HD81019/020

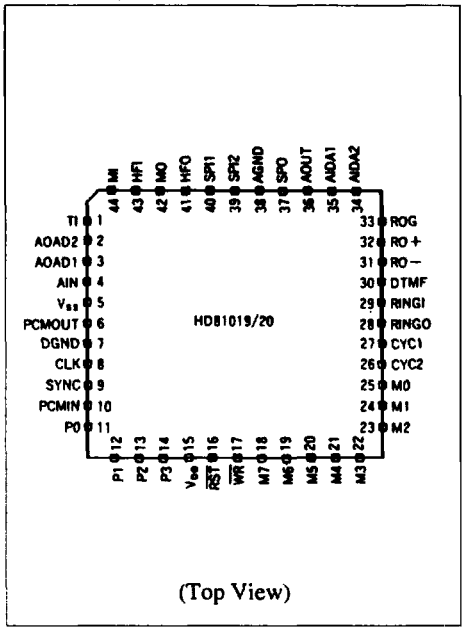
Terminal CODEC For Digital Telephone

HD81019/20 is a single chip CODEC specified for digital telephone. This LSI contains the function of CODEC with filters (corresponding to HD44270P series) and also includes analog input/output for Hands Free, input pin for DTMF signal, moreover Tone Ringer circuit and analog Gain Control circuit. All controls are available by microcomputer interface.

Features

- Single chip CMOS CODEC for digital telephone
  HD81019 : A-law
  HD81020 : μ-law
- Power Supply Voltage: ±5 V±5%, Low power dissipation: 300 mW max.
- Analog input/output for hand set/hands free
- Gain control for analog signals
- Ringing signal generator
  1, 2 and 3 tone are available.
  One of rectangle, steps and envelope wave is selectable.
- Input amplifier for addition of DTMF signal
- Microcomputer interface (8 bits parallel inputs)
- QFP (Quad flat package) 44 pin package

