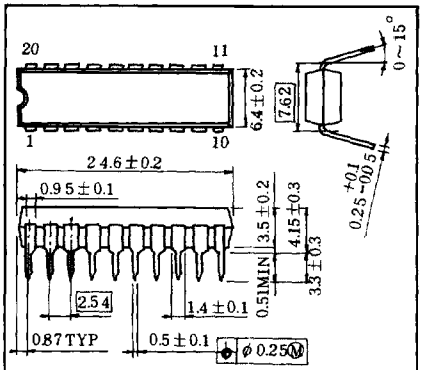
TA31031P, TA31031F

SPEECH NETWORK (For Telephone)

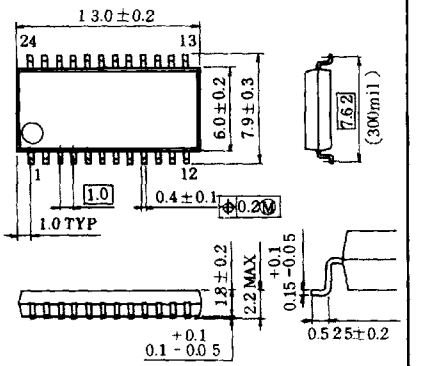
- Direct interface with light and compact ceramic transmitter-receiver is possible.
- Switching between transmitter output and DTMF output is possible.
- Switching between input from the line and external signal is possible.
- Gain control (auto pad) is made automatically according to line current.
- Gain control terminal (manual pad) for PBX system is provided.
- Low operating voltage provides an excellent branch performance.
- Total Gain of transmit and receiving, and frequency characteristics are possible to be controlled by means of external components.
- Flat package for surface mount is provided.
  TA31031F(MFP-24 PIN)

Unit in mm



Package width and length do not include mold protrusion.
Allowable mold protrusion is 0.15mm.

JEDEC	—
TOSHIBA	DIP20-P-300A



Package width and length do not include mold protrusion.
Allowable mold protrusion is 0.15mm.

JEDEC	—
TOSHIBA	SSOP24-P-300

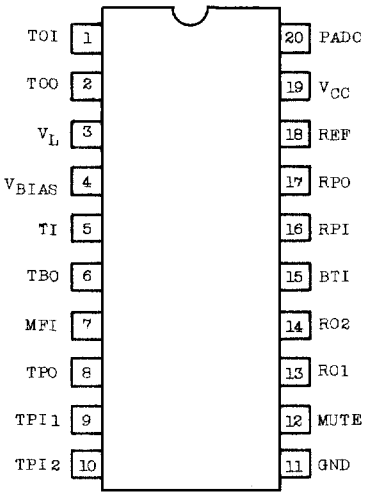
MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC		SYMBOL	RATING	UNIT
Line Voltage		V_L	15	V
Line Current		I_L	150	mA
Power Dissipation	TA31031P	P_D	1300	mW
	TA31031F		450	
Operating Temperature	TA31031P	T_{opr}	-40~85	°C
	TA31031F		-30~60	
Storage Temperature		T_{stg}	-55~150	°C
Peak Line Current *		$I_{L\ peak}$	200	mA

* TA31031P only.

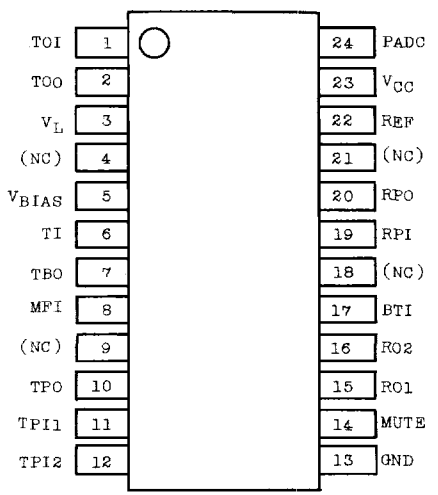
PIN CONNECTION

TA31031P



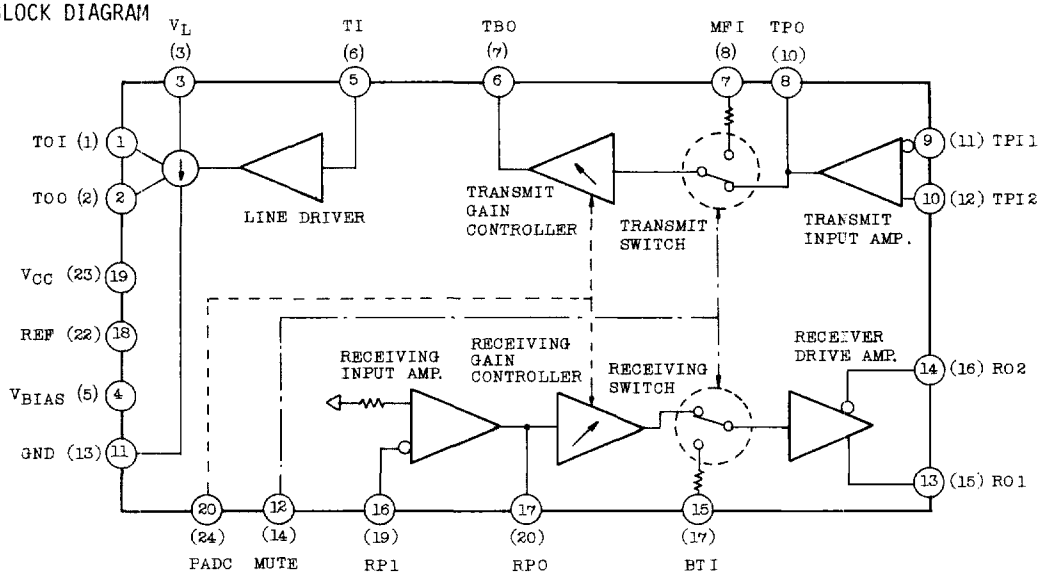
(TOP VIEW)

TA31031F



(TOP VIEW)

BLOCK DIAGRAM



No. of pin in ( ) is TA31031F.

ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Line Voltage		V_L	1	I_L=20mA		2.5	2.8	3.25	V
				I_L=80mA		6.8	7.6	8.6	
Internal Power Supply Voltage		V_{CC}	1	I_L=20mA		1.7	1.9	2.3	V
				I_L=80mA		4.8	5.4	6.0	
Transmit Gain		G_T	2	f=1kHz	I_L=30mA	38	40	42	dB
				v_{in}=-55dBV	I_L=80mA	33	35	37	
Receiving Gain		G_R	4	f=1kHz	I_L=30mA	12	14.5	17	dB
				v_{in}=-30dBV	I_L=80mA	8.0	10.5	13	
MF Gain		G_{MF}	3	f=1kHz	I_L=30mA	19	21	23	dB
				v_{in}=-35dBV	I_L=80mA	14	16	18	
Beep Gain		G_{BP}	5	f=1kHz	I_L=30mA	15.5	18	20.5	dB
				v_{in}=-35dBV	I_L=80mA	17	19.5	22	
Transmit Dynamic Range	TA31031P	DR_T	2	Distortion Ratio 4%	I_L=30mA	3.0	4.5	-	Vp-p
					I_L=80mA	5.0	6.5	-	
	TA31031F				I_L=30mA	2.5	3.5	-	
					I_L=80mA	4.5	5.5	-	
Receiving Dynamic Range		DR_R	4	Distortion Ratio 4%	I_L=30mA	2.5	3.2	-	Vp-p
					I_L=80mA	4.0	5.0	-	
Transmit Manual Pad Attenuation		ΔG_{TM}	-	I_L=30mA		-	-5	-	dB
Receiving Manual Pad Attenuation		ΔG_{RM}	-	I_L=30mA		-	-5	-	dB
MFI Input Impedance		Z_{MFI}	-			12	-	-	kΩ
BTI Input Impedance		Z_{BTI}	-			12	-	-	kΩ

FUNCTION OF EACH TERMINAL

TERMINAL No.	SYMBOL	FUNCTION
1 (1)	TCI	[Current input terminal of transmit output] This terminal is connected to V_L terminal (③ (3) pin) through 27Ω. Almost all the line currents are flowed in from this terminal, and set allowable power of resistance 27Ω to be connected to V_L terminal from this terminal considering the maximum current of the line current expected to be used.
2 (2)	TCO	[Current output terminal of transmit output] This terminal is connected to GND terminal (⑪ (13) pin) through 15Ω. Almost all the line currents are flowed out from this terminal, and set allowable power of resistance 15Ω to be connected to GND terminal from this terminal considering the maximum current of the line current expected to be used.
3 (3)	V_L	[Line current flow-in terminal] This terminal is connected to positive output of diode bridge circuit. The DC potential of this terminal determines the 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.
4 (5)	V_{BIAS}	[DC voltage reference power supply] This terminal is connected to GND terminal (⑪ (13) pin) through capacitor 0.47μF. Never use this terminal as an external power supply.
5 (6)	TI	[Input terminal of line driver amplifier]
6 (7)	TBO	[Output terminal of transmit gain controller] To this terminal, either of the signals selected from the signal input from a transmitter and the signal input from MFI terminal (⑦ (8) pin) is output. In auto pad condition (described later), the signal is output in the condition where gain is controlled.

No. of pin in ( ) is TA31031F.

FUNCTION OF EACH TERMINAL

TERMINAL No.	SYMBOL	FUNCTION
7 (8)	MFI	[Input terminal of DTMF or external signals] When MUTE terminal (⑫ (14) pin) is connected to GND terminal (⑪ (13) pin), the signal input in this terminal is output to TBO terminal (⑥ (7) pin). Since almost the same electric potential as that of REF terminal (⑱ (22) pin) is biased to this terminal avoide direct impress of external DC potential by capacitor at impressing external signal.
8 (10)	TPO	[Output terminal of transmit input amplifier] This terminal makes negative feedback to TPI1 terminal (⑨ (11)pin).
9 (11)	TPI1	[Inversion input terminal of transmit input amplifier] This terminal receives negative feedback from TPO terminal (⑧ (10) pin).
10 (12)	TPI2	[Non-inversion input terminal of transmit input amplifier] Apply DC bias to this terminal from REF terminal (⑱ (22) pin) through resistance.
11 (13)	GND	[Ground terminal] This terminal is connected to negative output of diode bridge circuit.
12 (14)	MUTE	[Mute terminal] [Terminal for switching DTMF signal and transmit signal in the transmit system] [Terminal for switching BEEP signal and receiving signal in the receiving system] When this terminal is connected to GND terminal, the input signal from MFI terminal (⑦ (8) pin) is output to TBO terminal (⑥ (7) pin). Further, the input signal from BTI terminal (⑮ (17) pin) is output to RO1 and RO2 terminals (⑬ (15) and ⑭ (16) pins).
13 (15)	RO1	[Receiving output terminal] This terminal is connected to the ceramic receiver directly or through resistance.

