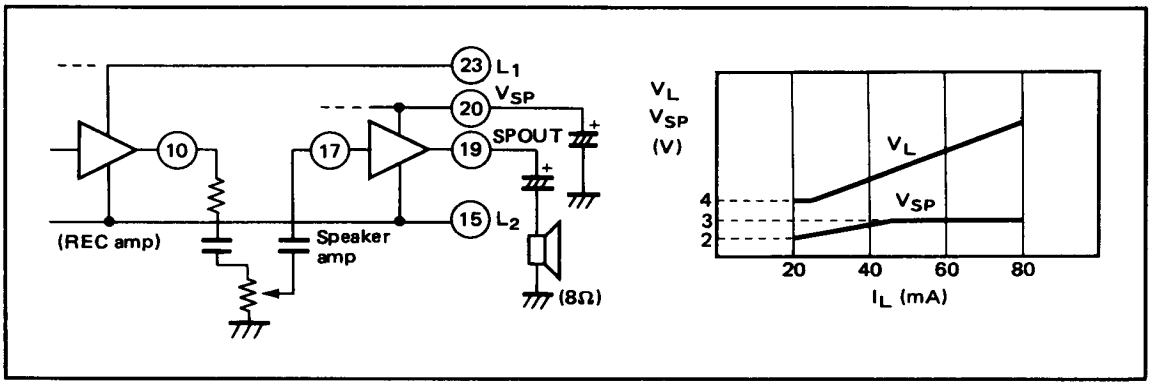


6. Speaker Amp.

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 $20mA \leqq I_L \leqq 50mA$, and V_{SP} is constant to 3V when $I_L \leqq 50mA$.



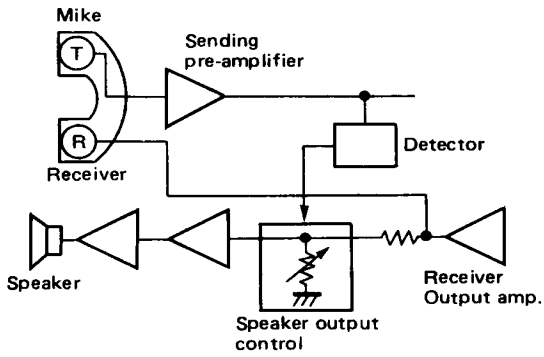
7. Speech in Speaker Amp. Mode (Handset Speaker Amp.)

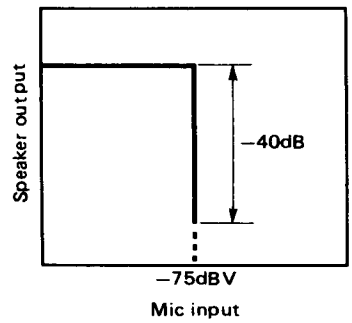
It's possible to talk holding handset in the speaker amp. mode. However, in order to prevent howing (that is resonance between the speaker and handset mike), a speaker output loss of about – 40dB is provided in cases when signals are input into the mike.

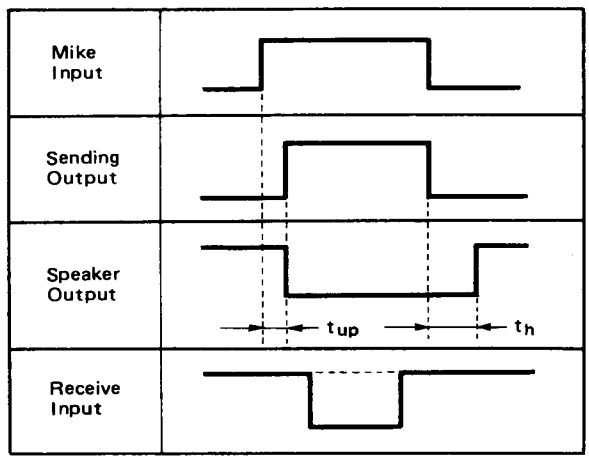
As a result, handset receiver output is heard normally while speaker output is eliminated. The mike input threshold is adjustable with Cex20.
Rise time t_{up} and hang – over time t_h are determined by Rex12 and Cex19 of pin (26) .

$t_{up} \fallingdotseq 13$ Cex19 (ms)

$t_h \fallingdotseq$ Cex19 · 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.

