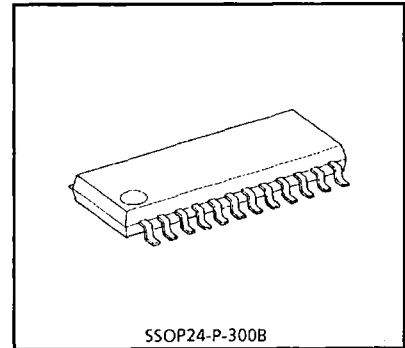


SPEECH NETWORK ICs

SPEECH NETWORK FOR TELEPHONE

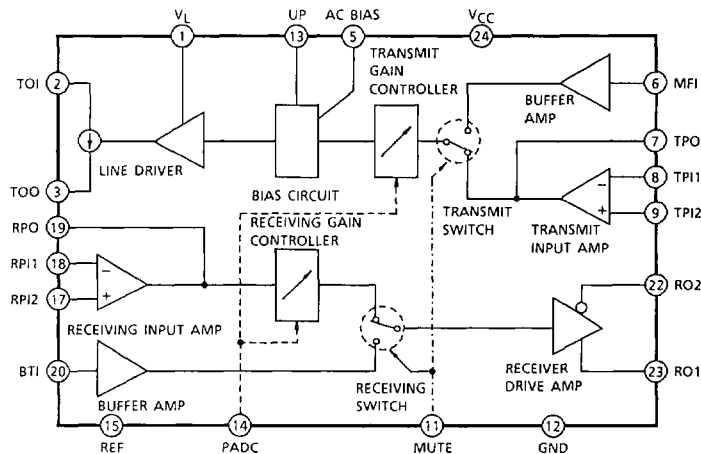
FEATURES

- Direct interface with light and compact ceramic transmitter-receiver is possible.
- Receiver of low impedance type can also be used.
- Low operating voltage provides an excellent branch performance.
- Switching between transmitter output and DTMF output is possible.
- Switching between input from the line and external signal is possible.
- Gain is automatically controlled according to the line current. (Auto pad function)
- The circuit for rising the line voltage is built in enabling the line voltage risen by the external terminal.
- Package is compact and thin. (MFP 24 pin)



Weight : 0.31g (Typ.)

BLOCK DIAGRAM



TA31065FA-1

SPEECH NETWORK ICs

PIN FUNCTION

PIN No.	PIN NAME	FUNCTION
1	V _L	[Line current flow-in terminal, line voltage terminal] Connected to positive output of diode bridge circuit. DC potential of this terminal determines line voltage, and if AC signal is not input, the highest DC potential appears. Transmit output signal and output signal of opposite transfer side are intermingled and output at this terminal in actual usage.
2	TOI	[Current flow-in terminal of transmit output] Connected to V _L terminal (pin 1) through 56Ω. Since almost all the line currents are flowed in from this terminal, set allowable power of resistance 56Ω to be connected to V _L terminal from this terminal considering the maximum current of line current expected to be used.
3	TOO	[Current output terminal of transmit output] Connected to GND terminal (pin 12) through 15Ω. Since almost all the line currents are flowed out from this terminal, set allowable power of resistance 15Ω to be connected to GND terminal from this terminal considering the maximum current of line current expected to be used. Transmit signal is sent from this terminal. Signal of this terminal varies current which is input from line through connected resistance 15Ω, and makes it be output at V _L terminal (pin 1).
5	AC BIAS	[AC signal reference voltage terminals] When AC signal is input to this terminal through capacitor (for blocking DC), signal is sent to line. Input from this terminal is output to line without any relation to gain control (PAD) or MUTE since this input does not pass through gain control circuit or MUTE function.
6	MFI	[Input terminal of DTMF or external input signals] Signal, which is input to this terminal, is output at V _L terminal (pin 1) only when MUTE terminal (pin 11) is in "L" state. Since this terminal is biased to almost the same potential as REF terminal (pin 15), avoid direct impress of external DC potential by using capacitor at inputting external signal.
7	TPO	[Output terminal of transmit input amplifier] Makes negative feedback to TPI1 terminal (pin 8).
8	TPI1	[Inversion input terminal of transmit input amplifier] Receives negative feedback from TPO terminal (pin 7).
9	TPI2	[Non-inversion input terminal of transmit input amplifier] Apply DC bias to this terminal from REF terminal (pin 15) through resistance.