Pin Arrangement

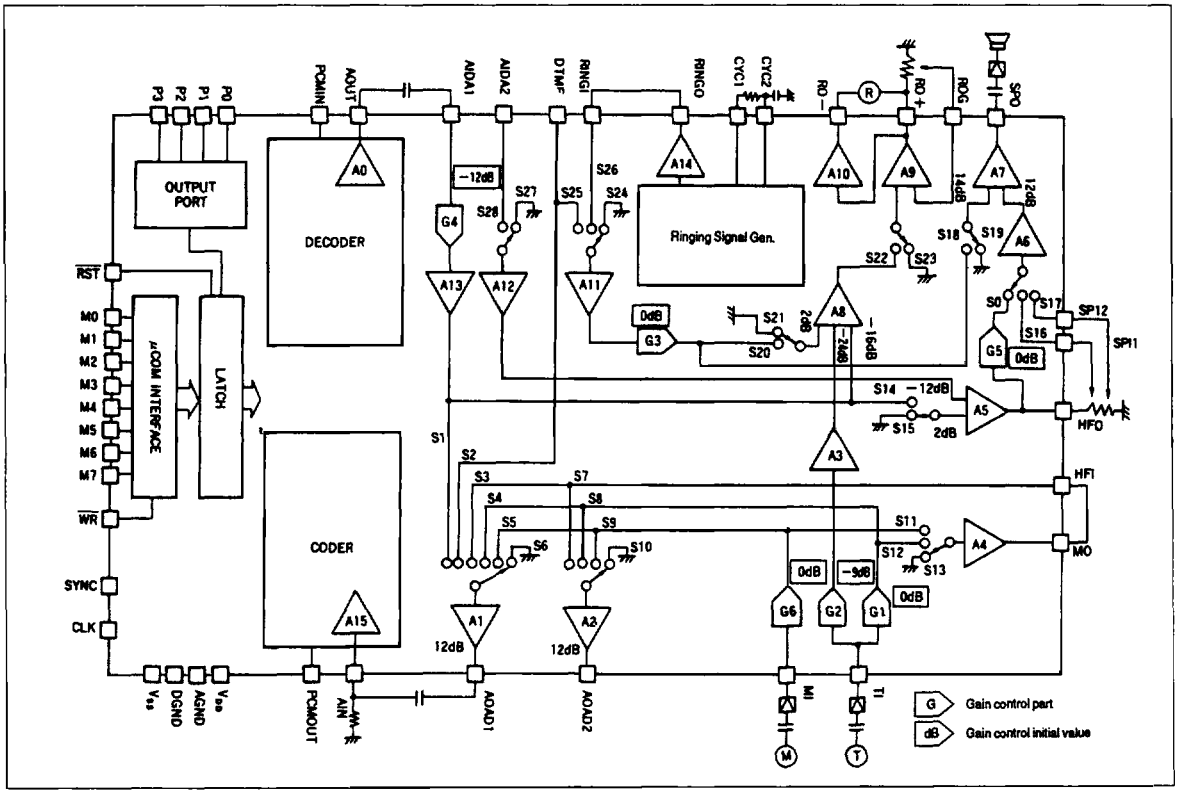


(Top View)

Pin Descriptions

Pin No.	Symbol	Power & clock	Analog I/O		Digital		Function
			Input	Output	Input	Output	
1	TI		O				Transmitter Input
2	AOAD2			O			Analog Output to A/D 2
3	AOAD1			O			Analog Output to A/D 1
4	AIN		O				Analog Input To A/D Part
5	Vss	O					Negative Power Supply (–5 V±5%)
6	PCMOUT					O	PCM Output : Open Drain
7	DGND	O					Digital Ground
8	CLK	O			O		PCM Shift Clock (64–2048kHz)
9	SYNC	O			O		Frame SYNC (8 kHz) With Pull-Up
10	PCMIN				O		PCM Input
11	P0					O	Output Port 0
12	P1					O	Output Port 1
13	P2					O	Output Port 2
14	P3					O	Output Port 3
15	V_{DD}	O					Positive Power Supply (+5 V±5%)
16	RST				O		Reset
17	WR				O		Write
18	M7				O		Data Bus 7
19	M6				O		Data Bus 6
20	M5				O		Data Bus 5
21	M4				O		Data Bus 4
22	M3				O		Data Bus 3
23	M2				O		Data Bus 2
24	M1				O		Data Bus 1
25	M0				O		Data Bus 0
26	CYC2		O	O			Cycle Freq. Adjust 2
27	CYC1			O			Cycle Freq. Adjust 1
28	RINGO			O			Ringing Signal Output
29	RINGI		O				Ringing Signal Input
30	DTMF		O				DTMF Signal Input
31	RO–			O			Receiver Output –
32	RO+			O			Receiver Output +
33	RQG		O				Receiver Gain Control
34	AIDA2		O				Analog Input From D/A 2
35	AIDA1		O				Analog Input From D/A 1
36	AOUT			O			Analog Output From D/A Part
37	SPO			O			Speaker Output
38	AGND	O					Analog Ground
39	SPI2		O				Speaker Input 2
40	SPI1		O				Speaker Input 1
41	HFO			O			Hands Free Output
42	MO			O			Microphone Output
43	HFI		O				Hands Free Input
44	MI		O				Microphone Input

Block Diagram



Descriptions for Function

Block Diagram of special CODEC LSI for digital telephone is shown in Fig. 2. The descriptions for function in each block are as follows.

CODEC Part

CODEC core is corresponding to HD44277P (A-law) and HD44278P (μ-law) for HD81019 and HD81020 respectively.

For a sampling rate of 8 kHz, PCM input/output data rate can be selected from 64 kHz to 2048 kHz in synchronous operation. Internal PLL circuit generates the internal clock from the 8kHz synchronization clock.

Analog Signal Input

Analog input for transmission (TI and MI pins)

Two analog input pins are provided for transmission. One is MI pin input from microphone and the other is TI pin input from Transmitter.

The input signal from Transmitter is transfered to following four lines after Gain Control.

1. AMP A4 : The line to output to external treatment for echo cancellation
2. AMP A1 : The line to output to CODEC part (A to D side) directly
3. AMP A2 : The line to output to external CODEC (A to D side) directly
4. AMP A8 : The line to output side tone to Receiver (the output of analog addition)

And input signal from microphone is transfered to following three lines.

1. AMP A4 : The line to output to external treatment for echo cancellation
2. AMP A1 : The line to output to CODEC part (A to D side) directly
3. AMP A2 : The line to output to external CODEC (A to D side) directly

Echo cancellation input (HFI pin)

The input signal from Microphone or Transmitter is output by AMP A4, and input to HFI pin after external treatment for echo cancellation.

And analog input signal from HFI pin is transfered to following two lines.