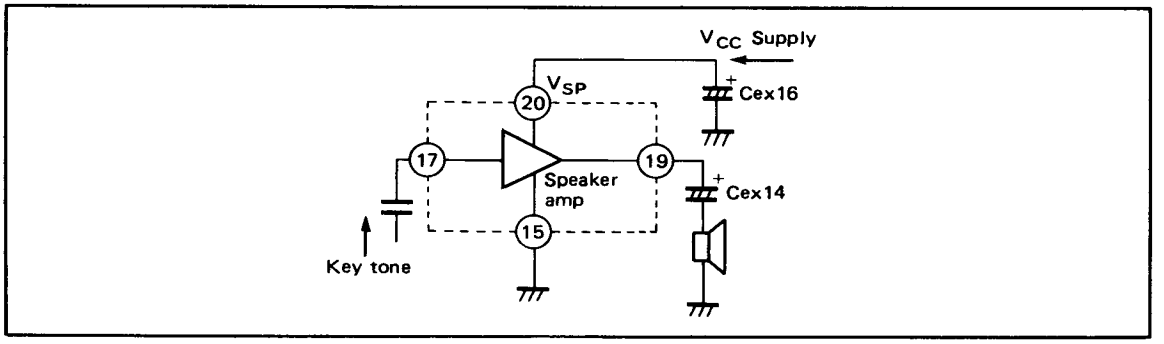
⑤	Pre-Amplifier
GND	ON
OPEN	OFF

9. Line Current Detection

Line current is detected by Rex13 of pin ㉚
The voltage of pin ㉙ is,
V ㉙ = V ㉚ + 0.3V
The line matching impedance is proportionate to the Rex13.
$Z_{IN} \propto$ Rex13

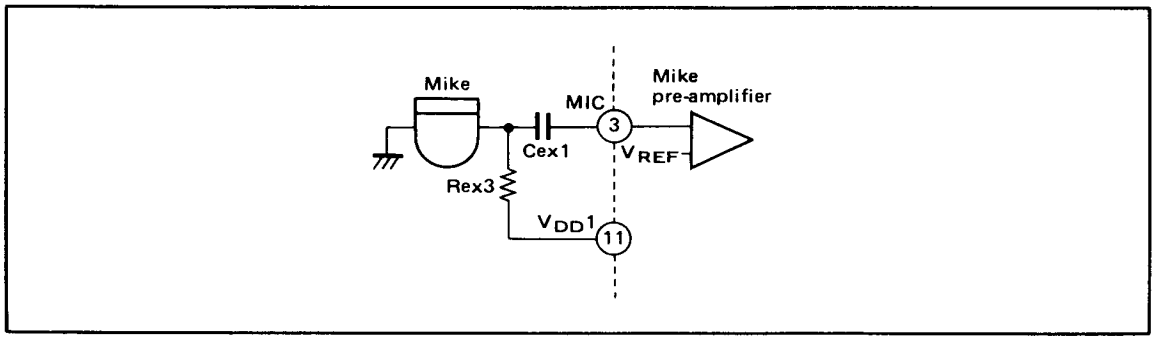
10. Key Tone Amplifier

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 ⑳), 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 inputing the key tone in pin ⑰ .



11. Mike Bias

Mike bias is provided for capacitor mike. Pin ⑪ $V_{DD}1$ is used for mike bias source. This $V_{DD}1$ 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:

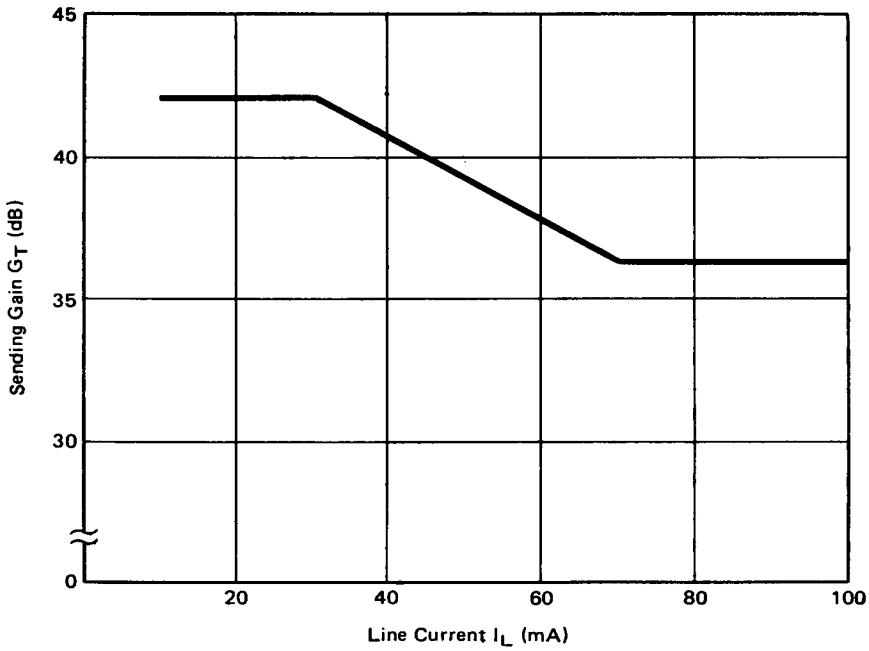
Item		Symbol	Min	Typ	Max	Unit	I_L mA	Test Conditions
Supply Voltage	Speaking	V_L	2.5	2.8	3.0	V	20	
			5.0	6.5	8.0	V	80	
	Dialing		3.6	4.0	4.4	V	20	
			6.5	8.0	9.5	V	80	
Receiver Gain		G_R	−6	−4	−2	dB	30	f=1kHz
			−11	−9	−7	dB	80	
	Up Mode		2.5	6.5	10.5	dB	30	Rex 9=0Ω
Sending Gain		G_T	39	41	43	dB	30	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=5%
			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	Stand-by	V_{DD1}	1.6	1.8	2.0	V	20	
	Mute		2.2	2.4	2.6	V	20	
DTMF Supply	Stand-by	I_{DD1}	220	–	–	μA	20	$V_{DD} \geqq 1.6V$
	Mute		2	–	–	mA	20	$V_{DD} \geqq 2.2V$
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