2

TA31065FA-2

SPEECH NETWORK ICs

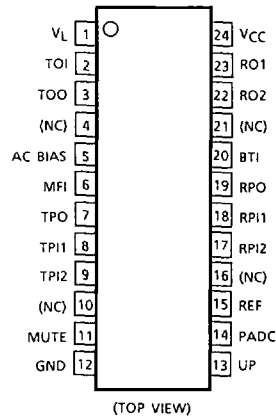
PIN No.	PIN NAME	FUNCTION
11	MUTE	<p>[MUTE terminal]</p> <p>Switching terminal of transmit signal with MFI input signal in transmit system. Switching terminal of receiving signal with BTI input in receiving system.</p> <p>"L" state Signal, which is input from MFI, is output to V_L terminal (pin 1). Signal, which is input from BTI, is output to terminals RO1 and RO2 (pin 23, pin 22).</p> <p>"H" or "OPEN" state .. Transmit input signal is output to V_L terminal (pin 1). Receiving input signal is output to terminal RO1 and RO2 (pin 23, pin 25).</p> <p>This terminal is pulled up by constant-current circuit.</p>
12	GND	<p>[Ground terminal]</p> <p>Connected to negative output of diode bridge circuit.</p>
13	UP	<p>[DC impedance control terminal]</p> <p>When this terminal is connected to GND terminal (pin 12) directly or through resistance, DC potential of V_L terminal (pin 1) can be increased up to max. 1.5V (Typ.) in the same line current.</p> <p>This function has no relation with state of MUTE terminal.</p>
14	PADC	<p>[Pad control terminal]</p> <p>When this terminal is connected to GND terminal (pin 12) or V_{CC} terminal (pin 24) through resistance, operation current of gain control (auto-pad) performed by line current can be controlled.</p>
15	REF	<p>[Internal reference voltage output terminal]</p> <p>Voltage of this terminal is used as reference voltage of internal pre-amplifier. Never use this terminal as an external power supply.</p>
17	RPI2	<p>[Non-inversion input terminal of receiving input amplifier]</p> <p>Apply DC bias to this terminal from REF terminal (pin 15) through resistance.</p>
18	RPI1	<p>[Inversion input terminal of receiving input amplifier]</p> <p>Receives negative feedback from RPO terminal (pin 19).</p>
19	RPO	<p>[Output terminal of receiving input amplifier]</p> <p>Makes negative feedback to RPI1 terminal (pin 18).</p>
20	BTI	<p>[Dial confirmation sound (Beep tone, DTMF), monitor sound input terminal]</p> <p>Signal, which is input to this terminal, is output to terminals RO1 and RO2 (pin 23 and pin 22) only when MUTE terminal (pin 11) is in "L" state.</p> <p>Since this terminal is biased to about the same potential as REF terminal (pin 15), avoid direct impressing of external DC voltage through capacitor at inputting external signal.</p>

TA31065FA-3

SPEECH NETWORK ICs

PIN No.	PIN NAME	FUNCTION
22	RO2	[Receiving output terminal, inversion output] Output terminal to receiver. Signal, of which phase is negative of RO1 terminal (pin 23), is output.
23	RO1	[Receiving output terminal, non-inversion output] Output terminal to receiver. Signal, of which phase is negative to RO2 terminal (pin 22), is output.
24	VCC	[Internal power supply voltage terminal] Power supply of internal pre-amplifier.