1. AMP A1 : The line to output to CODEC part (A to D side) directly
2. AMP A2 : The line to output to external CODEC (A to D side) directly

(3)Analog Inputs for Receiving Signals (AIDA1 and AIDA2 pins)

Two amplifiers are prepared for receiving analog signals.

One (AIDA1) is to input receiving analog signal from CODEC part (D to A side). The other is to input analog signal from external CODEC (D to A side). Analog input signal from CODEC part is transfered to following three lines after Gain Control.

1. AMP A1 : The line for analog loopback
2. AMP A5 : The line for output to Speaker
3. AMP A8 : The line for output to Receiver

DTMF signal Input (DTMF pin)

It's a input pin for DTMF signal. DTMF signal is transfered to two lines. One is to output to CODEC part directly, the other is to input to AMP A11. The output of AMP A11 is transfered to following two directions after Gain Control.

1. AMP A7 : DTMF Signal output line to Speaker (the output of analog addition)
2. AMP A8 : The line to output DTMF signal to Receiver (the output of analog addition)

Ringing signal Input (RINGI pin)

It's to input Ringing signal.

AMP A11 : Amplifier for Ringing signal Input
The output of AMP A11 is transfered to AMP A7 or A8 after Gain Control.

1. AMP A7 : The line to output Ringing signal to Speaker (the output of analog addition)
2. AMP A8 : The line to output Ringing signal to Receiver (the output of analog addition)

Input pin to output speech signal to Loud Speaker (SPI pin)

External speech signal is input at this pin and output to Loud Speaker.

AMP A6 : Input amplifier to output speech signal to Loud Speaker

Analog Signal Output

Output pin 1 for transmission signal (AOAD1 pin)

It's a output pin to output analog signal to CODEC part (A to D side) directly.

AMP A1 : Amplifier for selection of analog signal

The output from this amplifier is one of following four.

1. AMP A13 : Signal for analog loopback (via Gain Control)
2. Transmitter Input Signal or one via external treatment for echo cancellation (via Gain Control)
3. DTMF signal
4. Microphone Input Signal or one via external treatment for echo cancellation (via Gain Control)

Output pin 2 for transmission signal (AOAD2 pin)

It's a output pin to output analog signal to external CODEC (A to D side) directly.

AMP A2 : Amplifier for selection of analog signals

The output from this amplifier is one of followings.

1. Input signal from Transmitter or one via external treatment for echo cancellation (via Gain Control)
2. Input signal from Microphone or one via external treatment for echo cancellation (via Gain Control)

Output pin for Receiving analog signal to Speaker

On Hands Free mode, it's a output pin to output the signal once to external. The signal becomes input to Loud Speaker.

AMP A5 : the amplifier to select or add analog signals

The signal from this amplifier is one of followings or addition of them.

1. Analog signal from CODEC part (via Gain Control)
2. Analog signal from external CODEC

Output pin to Loud Speaker (SPO pin)

It's a output pin to Loud Speaker.

AMP A7 : the amplifier to select or add analog signals

The output of this amplifier is the selection or the addition of followings.

1. AMP A6 :Speech signal output to Loud Speaker
2. AMP A1 : Ringing or DTMF signal (via Gain Control)

Output pins to Receiver (RO+ and RO– pins)

They are output pins to Receiver.

AMP A8 : the amplifier to select or add analog signals

AMP A9 : the amplifier for Gain Control by external resistors

AMP A10 : The amplifier to invert the output of AMP A9

The outputs of these amplifiers are the selection or the addition of followings.

1. Side Tone of Transmitter input signal (via Gain Control)
2. AMP A11 : Ringing Signal or DTMF Signal (via Gain Control)
3. Receiving speech signal from CODEC part (via Gain Control)

Output pin to Microphone (MO pin)

AMP A4 : Output amplifier for external treatment for echo cancellation

The output from this amplifier is one of followings.

1. The input from Microphone (via Gain Control)
2. The input from Transmitter (via Gain Control)

Ringing Signal Generator

Tone

Ringing Tone is selected one of 1 tone, 2 tone, 3 tone and no output by the signal from microcomputer interface.

M7	M6	M5	M4	M3	M2	M1	M0		
0	1	1	1	*	*	T1	T0	Output	Note
0	1	1	1	*	*	0	0	No Output	output becomes GND level
						0	1	1 Tone	the waveform with freq. F1 is output
						1	0	2 Tone	the waveforms with freq. F1 and F2 are output alternately :Note 1
						1	1	3 Tone	the waveforms with freq. F1, F2 and F3 are output in sequence :Note 1

Note 1: The period of warble is determined by external CR.