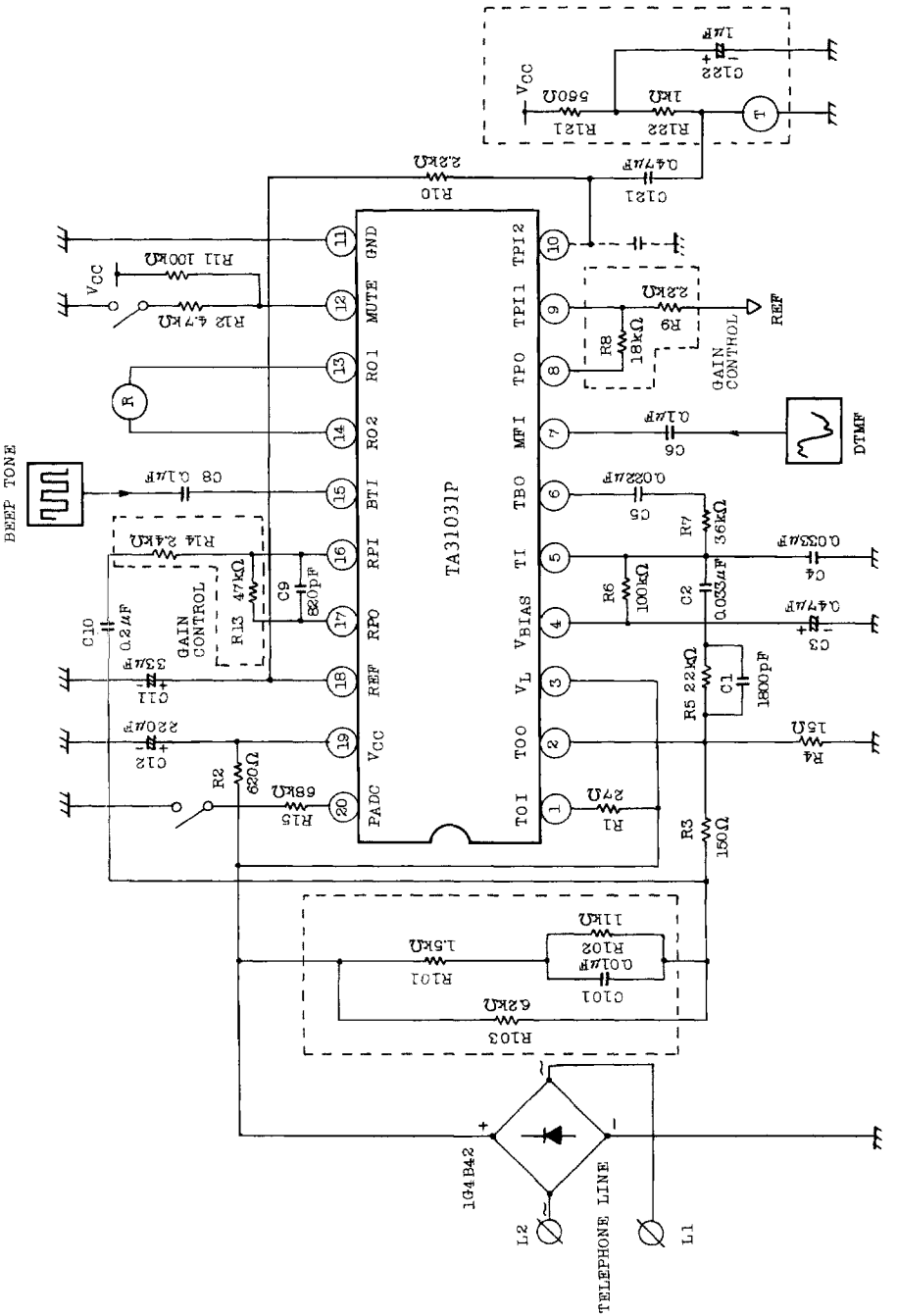
No. of pin in ( ) is TA31031F.