PIN CONNECTION

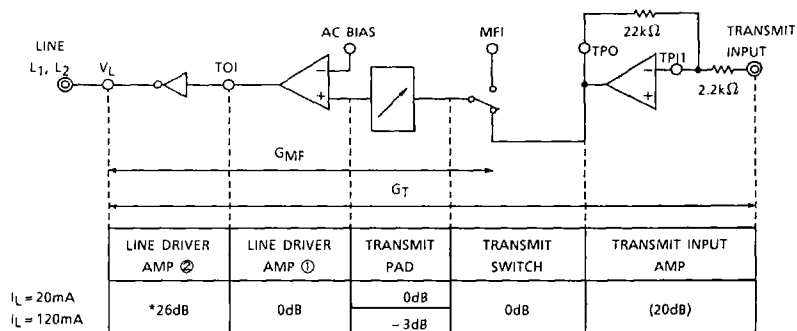


SPEECH NETWORK ICs

DESCRIPTION

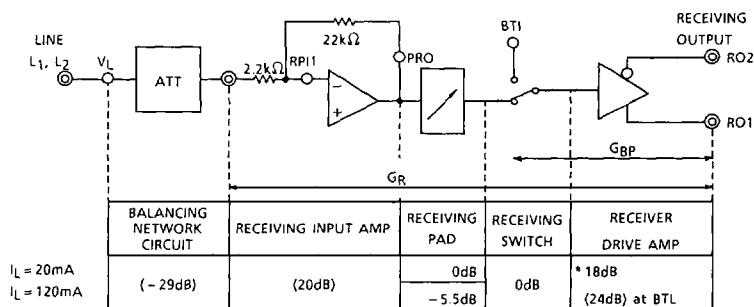
1. Gain distribution

(1) Transmit system gain distribution



* At line 600Ω termination

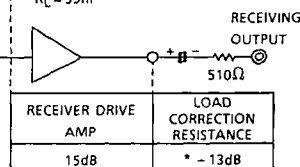
(2) Receiving system gain distribution



* Ceramic receiver

$R_L = 55\text{nF}$

FOR RECEIVER OF LOW-IMPEDANCE TYPE
~150Ω



* Dynamic receiver

$R_L = 150\Omega$

- The gain value is the one roughly determined.
- Contents in () can externally be varied.

TA31065FA-5

2. Gain control circuit (PADC terminal)

(1) PADC terminal open state

Transmit and receiving gains automatically vary according to the line current amount (auto-pad). With the increase of line current amount, the gain attenuates by about -3dB at transmit and about -5.5dB at receiving.

(2) In case PADC terminal is connected to GND by resistance.

The gain begins to attenuate with the line current amount less than that when PADC terminal is open.

Set the value of resistance to be connected at $25\text{k}\Omega$ or over.

(3) In case PADC terminal is connected to V_{CC} by resistance.

The gain begins to attenuate with the line current amount more than that when PADC terminal is open.

Set the value of resistance to be connected at $10\text{k}\Omega$ or over.

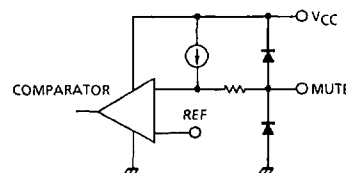
3. Muting circuit (MUTE terminal)

The internal equivalent circuit in the MUTE terminal is as shown in the figure below.

Since the protective diode is connected between V_{CC} and GND, avoid impressing the voltage over that of V_{CC} or below GND.

This is most suitable for the input from the output of open drain or open collector type.

INTERNAL EQUIVALENT CIRCUIT OF MUTE TERMINAL



4. Line voltage-increasing circuit (UP terminal)

The voltage of V_L , V_{CC} or V_{REF} can be increased by connecting UP terminal to GND directly or through the resistance.

The internal equivalent circuit is as shown in the figure.

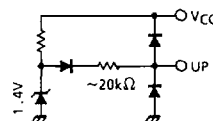
(1) The voltage increased the most up to about 1.5V in V_L when UP terminal is directly connected to GND. When the resistance is inserted, the voltage increases according to the resistance value. (See graph.)

(2) In case of usage with MUTE terminal connected, the line voltage can be increased only at muting. (The same effect as that at using UPS terminals of TA31032P and TA31033P.)

(3) Avoid impressing the voltage over V_{CC} or under GND.

(4) When not in use, make the circuit open or connected to V_{CC} .

INTERNAL EQUIVALENT CIRCUIT OF UP TERMINAL



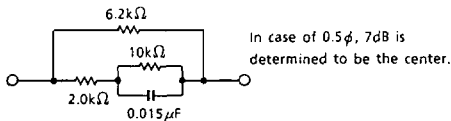
SPEECH NETWORK ICs

5. Side tone protection circuit (Balancing network)

The constant (hereafter referred to as BN constant) of the side tone protection circuit in the example of application circuit is adjusted nearly to 0.4ϕ 7dB.

Since the side tone characteristic varies according to this BN constant, adjust the constant confirming to the function of the telephone set.

EXAMPLE OF BN CONSTANT



6. Transmitter

As the transmitter, (1) the condenser microphone, (2) the ceramic type and (3) the dynamic type (speaker type) are available. However, since (1) and (2) of FET-or-transistor built-in type require the bias circuit, externally provide the bias circuit.

For the circuit example, refer to the example of the application circuit.

7. Receiver

As the receiver, (1) the ceramic type (2) the low-impedance type (dynamic type) are available.

- (1) Ceramic type The receiver of equivalent capacity of about 55nF is assumed.
In case of the ceramic type, since the large voltage amplitude is generally required at driving, make the receiver function in BTL mode.
- (2) Low-impedance type .. The receiver of equivalent resistance of about 150Ω is assumed.
For the connection, refer to the example of application circuit.