Example; 2 Tone: F1 → F2 → F1 → F2 → ···
3 Tone: F1 → F2 → F3 → F1 → F2 → F3 → ···

Frequency

F1 is selected one of sixteen frequencys by 4 bits (R13–R10) optionally.
F2 is selected one of sixteen frequencys by 4 bits (R23–R20) optionally.
F3 is selected one of sixteen frequencys by 4 bits (R33–R30) optionally.

M7	M6	M5	M4	M3	M2	M1	M0	Hex	(μs)	(Hz)
1	1	0	0	0	0	0	0	0	0	0
	(F1)			0	0	0	1	1	250	4000
	OR			0	0	1	0	2	500	2000
1	1	0	1	0	0	1	1	3	750	1333.3
	(F2)			0	1	0	0	4	1000	1000
	OR			0	1	0	1	5	1250	800
1	1	1	0	0	1	1	0	6	1500	666.7
	(F3)			0	1	1	1	7	1750	571.4
				1	0	0	0	8	2000	500
				1	0	0	1	9	2250	444.4
				1	0	1	0	A	2500	400
				1	0	1	1	B	2750	363.6
				1	1	0	0	C	3000	333.3
				1	1	0	1	D	3250	307.7
				1	1	1	0	E	3500	285.7
				1	1	1	1	F	3750	266.7

Waveform

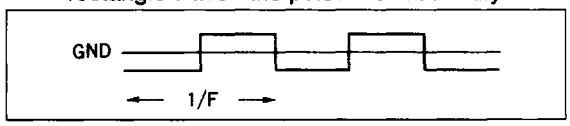
Waveform is selected one of rectangle, steps and envelope wave.

rectangle/steps wave (ENV = "0" on this mode)

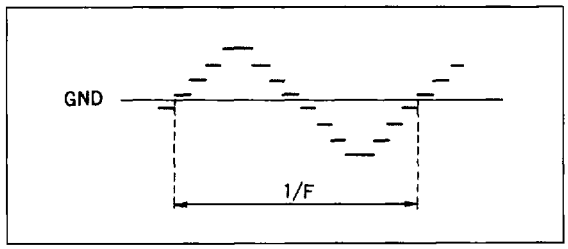
M7	M6	M5	M4	M3	M2	M1	M0
0	1	1	1	Mute	PL/LD	*	*

PL/LD : "0" = rectangle wave, "1" = steps wave

rectangle wave : the pulse with 50% duty



steps wave : 16 steps per period with 8 amplitudes



Envelope

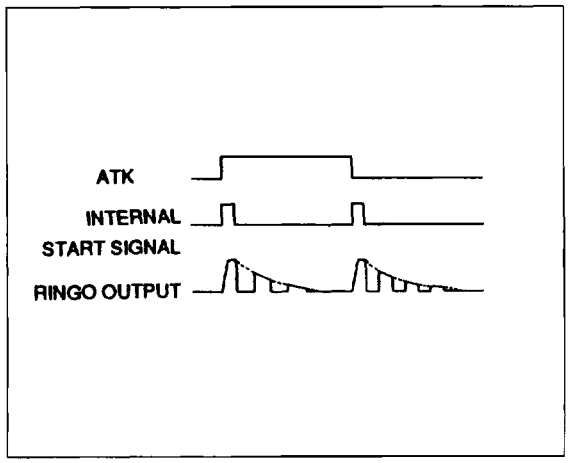
M7	M6	M5	M4	M3	M2	M1	M0
0	1	0	1	*	*	ENV	ATK

ENV : "0" = rectangle or steps wave, "1" = envelope

Note: the setting of ENV = "1" is prior to the one of rectangle/steps. ENV = "0" should be set on rectangle/steps mode.

ATK : When ATK is changed as 0→1 or 1→0, internal start signal for envelope is generated.