On Speaker Amp. Mode:

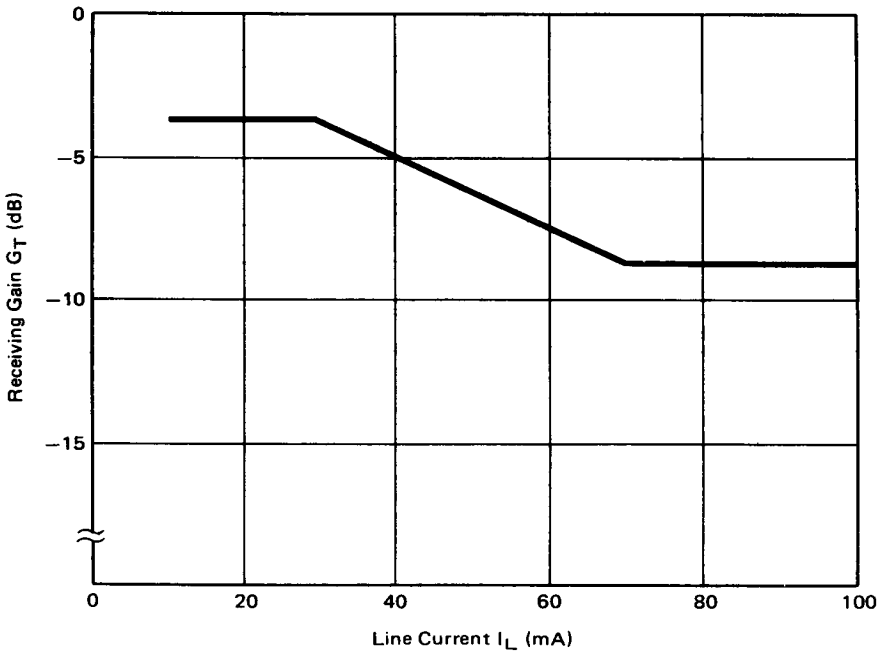
Item		Symbol	Min	Typ	Max	Unit	I_L mA	Test Conditions
Supply Voltage	Speaking	V_{LSP}	3.6	4.0	4.4	V	20	
			6.6	7.8	9.0	V	80	
	Dialing		3.5	3.9	4.3	V	20	
			6.6	7.8	9.0	V	80	
Receiving Gain		G_{RSP}	−6.5	−4.0	−1.5	dB	30	f=1kHz
			−12.0	−9.5	−7.0	dB	80	
Sending Gain		G_{TSP}	38.5	41	43.5	dB	30	f=1kHz
			33	35.5	38	dB	80	
DTMF Sending Gain		G_{MFSP}	21.5	24	26.5	dB	30	f=1kHz
			18.5	21	23.5	dB	80	
Sending Dynamic Range		DR_{TSP}	2.5	3.8	—	Vp-p	50	f=1kHz Distortion=5%
Receiving (SP) Dynamic Range		DR_{SP}	0.7	1.0	—	Vp-p	50	SP Output, f=1kHz, Distortion=5%
On Dialing Dynamic Range		DR_{MFSP}	2.5	3.5	—	Vp-p	50	f=1kHz, Distortion=5%
DTMF Backtone	Speaker	BT_{MFSP}	7	10	13	dB	50	Vin=50mV, f=1kHz
Line Matching Impedance		Z_{INSP}	450	600	750	Ω	30, 80	f=1kHz
Speaker Amp. Gain		G_{SP}	8	12	16	dB	30	f=1kHz

On Holding Mode :