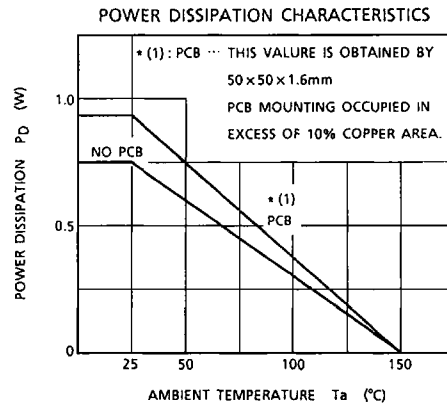
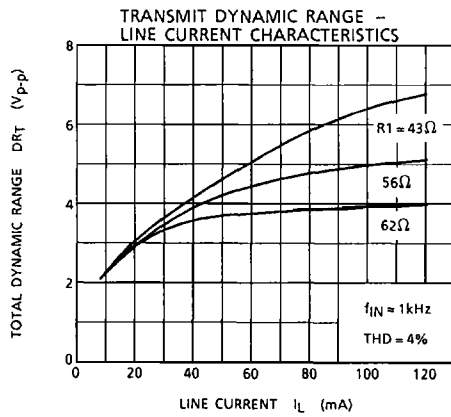
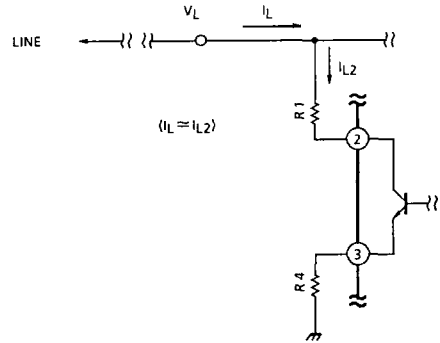
SPEECH NETWORK ICs

8. Transmit dynamic range

Transmit dynamic range is adjusted in R1.

(Take care of radiation in IC, when resist R1 varied to small.)

$$[P_D \approx V_L \cdot I_L - (R1 + R4) \cdot I_L^2]$$

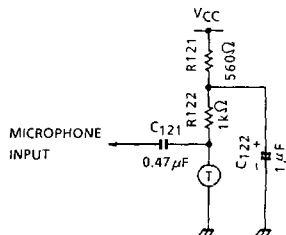


TA31065FA-8

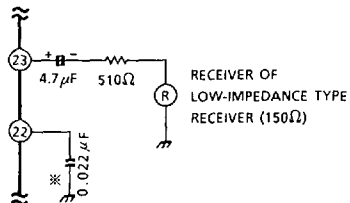
SPEECH NETWORK ICs

EXAMPLE OF APPLICATION CIRCUIT

1. Example of power supply circuit for condenser microphone



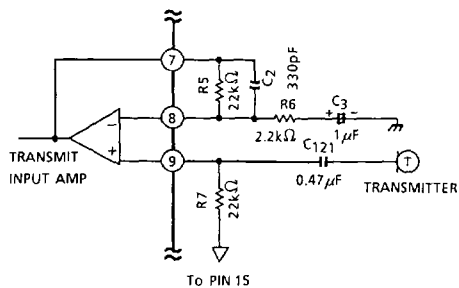
2. Example of connection circuit of low-impedance type receiver



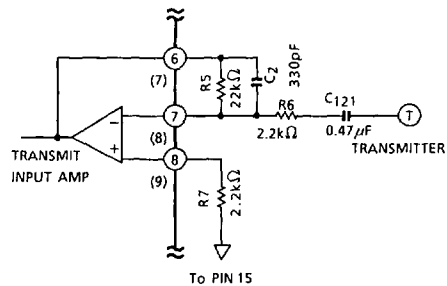
※ Insertion is required oscillation.

3. Example of application circuit of receiving input amplifier

(In case of using transmit input amplifier as non-inversion input)



(In case of using transmit amplifier as inversion input)



(Note) In test circuit and example of application circuit, transmit input amplifier is set at inversion input.

TA31065FA-9

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Line Voltage	V_L	20	V
Line Current	I_L	150	mA
Power Dissipation	P_D	(*1) 750 (*2) 950	mW
Operating Temperature	T_{opr}	-30~60	°C
Storage Temperature	T_{stg}	-55~150	°C

(*1) No PCB

(*2) This value is obtained by 50 x 50 x 1.6mm PCB mounting occupied in excess of 10% of copper area.