Example:

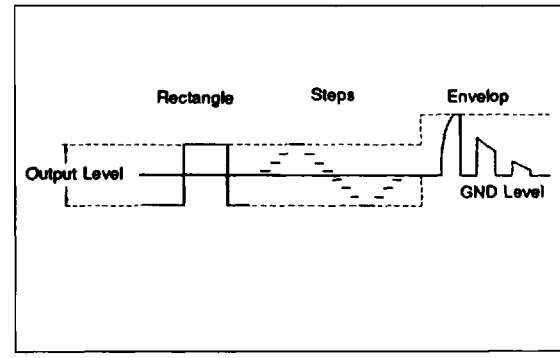


The time constant for envelope is defined by external C,R.

On 2 or 3 tone mode the change of frequencys is done by internal start signal.

Output Level (RINGO Output)

Output level is fixed to –24 dBV (0.063 Vrms) on steps wave.



Output Port

Four output ports (P0 to P3) are provided to control external amplifiers and etc.. Each port is controlled by the signal from 8 bit microcomputer interface.

M7	M6	M5	M4	M3	M2	M1	M0
0	1	1	0	P3	P2	P1	P0

Bit	"1"	"0"
P3	Port3 High	Port3 Low
P2	Port2 High	Port2 Low
P1	Port1 High	Port1 Low
P0	Port0 High	Port0 Low

Microcomputer Interface

Various kinds of control commands on data bus (M0 to M7) are latched by WR, and following states are set.

1. states of various analog switches
2. Gain Control level for lines
3. output level for output ports
4. Ringing signal

And each switch and Gain Control is initialized by input low level at RST pin. Initial value is shown in the later pages on microcomputer interface command.

Others

Power down

There are two methods for power down.

stopping SYNC pulse

By this method only CODEC part puts into power down mode.

And the function of Ringing is stopped.

The strobes can be high, low or floating, but as long as it is static, the powered down mode is in effect.

by the command from microcomputer interface

M7	M6	M5	M4	M3	M2	M1	M0
0	1	0	0	*	*	*	PD

PD = "1" : Power Down

PD = "0" : Normal

By this method all parts except microcomputer interface put into power down mode. The contents in command latches aren't changed.

Mute

By Mute command, following analog outputs are kept GND level.

After release the Mute command, all states come back to previous.

The contents in command latches aren't changed.

M7	M6	M5	M4	M3	M2	M1	M0
0	1	1	1	Mute	*	*	*

Mute : "0" = Normal

"1" = Mute

On Mute mode, switches as S6, S10, S13, S15, S19, S23, S27 are put on, consequently following analog outputs become GND level.

AOAD1, AOAD2, MO, HFO, SPO, RO+, RO–, RINGO

Microcomputer Interface Command

Microcomputer Interface (Command List)

MSB							LSB	Note
M7	M6	M5	M4	M3	M2	M1	M0	
0	0	0	0	*	*	*	*	NOP
0	0	0	1	G41	G40	G11	G10	Gain Control:G4,G1
0	0	1	0	G22	G21	G20	*	Gain Control:G2
0	0	1	1	G32	G31	G30	*	Gain Control:G3
0	1	0	0	G52	G51	G50	PD	Gain Control:G5, PWR DWN
0	1	0	1	G61	G60	ENV	ATK	Gain Control:G6, Envelop
0	1	1	0	P3	P2	P1	P0	Port Signal
0	1	1	1	Mute	PL/LD	T1	T0	Ringing Control
1	0	0	0	A12	A11	A10	27/28	Switch Control 1
1	0	0	1	A21	A20	A41	A40	Switch Control 2
1	0	1	0	A111	A110	21/20	19/18	Switch Control 3
1	0	1	1	23/22	15/14	A61	A60	Switch Control 4
1	1	0	0	R13	R12	R11	R10	Ringing Tone 1
1	1	0	1	R23	R22	R21	R20	Ringing Tone 2
1	1	1	0	R33	R32	R31	R30	Ringing Tone 3
1	1	1	1	*	*	*	*	NOP

Gain Control

[ ] Initial

G1 0 0 0 1 * * G11 G10

M7	M6	M5	M4	M3	M2	M1	M0	Gain (dB)
0	0	0	1	*	*	0	0	[0]
				*	*	0	1	–3
				*	*	1	0	–6
				*	*	1	1	–9

G4 0 0 0 1 G41 G40 * *

M7	M6	M5	M4	M3	M2	M1	M0	Gain (dB)
0	0	0	1	0	0	*	*	–6
				0	1	*	*	[–12]
				1	0	*	*	–15
				1	1	*	*	–∞