FUNCTION OF EACH TERMINAL

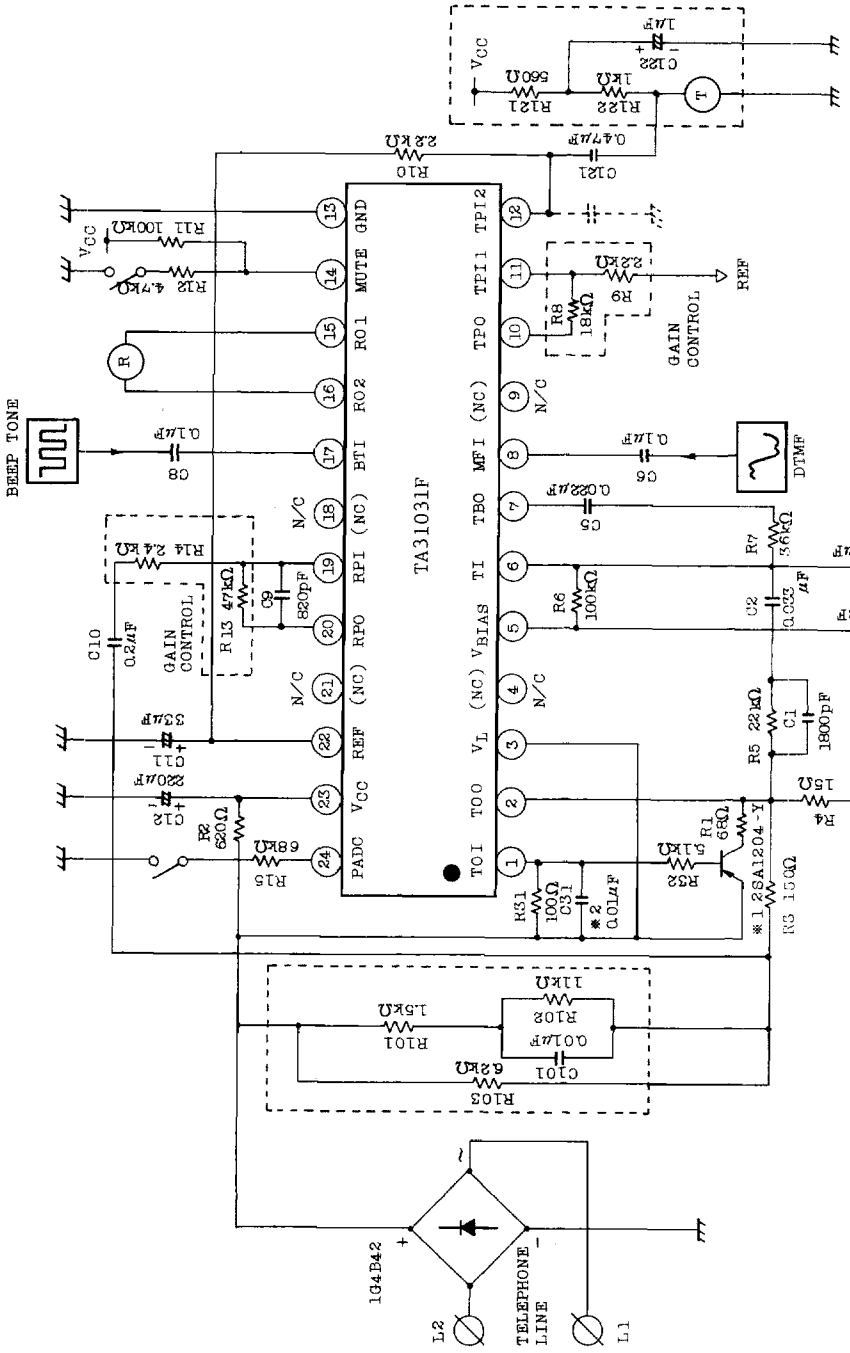
TERMINAL No.	SYMBOL	FUNCTION
14 (16)	RO2	[Receiving output terminal (inversion side)] This terminal outputs the signal of reverse phase to RO1 terminal (⑬ (15) pin). It is connected to the ceramic receiver directly or through resistance.
15 (17)	BTI	[Input terminal of dial confirmation sound (BEEP TONE) or external signals] When MUTE terminal (⑫ (14) pin) is connected to GND terminal (⑪ (13) pin), the signal input in this terminal is output to RO1 and RO2 terminals (⑬ (15) and ⑭ (16) pins). The electrical characteristics are the same as those of MFI (⑦ (8) pin).
16 (19)	RPI	[Inversion input terminal of receiving input amplifier] This terminal receives negative feedback from RPO terminal (⑰ (20) pin).
17 (20)	RPO	[Output terminal of receiving input amplifier] This terminal makes negative feedback to RPI terminal (⑯ (19) pin).
18 (22)	REF	[Internal reference voltage output terminal] The voltage of this terminal is used for the reference voltage of an internal pre-amplifier. Never use this terminal as an external power supply.
19 (23)	V_{CC}	[Power supply voltage terminal]
20 (24)	PADC	[Pad control terminal] By connecting this terminal to GND terminal (⑪ (13) pin)(Manual pad), a fixed attenuation enters in transmit and receiving gain. In this case, the gain is not varied by the current value of the line.

No. of pin in ( ) is TA31031F.

TA31031P AN EXAMPLE OF APPLICATION CIRCUIT

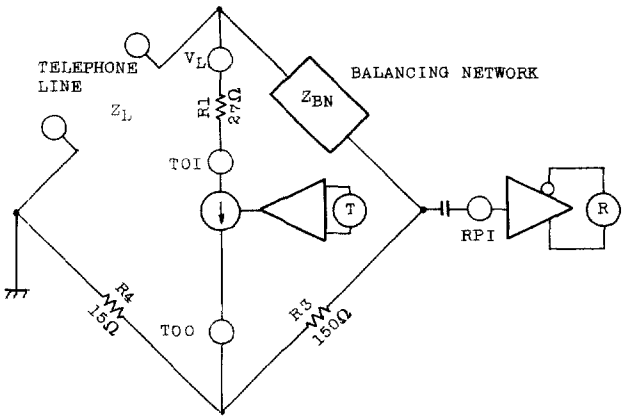


TA31031F AN EXAMPLE OF APPLICATION CIRCUIT



CONVERSION OF TWO-FOUR WIRES

The two-four wires conversion system denotes a system where signals of a telephone line (two wires) are divided into the signal line (four wires) of a transmitter and a receiver. In the example of application circuit, the two-four wires conversion system by bridge is used.
The principle drawing is as follows.



In case of the bridge method, taking the impedance of the telephone line as Z_L, a transmit signal is not output to the receiver if the following condition is established.

$$Z_{BN} : Z_L = 150 : 15$$

SIDETONE

Sidetone means that a sound input in a transmitter is output to the receiver of the same telephone (handset).

1) A sidetone is too many
   When speaking by telephone at a place where ambient noises are large, the voice of objective telephone becomes difficult to be heard due to the noises.
2) A sidetone is too few
   Since a speaker's ear is covered by a receiver, his own voice which should be heard by space propagation is made difficult to be heard, and his communication sense is lost.

The sidetone in this IC is produced when the bridges as shown in the two-four wires conversion system become unbalanced. Further, the impedance Z_L of the telephone line is various depending on the diameter and the length of the line.
It is necessary, therefore, to adjust the impedance of Z_{BN} at assembling a telephone set.

BALANCING NETWORK

Balancing network (hereinafter called BN) is used for adjusting a sidetone. Usually, the BN is constituted of resistance and capacitor of 2~4 elements. In case of bridge structure, no sound tone is produced by connecting the impedance constant of the BN, which is multiplied (in the application circuit, 10 times) by the bridge multiplying factor of the impedance of the line However, it varies depending on the line as described above, and the sidetone varies when BN is at a fixed constant value.
In the example of application circuit, the BN is approximated with 4 elements and the constant is determined on the supposition that the telephone line is of 0.4ϕ, the distance is long.
Further, the constant value of the BN has relation to the frequency characteristic of a receiving system, and the set value may be adjusted according to the frequency characteristic of the telephone to be used.