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Line Voltage	V_L	1	$I_L = 20\text{mA}$ $I_L = 120\text{mA}$	2.9 9	3.2 11	3.6 14	V
Internal Power Supply Voltage	V_{CC}	1	$I_L = 20\text{mA}$ $I_L = 120\text{mA}$	1.80 6.0	1.95 6.3	2.20 6.6	V
Line Voltage Rise Up Amount	ΔV_L	1	$I_L = 20\text{mA}$	1.1	1.5	2.1	V
Transmit Gain	G_T	2	$I_L = 20\text{mA}$ $I_L = 120\text{mA}$ $f_{IN} = 1\text{kHz}$ $V_{IN} = -55\text{dBV}$	43 40	46 43.2	48 45	dB
Receiving Gain	G_R	4	$I_L = 20\text{mA}$ $I_L = 120\text{mA}$ $f_{IN} = 1\text{kHz}$ $V_{IN} = -55\text{dBV}$	40 34.5	43.5 38	46 40.5	dB
MF Gain	G_{MF}	3	$I_L = 20\text{mA}$ $I_L = 120\text{mA}$ $f_{IN} = 1\text{kHz}$ $V_{IN} = -30\text{dBV}$	24 21.5	26.8 24	28 25.5	dB
Beep Gain	G_{BP}	5	$I_L = 20\text{mA}$ $I_L = 120\text{mA}$ $f_{IN} = 1\text{kHz}$ $V_{IN} = -30\text{dBV}$	21 21.5	24 24.5	27 27.5	dB
Transmit Dynamic Range	DR_T	2	$I_L = 20\text{mA}$ $I_L = 120\text{mA}$ Distortion Ratio 4%	— —	3.2 5.5	— —	V_{p-p}
Receiving Dynamic Range	DR_R	4	$I_L = 20\text{mA}$ $I_L = 120\text{mA}$ Distortion Ratio 10%	3.0 6.0	— —	— —	V_{p-p}
MFI Input Resistance	Z_I (MF)	—	—	21	30	—	k Ω
BTI Input Resistance	Z_I (BP)	—	—	7	10	—	k Ω
AC BIAS Input Resistance	Z_I (AB)	—	—	21	30	—	k Ω
MUTE Terminal Input Voltage	"H" Level	V_{IH} (MU)	—	$I_L = 20 \sim 120\text{mA}$	$V_{CC} - 0.5$	V_{CC}	V
	"L" Level	V_{IL} (MU)	—	$I_L = 20 \sim 120\text{mA}$	0	0.2	V

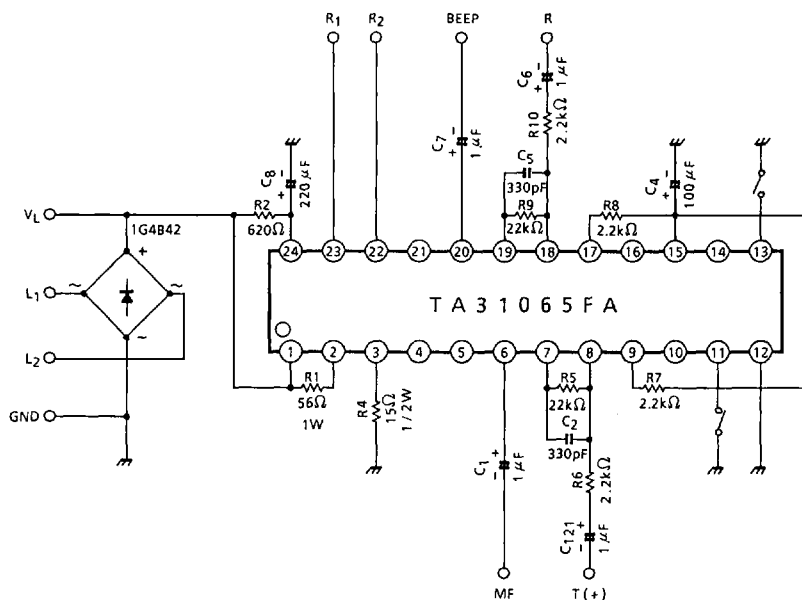
TA31065FA-10

SPEECH NETWORK ICs

REFERENCE DATA

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION	TYP.	UNIT
Internal Reference Voltage	V_{REF}	—	$I_L = 20\text{mA}$	0.66	V
			$I_L = 120\text{mA}$	2.8	
RO1, RO2 Output Impedance	Z_{RO}	—	$I_L = 30\text{mA}$, $f_{IN} = 1\text{kHz}$	200	Ω
Total Receiving Gain	G_R (TOTAL)	—	$I_L = 20\text{mA}$	14.5	dB
			$I_L = 120\text{mA}$ (Balancing network circuit included.)	9.0	
MUTE Terminal Input Current	I_{IL} (MU)	—	$I_L = 20\text{mA}$, $V_{IL} = 0.2\text{V}$	-50	μA
UP Terminal Input Current	I_{IL} (UP)	—	$I_L = 20\text{mA}$ at GND connection	-35	μA
AC Impedance	$ Z _{TEL}$	—	$I_L = 50\text{mA}$, $f_{IN} = 1\text{kHz}$	580	Ω
Phase	θ	—	$I_L = 50\text{mA}$, $f_{IN} = 1\text{kHz}$	3	$^\circ$