G2 0 0 1 0 G22 G21 G20 *

M7	M6	M5	M4	M3	M2	M1	M0	Gain (dB)
0	0	1	0	0	0	0	*	0
				0	0	1	*	–3
				0	1	0	*	–6
				0	1	1	*	[–9]
				1	0	0	*	–12
				1	0	1	*	–15
				1	1	0	*	–18
				1	1	1	*	–∞

G3	0	0	1	1	G32	G31	G30	*

M7	M6	M5	M4	M3	M2	M1	M0	Gain (dB)
0	0	1	1	0	0	0	*	0
				0	0	1	*	–6
				0	1	0	*	–12
				0	1	1	*	–18
				1	0	0	*	–24
				1	0	1	*	–30
				1	1	0	*	–36
				1	1	1	*	–42

G5	0	1	0	0	G52	G51	G50	*

M7	M6	M5	M4	M3	M2	M1	M0	Gain (dB)
0	1	0	0	0	0	0	*	0
				0	0	1	*	–6
				0	1	0	*	–12
				0	1	1	*	–18
				1	0	0	*	–24
				1	0	1	*	–30
				1	1	0	*	–36
				1	1	1	*	–∞

G6	0	1	0	1	G61	G60	*	*

M7	M6	M5	M4	M3	M2	M1	M0	Gain (dB)
0	1	0	1	0	0	*	*	0
				0	1	*	*	–3
				1	0	*	*	–6
				1	1	*	*	–9

Analog signal line setting function

Controlling analog switches (S1 to S28) allows the following lines to be set:

- Receive signal line (with handset).
- Transmit signal line (with handset).
- Side tone adjusting line.
- Receive signal line (with hands free).
- Transmit signal line (with hands free).
- Ringing signal output line (to loud speaker).
- Ringing signal output line (to receiver).
- Analog loopback line.
- Second transmission/receiving line.
- Loud speaker output line.

The analog switch control commands are given below.

Switch Control

[ ] Initial

Switch Control 1	1	0	0	0	A12	A11	A10	*	
	7	6	5	4	3	2	1	0	SW
	1	0	0	0	0	0	0	*	[SW6 ON]
					0	0	1	*	SW6 ON
					0	1	0	*	SW6 ON
					0	1	1	*	SW5 ON
					1	0	0	*	SW4 ON
					1	0	1	*	SW3 ON
					1	1	0	*	SW2 ON
					1	1	1	*	SW1 ON
	1	0	0	0	*	*	*	27/28	
	7	6	5	4	3	2	1	0	SW
	1	0	0	0	*	*	*	0	[SW27 ON]
					*	*	*	1	SW28 ON
Switch Control 2	1	0	0	1	A21	A20	*	*	
	7	6	5	4	3	2	1	0	SW
	1	0	0	1	0	0	*	*	[SW10 ON]
					0	1	*	*	SW9 ON
					1	0	*	*	SW8 ON
					1	1	*	*	SW7 ON
	1	0	0	1	*	*	A41	A40	
	7	6	5	4	3	2	1	0	SW
	1	0	0	1	*	*	0	0	[SW13 ON]
					*	*	0	1	SW13 ON
					*	*	1	0	SW12 ON
					*	*	1	1	SW11 ON

Switch Control 3

1	0	1	0	A111	A110	*	*	
7	6	5	4	3	2	1	0	SW
1	0	1	0	0	0	*	*	SW24 ON
				0	1	*	*	SW24 ON
				1	0	*	*	SW25 ON
				1	1	*	*	SW26 ON

1	0	1	0	*	*	21/20	19/18	
7	6	5	4	3	2	1	0	SW
1	0	1	0	*	*	0	*	SW21 ON
				*	*	1	*	SW20 ON

7	6	5	4	3	2	1	0	SW
1	0	1	0	*	*	*	0	SW19 ON
				*	*	*	1	SW18 ON

Switch Control 4

1	0	1	1	23/22	15/14	A61	A60	
7	6	5	4	3	2	1	0	SW
1	0	1	1	0	*	*	*	SW23 ON
				1	*	*	*	SW22 ON

7	6	5	4	3	2	1	0	SW
1	0	1	1	*	0	*	*	SW15 ON
				*	1	*	*	SW14 ON

7	6	5	4	3	2	1	0	SW
1	0	1	1	*	*	0	0	SW0 ON
				*	*	0	1	SW0 ON
				*	*	1	0	SW16 ON
				*	*	1	1	SW17 ON

Port Signal

M7	M6	M5	M4	M3	M2	M1	M0
0	1	1	0	P3	P2	P1	P0

Bit	"1"	"0"
P3	Port 3 High	Port 3 Low
P2	Port 2 High	Port 2 Low
P1	Port 1 High	Port 1 Low
P0	Port 0 High	Port 0 Low