CONDITIONS OF LINE

This IC and the application circuit are designed under supposition of mainly the telephone line of NTT. Accordingly, when the power supply system exchanger of the line is remarkably different, such a telephone as a private exchanger's telephone of special system may not be used.
The power supply of this IC is supplied from the line (exchanger), but the current value and the voltage value to be supplied are varied depending on the diameter and the length of the line.

AUTO PAD FUNCTION

A signal in telephone line is attenuated as the line diameter is small and the distance is ling. This IC has the functions to judge the line length and control the gain automatically by detecting the magnitude of a DC current.
It is set by making the PADC terminal (⑳ (24) pin) open or by connecting it to the V_{CC} (⑲ (23) pin).

MANUAL PAD FUNCTION

In case of a special exchanger (for example, a private branch exchange), the distance is sometimes short irrespective a small line current, and it is sometimes unnecessary to control gain by auto pad. In this case, when connecting the PADC terminal (⑳ (24) pin) to the GND terminal (⑪ (13) pin), an uniform attenuation enters in the gain control of a transmit and receiving system and the attenuation is not varied by the current value of the line.

MUTE FUNCTION

This is the function for muting a transmit output and a receiving output.

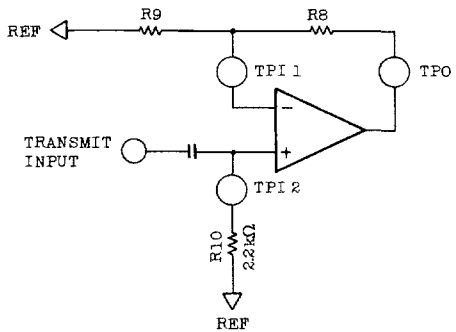
STATE OF MUTE TERMINAL	OUTPUT STATE OF TBO TERMINAL (⑥ (7) pin)	OUTPUT STATE OF RO1,RO2 TERMINAL (⑬ (15), ⑭ (16) pins)
"H" (Hand set speaking state)	The signal from a transmit input amplifier is output.	A signal from a receiving input amplifier is output.
"L" (Muting state)	The input signal from the MFI terminal (⑦ (8) pin) is output. Supposed input in MFI ① No input (transmit cut) ② DTMF (dial signal) ③ Melody, etc.	The input signal from the BTI terminal (⑮ (17) pin) is output. Supposed input in BTI ① No input (receiving cut) ② Beep tone (key checking sound) ③ Melody, etc.

Note: The signal input from MFI is gain controlled by auto pad function, but the signal input from BTI is not gain controlled.

TRANSMIT GAIN

TA31031P, TA31031F can control gains to meet various transmitters.
Gain control of transmit should be performed by a transmit input amplifier.
Gain of the transmit system is determined as follows.
Transmit gain = gain of transmit input amplifier + gain of transmit gain controller + gain of line driver amplifier.

1. Gain of Transmit Input Amplifier
   The gain of a transmit input amplifier is determined by external resistances R8 and R9.



2. Gain of Transmit Gain Controller
   The gain (practically attenuation) is determined by a line current.
   At (line current) 30mA about 0dB
   At (line current) 80mA about -5dB

3. Gain of Line Driver Amplifier
   The gain of a line driver amplifier is about 21dB.

RECEIVING GAIN

The same as in transmit gain, the gain of a receiving system can be adjusted to meet various receivers.

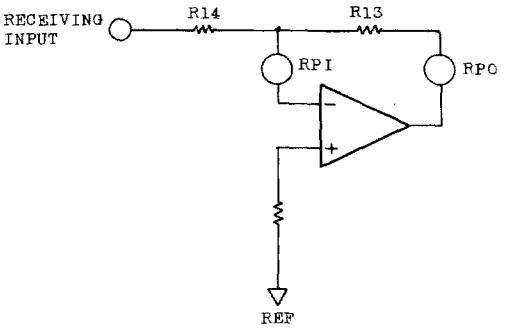
The gain adjustment of the receiving system should be performed by a receiving input amplifier.

Gain of the receiving system is determined as follows.

Receiving gain = attenuation of balancing network + gain of receiving input amplifier + gain of receiving gain controller + gain of receiver drive amplifier.

1. Gain of Receiving Input Amplifier

   The gain of a receiving input amplifier is determined by external resistances R13 and R14.