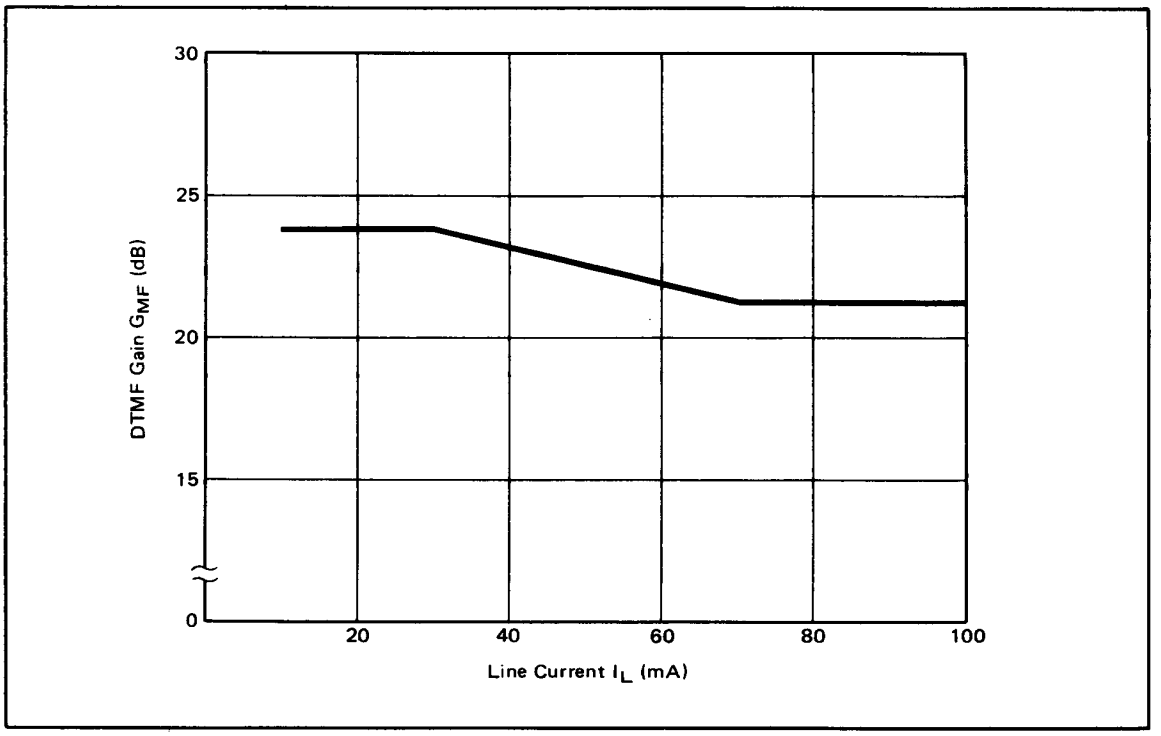
Item		Symbol	Min	Typ	Max	Unit	I_L mA	Test Conditions
Supply Voltage		V_{LHD}	3.6	4.0	4.4	V	20	
			6.5	7.7	8.9	V	80	
Melody IC	Voltage	V_{DD2}	1.2	1.5	1.8	V	20	
Supply	Current	I_{DD2}	200	300	—	μA	20	
Melody Sending Gain		G_{HD}	21.5	24	26.5	dB	30	f = 1kHz
			18.5	21	23.5	dB	80	
Melody Sending Dynamic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