Ringing Control

M7	M6	M5	M4	M3	M2	M1	M0
0	1	1	1	Mute	PL/LD	T1	T0	

MUTE: "1" = MUTE, "0" = NORMAL
PL/LD: "1" = STEPS WAVE, "0" = RECTANGLE WAVE

T1	T0	Tone
0	0	No Output
0	1	1 Tone
1	0	2 Tone
1	1	3 Tone

M7	M6	M5	M4	M3	M2	M1	M0	Hex	(μs)	(Hz)
1	1	0	0	0	0	0	0	0	0	0
	(F1)			0	0	0	1	1	250	4000
	OR			0	0	1	0	2	500	2000
1	1	0	1	0	0	1	1	3	750	1333.3
	(F2)			0	1	0	0	4	1000	1000
	OR			0	1	0	1	5	1250	800
1	1	1	0	0	1	1	0	6	1500	666.7
	(F3)			0	1	1	1	7	1750	571.4
				1	0	0	0	8	2000	500
				1	0	0	1	9	2250	444.4
				1	0	1	0	A	2500	400
				1	0	1	1	B	2750	363.6
				1	1	0	0	C	3000	333.3
				1	1	0	1	D	3250	307.7
				1	1	1	0	E	3500	285.7
				1	1	1	1	F	3750	266.7

Pin/Function Descriptions

Pin No.	Symbol	Descriptions
8	CLK	Any of 64 kHz to 2048 kHz clock can be accepted with the pin. And it is automatically divided down to provide the internal clocks. This TTL compatible input shifts PCM data out of the coder on the positive going edge and PCM data into the decoder on the negative going edge after receiving a positive edge on the SYNC.
9	SYNC	This TTL compatible pulse input (typ.8 kHz) is used for analog sampling and for initiating the PCM output from the coder and initiate clocking of PCM input data into the decoder. They must be synchronized with the CLOCK with this positive going edge occurring after the falling edge of the CLOCK. The width of this signal is not critical. An internal bit counter generates the necessary timing for PCM output and input.
6	PCMOUT	This is a LS-TTL compatible open drain output. It is active only during transmission of PCM output for 8 bit periods of CLOCK signal following a positive edge on the SYNC input. Data is clocked out by the positive edge of the CLOCK. One 500 Ω pull-up per 8 CODECs is required.
10	PCMIN	This is a TTL compatible input for supplying PCM input data to the decoder. Data is clocked in by the negative edge of CLOCK.
4	AIN	It is the input of analog signal in the range of $-V_{REF}$ to $+V_{REF}$ (–2.5 to 2.5V).
36	AOUT	This is the buffered output of the recreated analog signal from the received PCM data words. It can drive the impedance of 600 Ω. C_L should be less than 100 pF.
15 5 38 7	V_{DD} V_{SS} AGND DGND	These are power supply pins. V_{DD} and V_{SS} are positive and negative supply pins respectively (+5 V,–5 V). Analog and digital ground pins are separated for minimizing crosstalk.
11–14	P0–P3	These pins are output ports for control of externally connected amplifiers. They are 4 ports, P0 to P4. Each ports are controlled by the signal from microcomputer interface.
16	$\overline{RST}$	Command latches in microcomputer interface are initialized by input of Low level. Consequently internal switches, Gain Control and Ringing part are initialized. This pin is TTL level input.
25–18	M0–M7	These are 8 bit parallel input for microcomputer interface, and TTL level input. Upper 4 bits show commands and lower 4 bits show data.
17	$\overline{WR}$	This is Write signal for M0–M7, 8 bit parallel input. The data of M0–M7 are latched at rising edge of WR. It is TTL level input.