2. Gain of Receiving Gain Controller

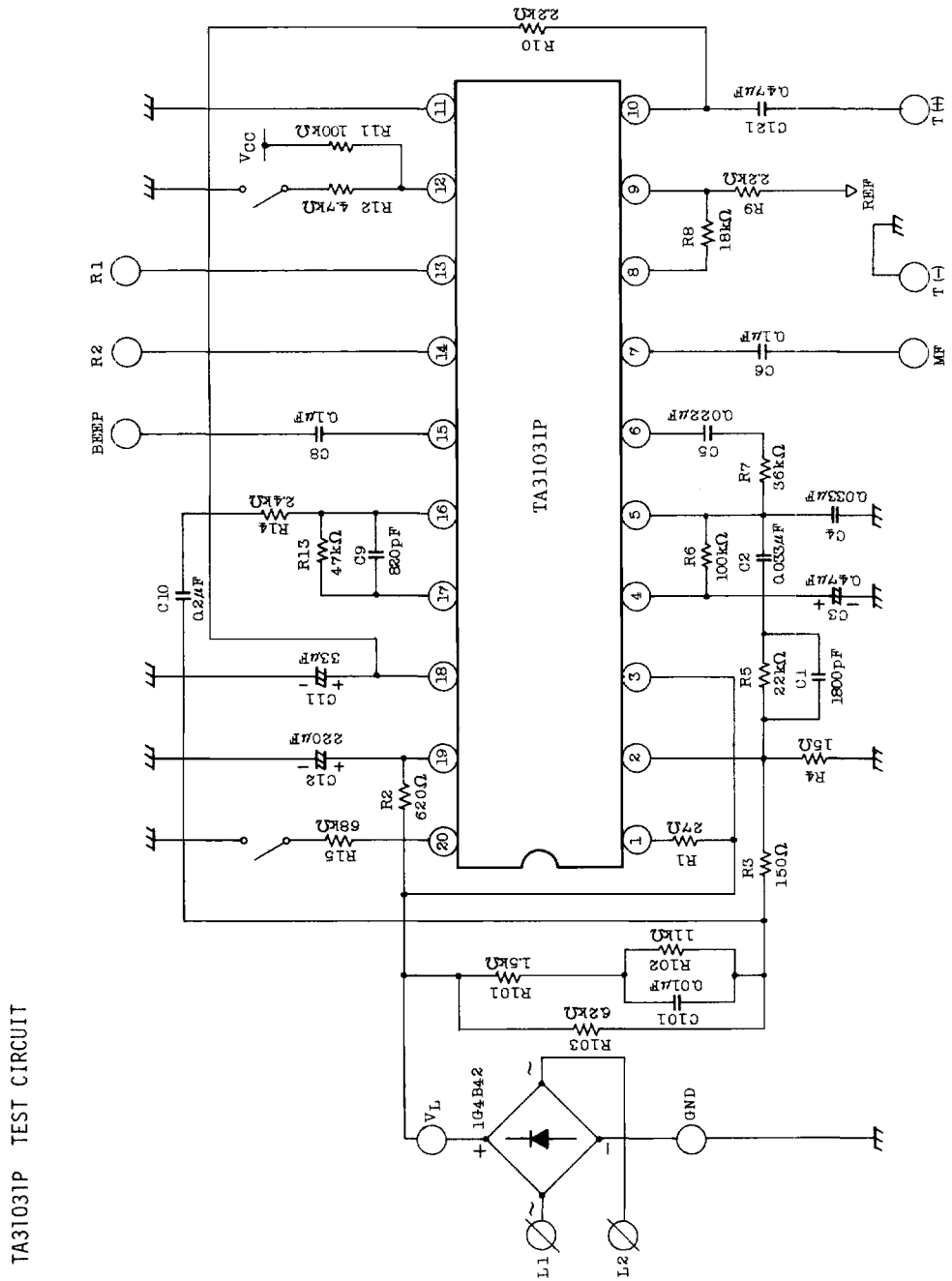
   The gain (practically attenuation) is determined by a line current.

   At (line current) 30mA about 0dB

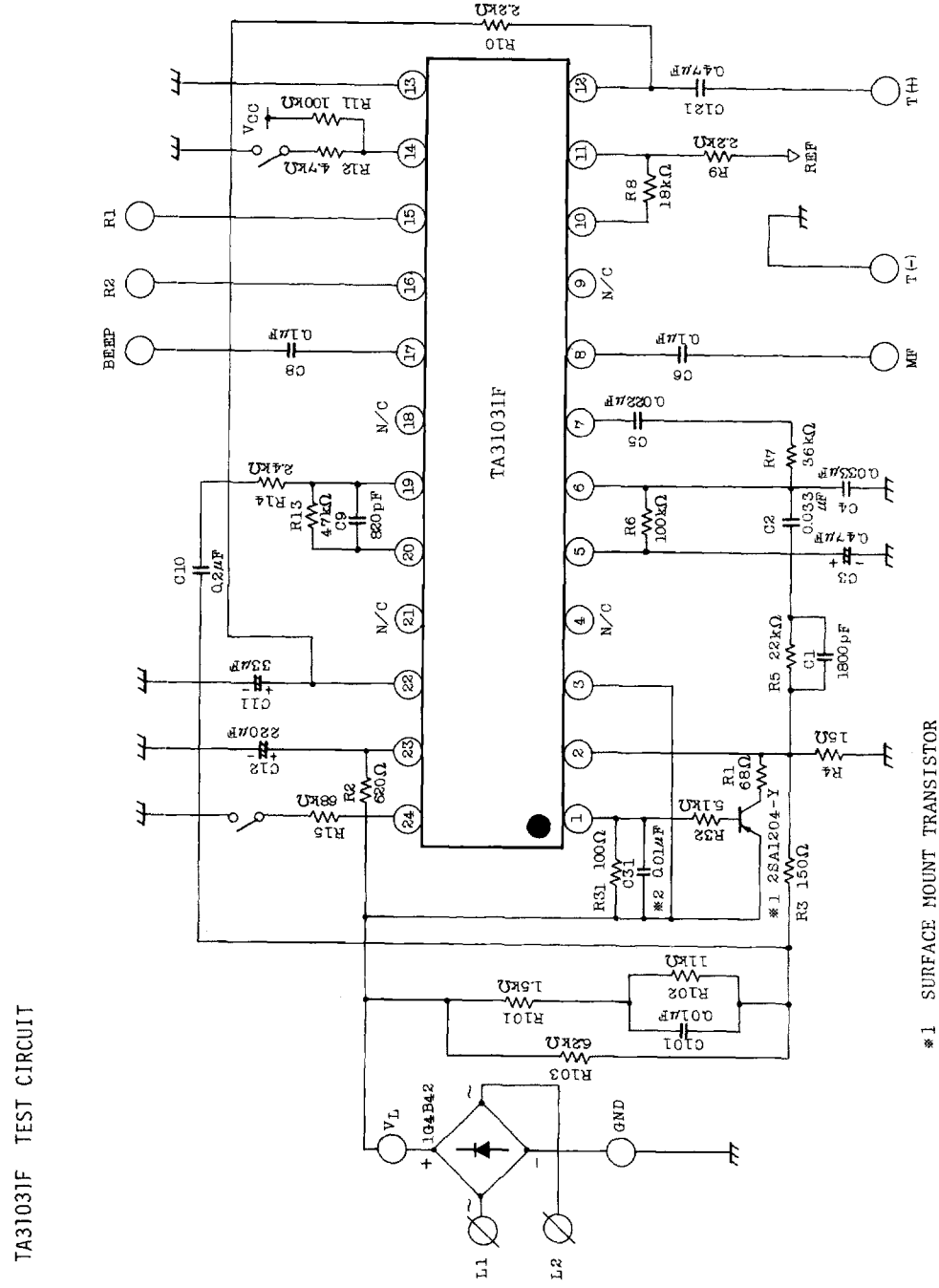
   At (line current) 80mA about -5dB

3. Gain of Receiver Drive Amplifier

   The gain of a built-in receiver drive amplifier is made to about 20dB by the differential operation.