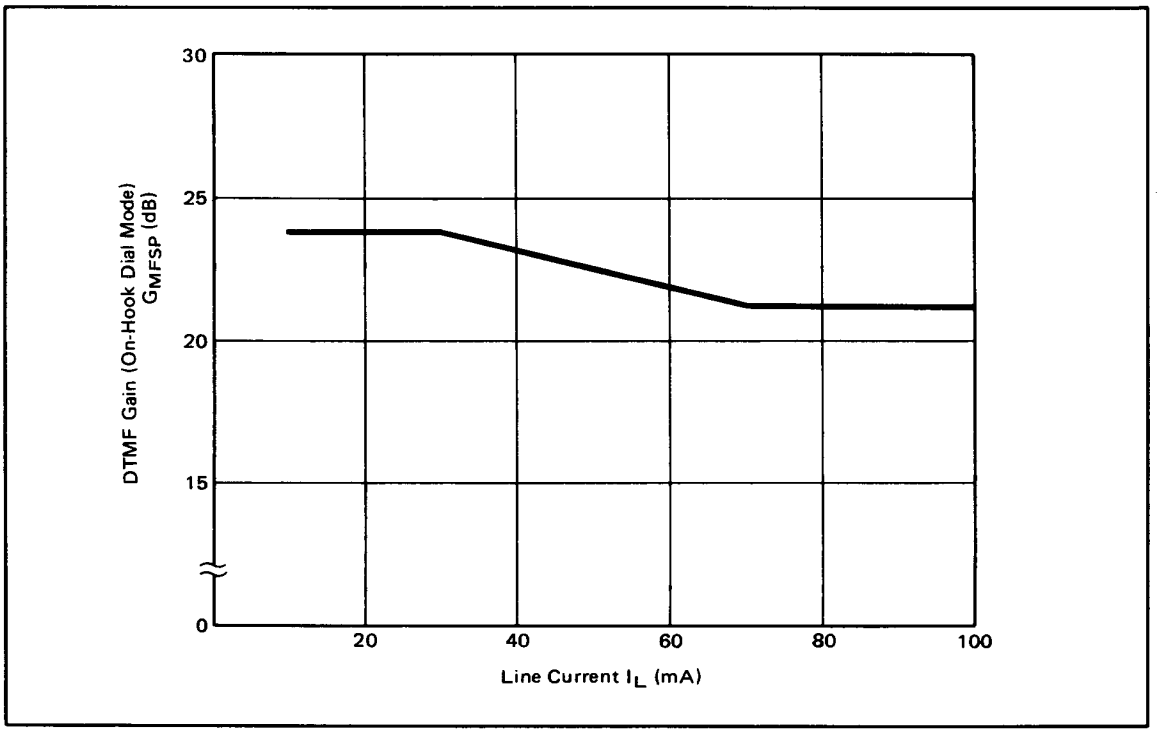
SENDING GAIN vs. LINE CURRENT



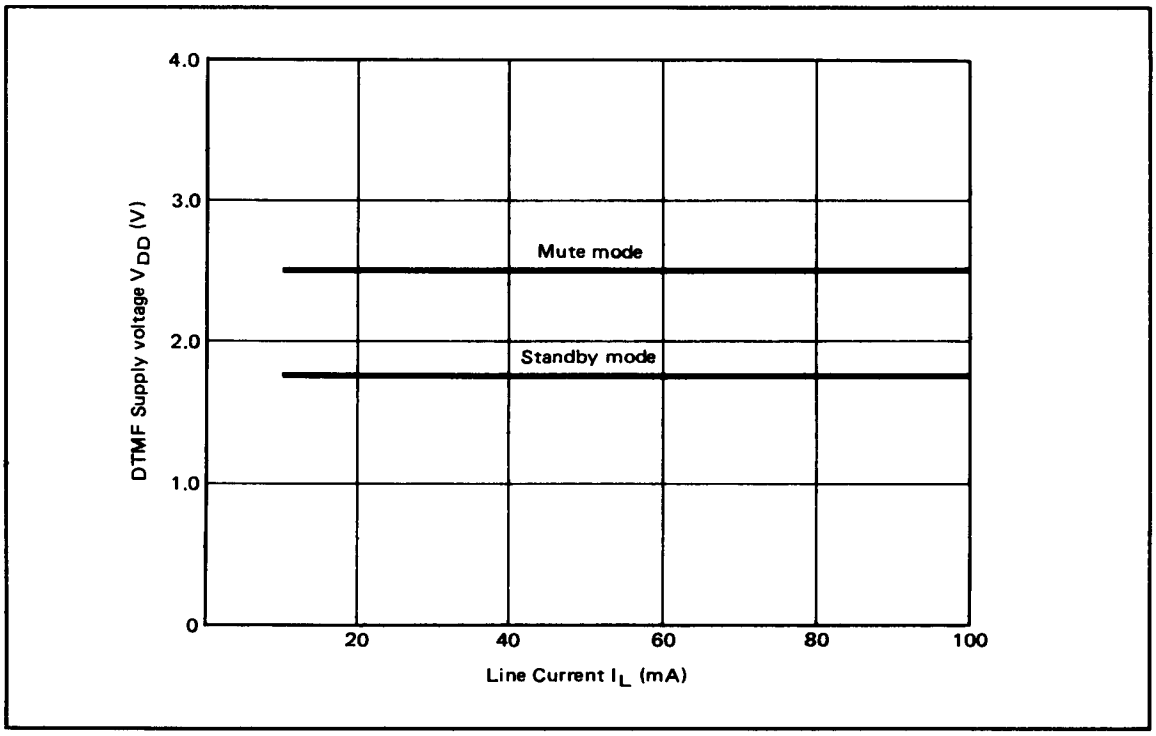
RECEIVING GAIN vs. LINE CURRENT



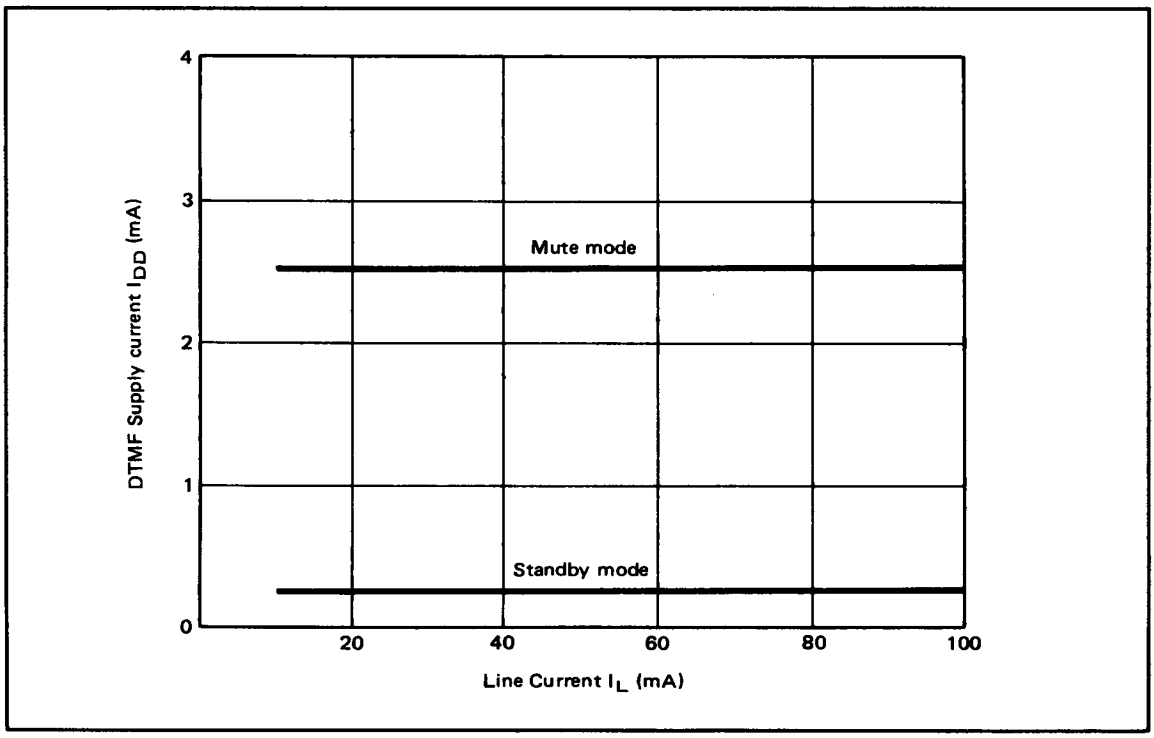
DTMF GAIN vs. LINE CURRENT