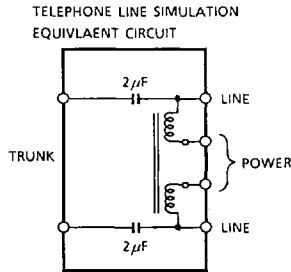
TEST CIRCUIT



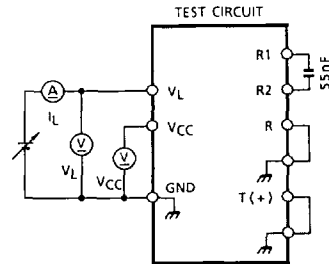
TA31065FA-11

SPEECH NETWORK ICs

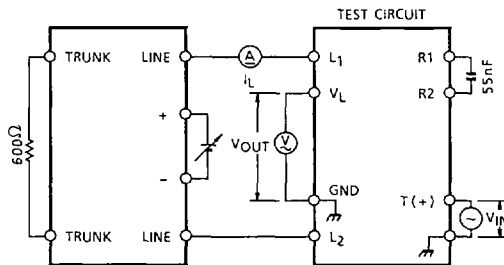
TEST CIRCUIT



(1) V_L , V_{CC}

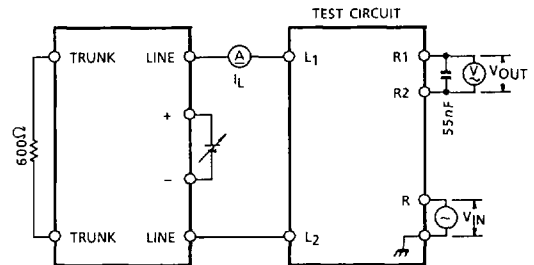


(2) G_T , DR_T



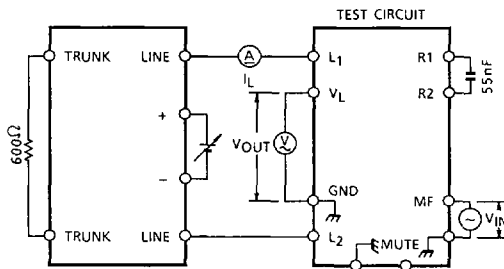
TRANSMIT GAIN : $G_T = 20 \log |V_{OUT} / V_{IN}|$ (dB)
TRANSMIT DYNAMIC RAGNE : $DR_T = V_{OUT}$ (Vp-p)
(at V_{OUT} : DIST = 4%)

(3) G_R , DR_R



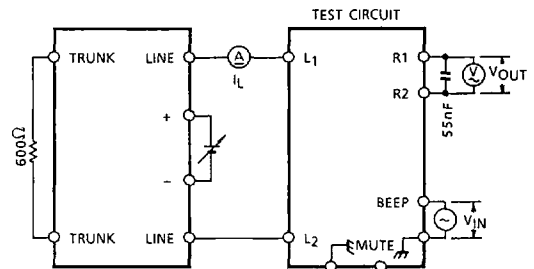
RECEIVING GAIN : $G_R = 20 \log |V_{OUT} / V_{IN}|$ (dB)
RECEIVING DYNAMIC RAGNE : $DR_R = V_{OUT}$ (Vp-p)
(at V_{OUT} : DIST = 10%)

(4) G_{MF}



MF GAIN : $G_{MF} = 20 \log |V_{OUT} / V_{IN}|$ (dB)