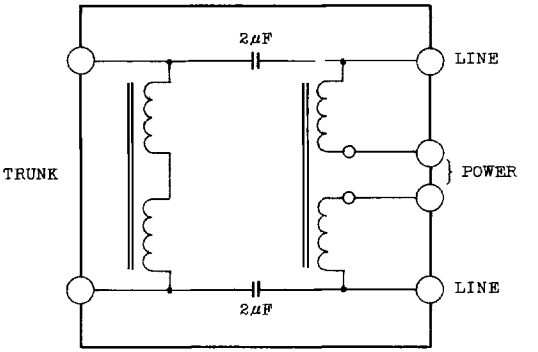
TA31031P TEST CIRCUIT



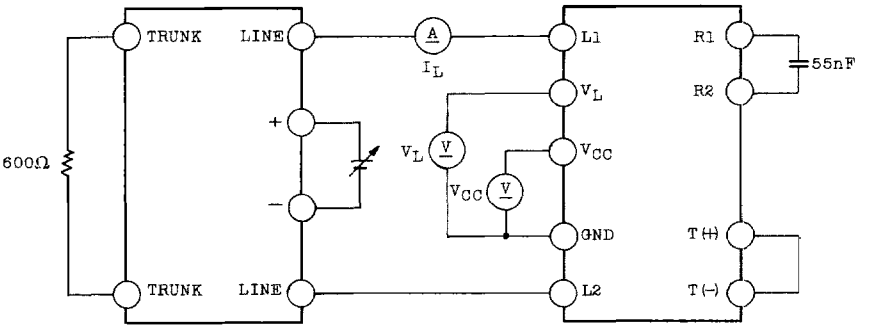
TA31031F TEST CIRCUIT

TEST CIRCUIT

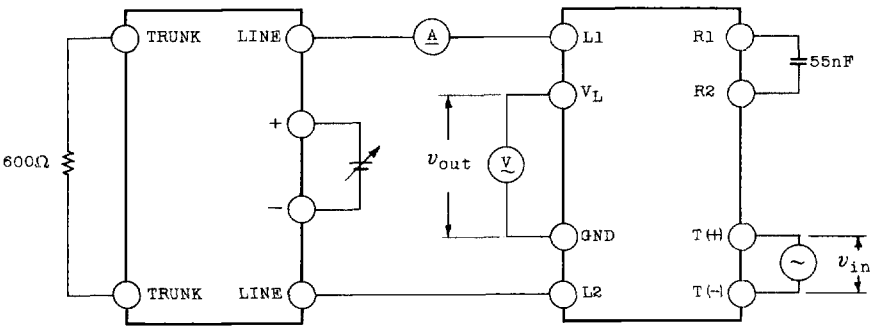
TELEPHONE LINE SIMULATION EQUIVALENT CIRCUIT (XB TYPE)



(1) V_L, V_{CC}



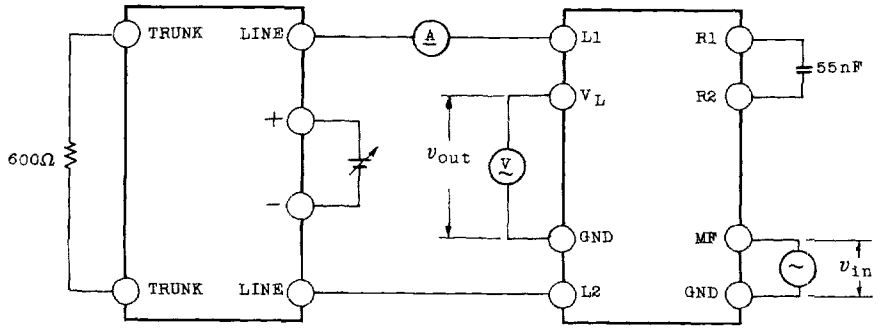
(2) G_T, DRT



TRANSMIT GAIN : $G_T=20\log|v_{out}/v_{in}|$ (dB)

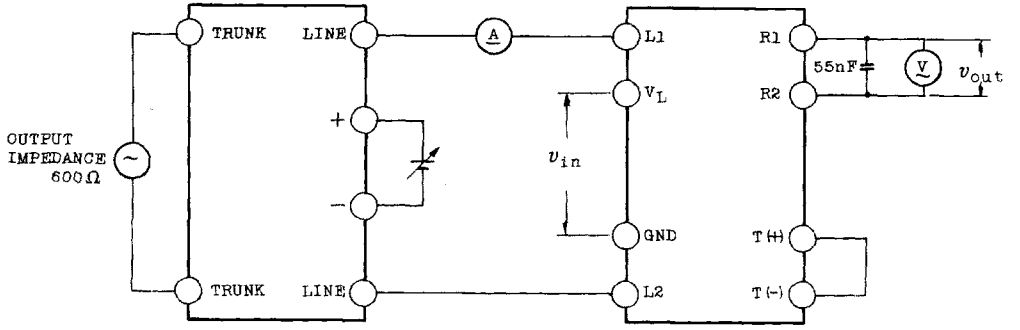
TRANSMIT DYNAMIC RANGE : $DR_T=v_{out}$ (Vp-p) (at v_{out} : DIST=4%)