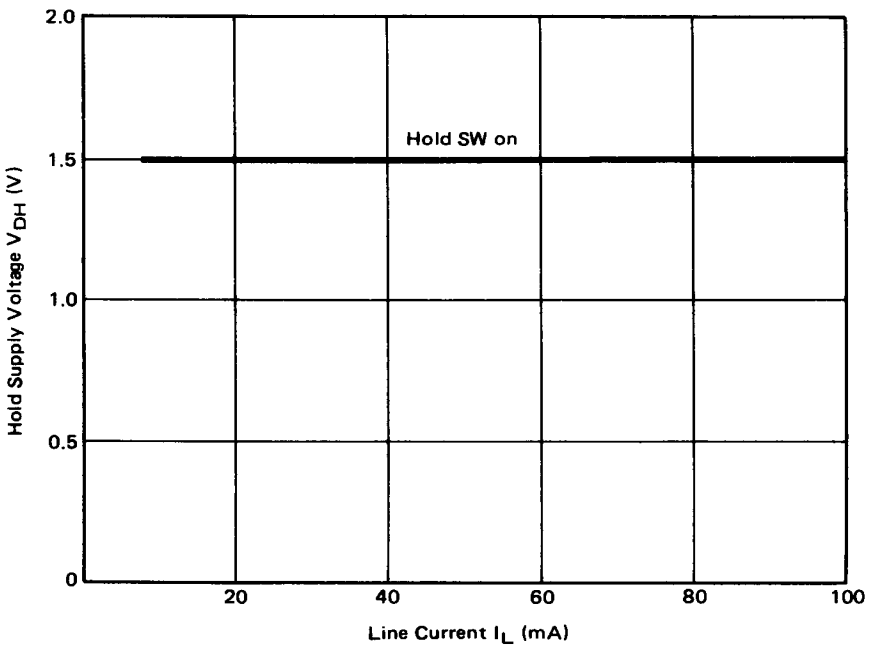
DTMF SENDING GAIN (ON-HOOK DIAL MODE) vs. LINE CURRENT



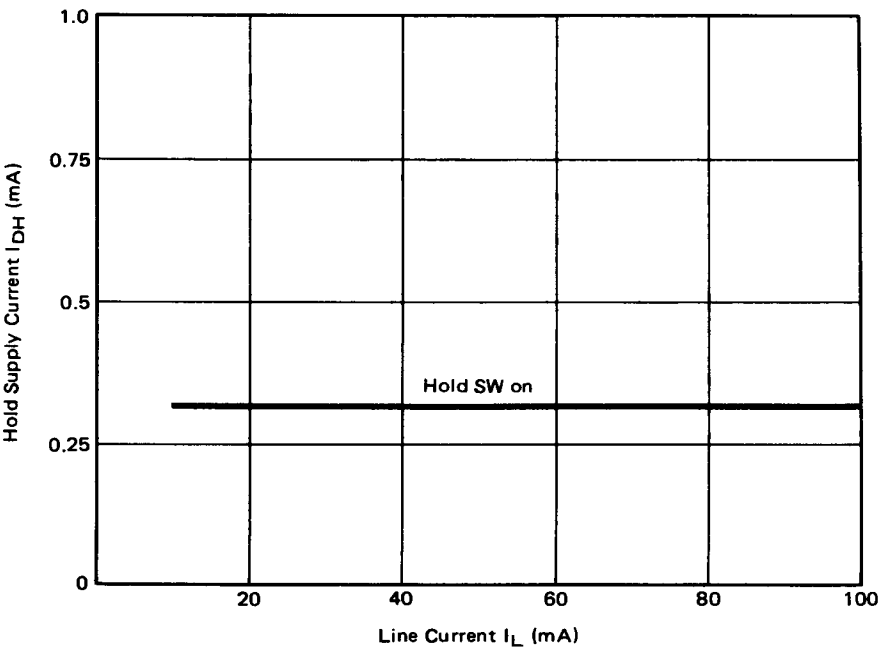
DTMF SUPPLY VOLTAGE vs. LINE CURRENT



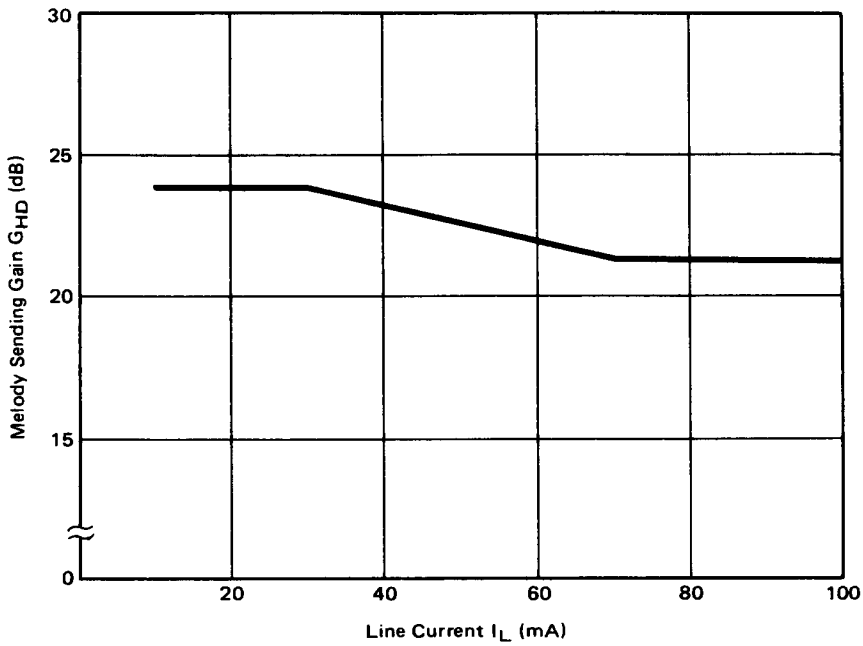