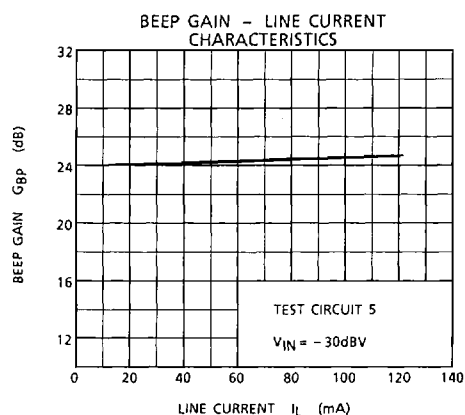
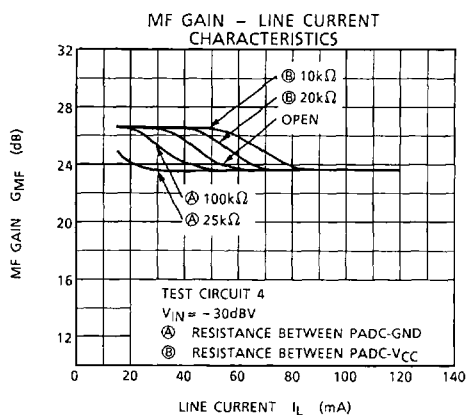
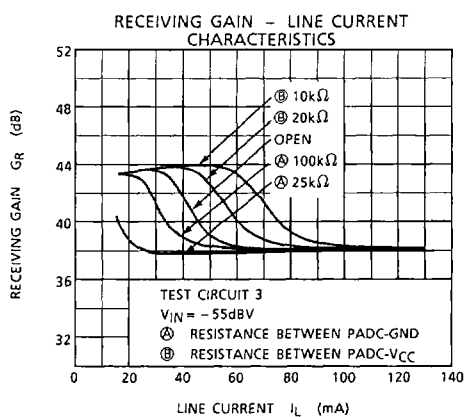
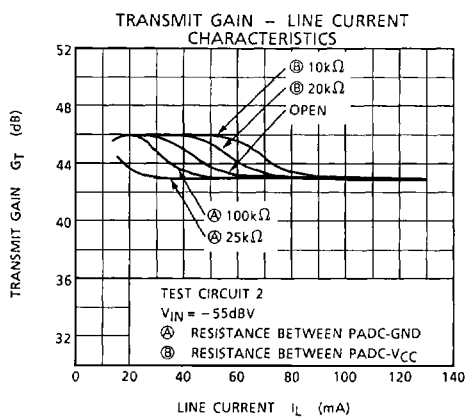
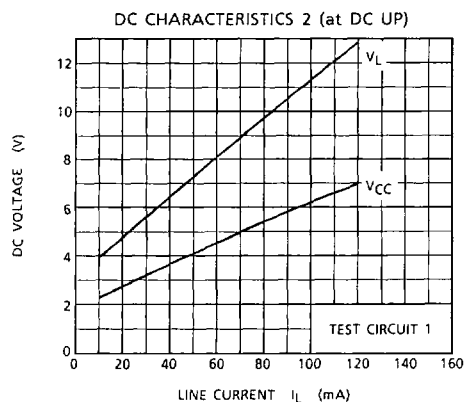
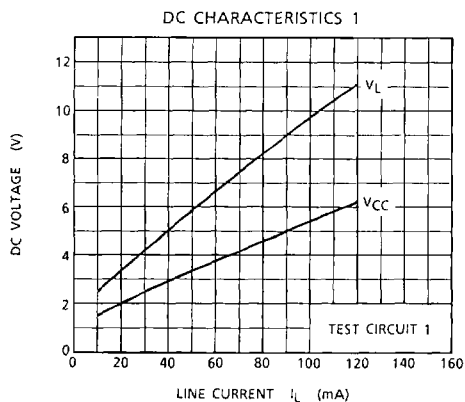
(5) G_{BP}