(3) G_{MF}



MF GAIN : $G_{MF}=20\ell og|v_{out}/v_{in}|$ (dB)

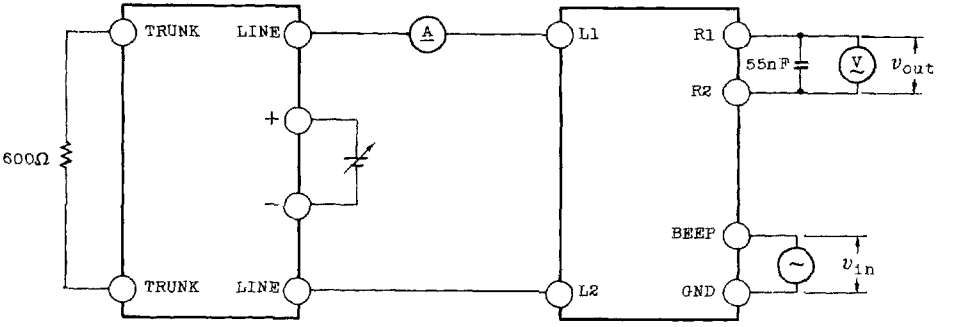
(4) G_R, DR_R



RECEIVING GAIN : $G_R=20\ell og|v_{out}/v_{in}|$ (dB)

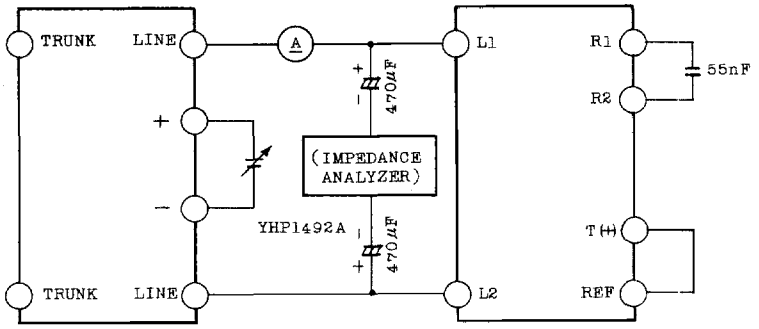
RECEIVING DYNAMIC RANGE : $DR_R=v_{out}$ (Vp-p) (at v_{out} : DIST=4%)

(5) G_{BP}



BEEP GAIN : $G_{BP}=20\ell og|v_{out}/v_{in}|$ (dB)

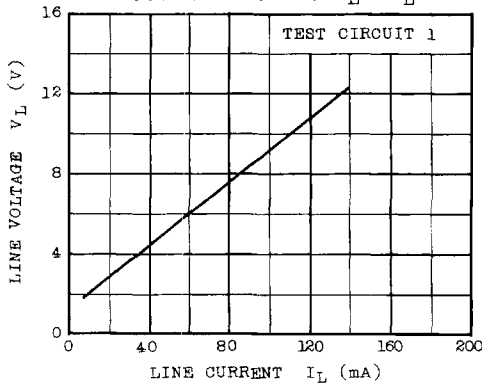
(6) Z_{tel} (AC impedance characteristics)



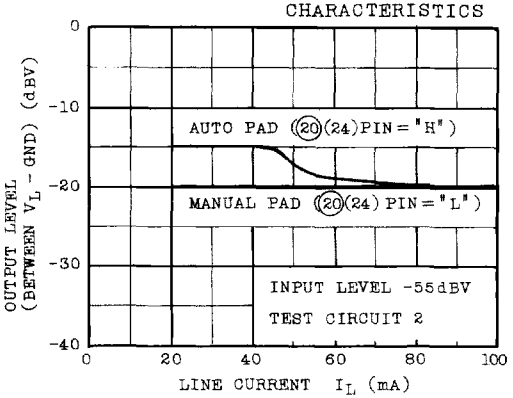
MEASUREMENT LEVLE : $0.1V_{rms}$

MEASUREMENT FREQUENCY : 0.3~4kHz

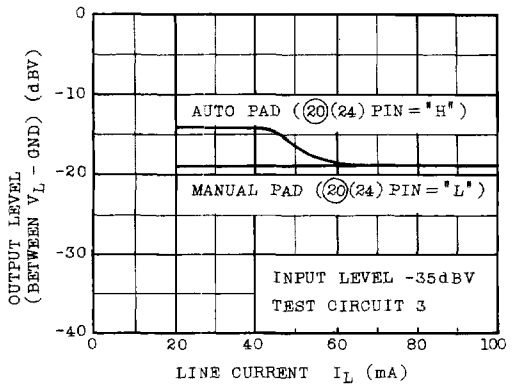
DC CHARACTERISTICS $V_L - I_L$



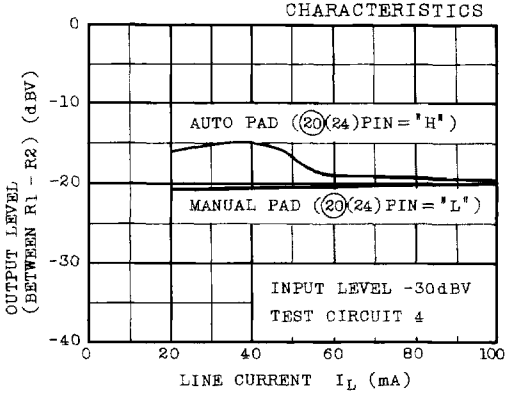
TRANSMIT GAIN TO CURRENT CHARACTERISTICS



MF GAIN TO CURRENT CHARACTERISTICS



RECEIVING GAIN TO CURRENT CHARACTERISTICS



AC IMPEDANCE CHARACTERISTICS