DTMF SUPPLY CURRENT vs. LINE CURRENT



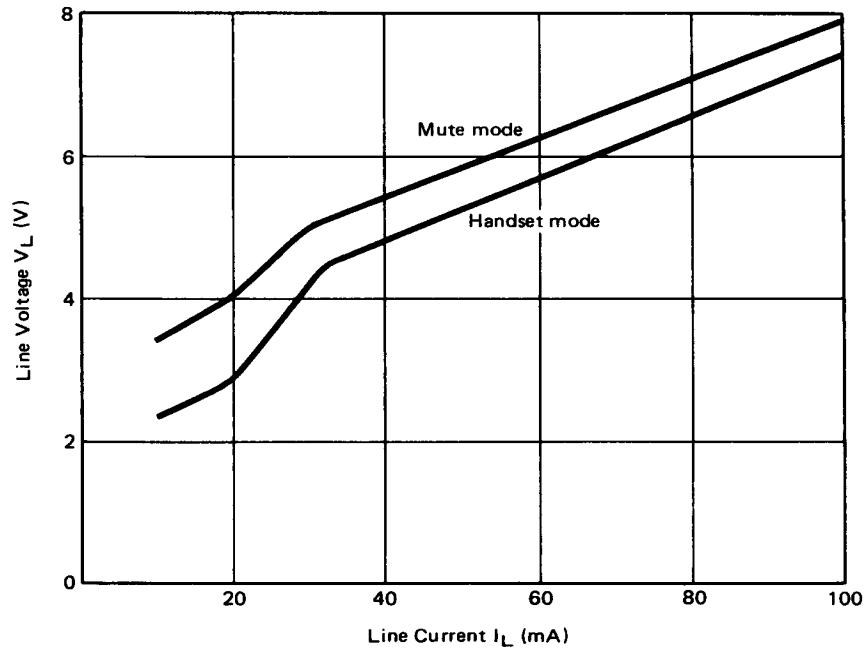
HOLD SUPPLY VOLTAGE vs. LINE CURRENT



HOLD SUPPLY CURRENT vs. LINE CURRENT

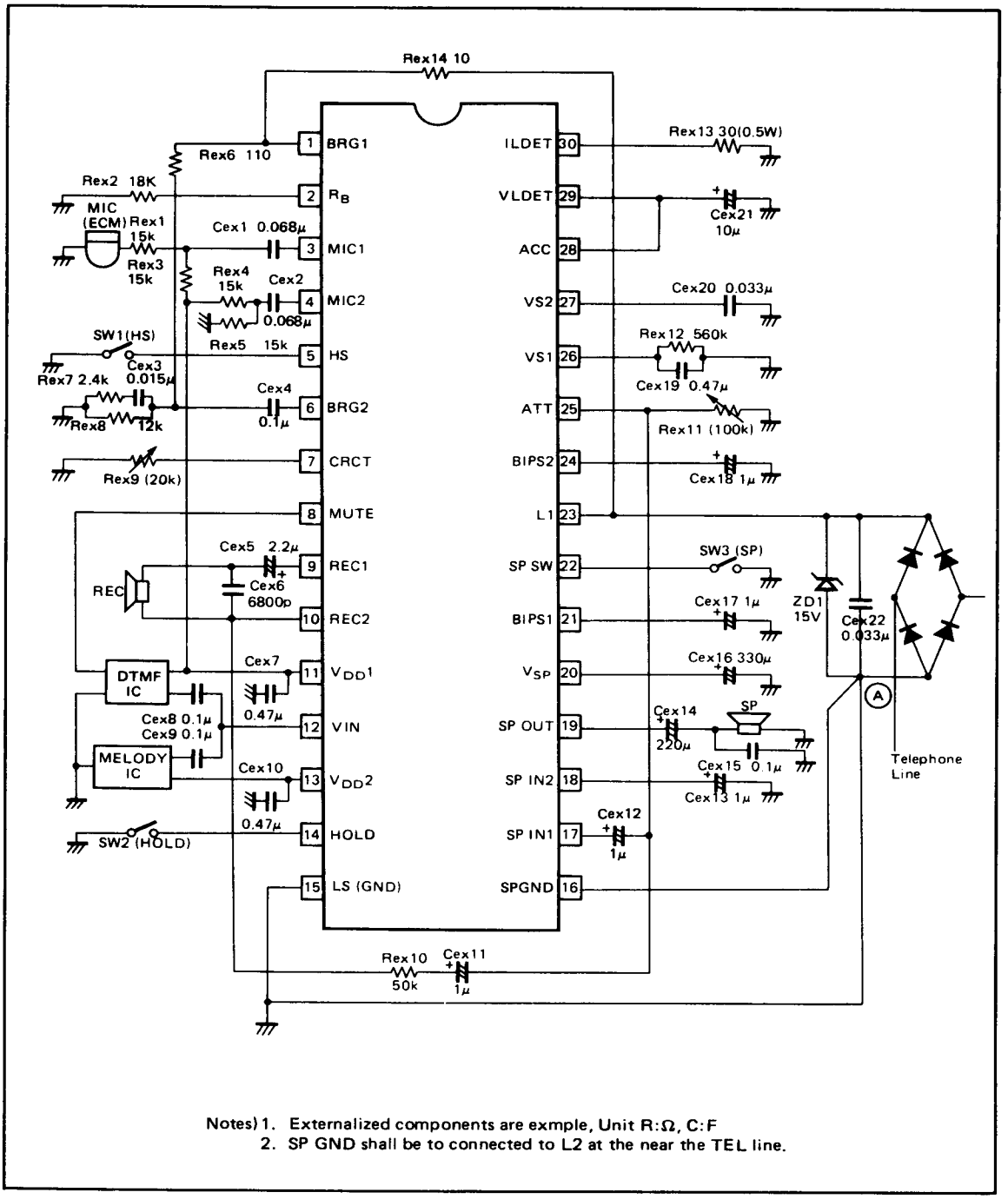


MELODY SENDING GAIN vs. LINE CURRENT



LINE VOLTAGE vs. LINE CURRENT

Circuit Example



Notes) 1. Externalized components are exmple, Unit R:Ω, C:F
2. SP GND shall be to connected to L2 at the near the TEL line.