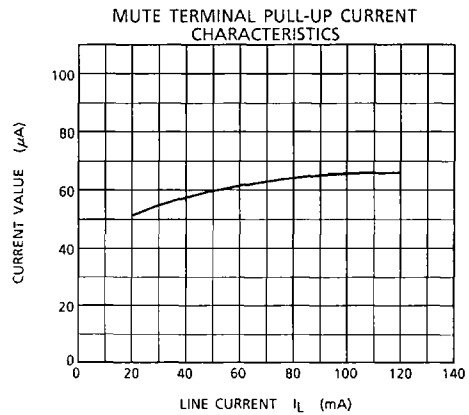
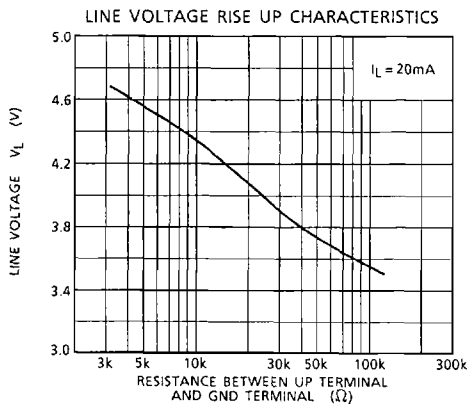
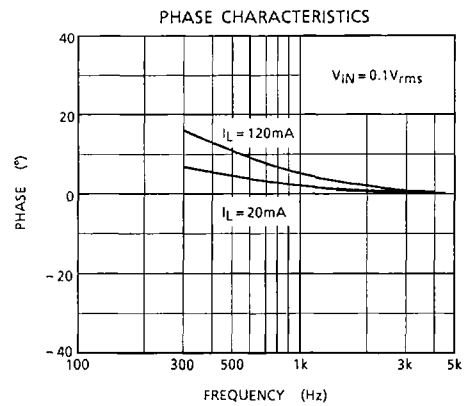
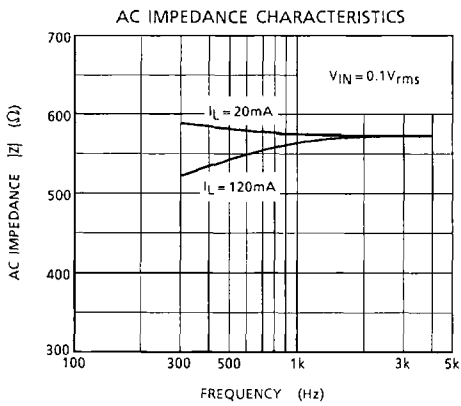
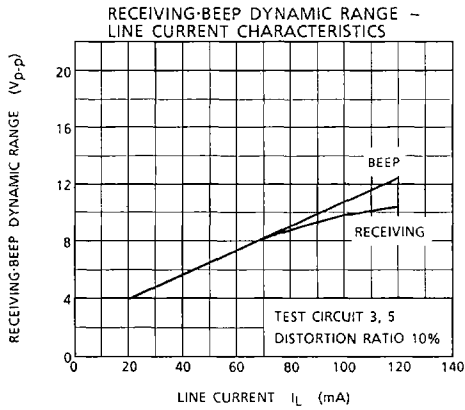
BEEP GAIN : $G_{BP} = 20 \log |V_{OUT} / V_{IN}|$ (dB)

TA31065FA-12

SPEECH NETWORK ICs



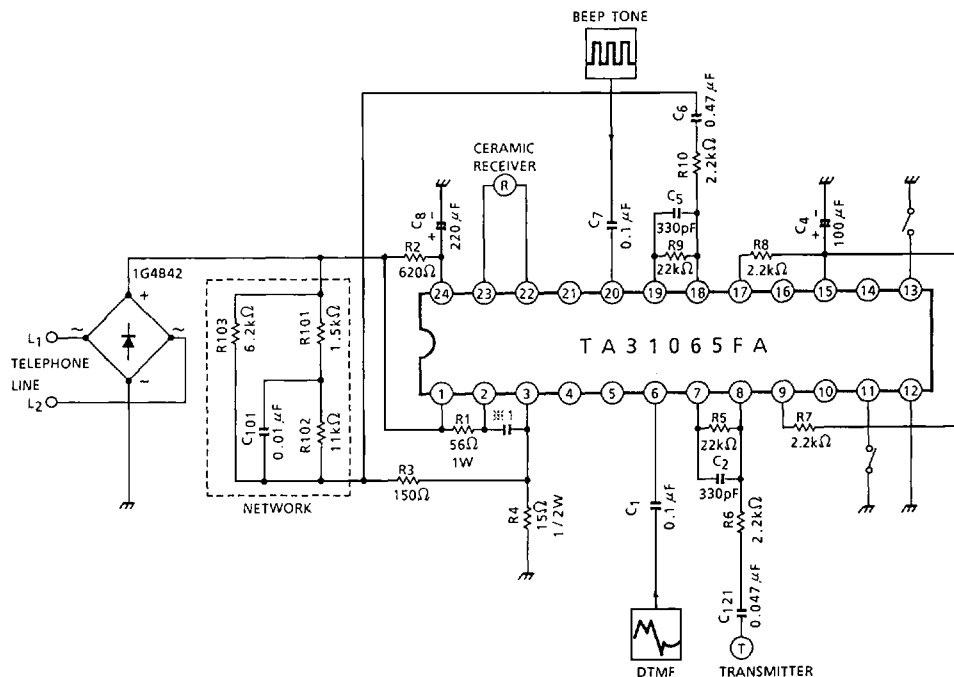
TA31065FA-13



TA31065FA-14

SPEECH NETWORK ICs

EXAMPLE OF APPLICATION CIRCUIT



※ 1 : When the oscillation is mode due to the loaded condition between the V_L and the GND, insert the capacitor of approx $0.1\mu F$.

TA31065FA-15