Pin/Function Descriptions

Pin No.	Symbol	Descriptions
3	AOAD1	This is analog signal output pin (No.1) for transmit. This output signal is input to CODEC part (A to D side). As output signal 1) Analog Loopback Signal 2) Transmitter Input Signal or one that is output from M0 after Gain Control and input from HFI after echo cancellation externally. 3) DTMF Signal 4) Microphone input signal or one that is output from M0 after Gain Control and input from HFI after echo cancellation externally. one of four is output.
2	AOAD2	This is analog signal output pin (No.2) for transmit. This output signal is normally input to external CODEC (A to D side of external CODEC). As output signal, either above mentioned 2) or 4) is output.
41	HFO	It's output of analog received signal for Hands Free. One of analog signal from CODEC part and from external CODEC, or addition of them is output.
37	SPO	It's output pin to Loud Speaker. One of the signal from CODEC part, external CODEC, ringing signal and DTMF signal is selected, or addition of these is output.
1	TI	It's input pin for Transmitter Signal.
44	MI	It's input pin for Microphone Signal.
43	HFI	Input signal from Transmitter or Microphone is output to MO pin after gain control, and it is input from HFI after external echo cancellation.
35	AIDA1	It's input pin for analog signal from CODEC part.
34	AIDA2	It's input pin for analog signal from external CODEC.
40 39	SPI1 SPI2	These are input pins to control the gain of analog receive signal (HFO output) for Hands Free.
42	MO	This is output pin of Microphone or transmitter input after Gain Control.
32 31	RO+ RO–	Receiver output pin (double end)
33	ROG	Gain Control pin for Receiver output
30	DTMF	DTMF Signal input pin
28	RINGO	Ringing Signal output pin

Pin/Function Descriptions

Pin No.	Symbol	Descriptions
29	RINGI	Input pin for Ringing Signal This pin is used to input from RINGO directly or to input from external Ringer.
27 26	CYC1 CYC2	External C, R is attached at these pins to define warble frequency on 2 tone or 3 tone mode. And on envelope mode external C, R is attached at these pins for envelope's time constant.

Electrical Characteristics

Absolute Maximum Ratings

Note1, Note2

Item	Symbol	Rating	Unit
Positive Power Supply	V_{DD}	−0.3—+7	V
Negative Power Supply	Vss	−7—+0.3	V
Digital Input/Output Voltage	Vd	−0.3<Vd<V_{DD}+0.3	V
Analog Input/Output Voltage	Va	Vss−0.3<Va<V_{DD}+0.3	V
Power Dissipation	Pd	500	mW
Operation temperature	Topr	0—+70	°C
Storage Temperature	Tstg	−55—+125	°C

Notes 1 : All voltage is based on both AGND (analog ground) and DGND (digital ground).
2 : This rating is also applied on power-on and power-off.

Static Characteristics (V_{DD} = 5 ± 0.25 V, Vss = −5 ± 0.25 V, V_{CC} = 5 ± 0.25 V, Ta = 0 to+70°C)

Symbol	Pin No.	Item		Min	Typ	Max	Unit	Condition & Note
I_{DD}	15	V_{DD} Current		—	18.0	28.0	mA	AIN = 0V
Iss	5	Vss Current		−28.0	−18.0	—		PCMIN = +0 code
I_{DDST}	15	V_{DD} Current	PD	—	2.0	5.0		R_L(AOUT) = 600Ω
		(Standby)	SYNC	—	14.0	23.0		
I_{SSST}	5	Vss Current	PD	−2.0	−0.2	—		
		(Standby)	SYNC	−23.0	−13.0	—		
I_L	All Input	Input Leak Current		−10.0	—	10.0	μA	V_M = 0.8 V
	Except 9			−10.0	—	10.0		V_M = 2.0 V
				—	—	10.0		V_{DD} = V_M = 5.25 V
I_{PL}	9	Pull Up Current		−100	—	0	μA	
I_{DL}	6	Digital Output Leak Current		—	—	10.0	μA	V_{DD} = V_M = 5.25 V
C_{AIN}	4	Analog Input Cap.		—	—	10	pF	@ 1MHz, Vbias = 0 V
C_{DIN}	8–10 16–25	Digital Input Cap.		—	—	10	pF	
V_{OFFIN}	4	Analog Offset Input		−200	—	200	mV	
V_{OFFO}	36	Analog Offset Output		−100	—	100	mV	PCMIN = +0 code
C_{DOUT}	6, 11–14	Digital Output Cap.		—	—	15.0	pF	@ 1 MHz, Vbias = 0 V
V_{OL1}	6	PCM Output Low Voltage		—	—	0.4	V	R_L = 500Ω + I_{OL} = 0.8 mA
V_{OH1}	6	PCM Output High Voltage		V_{CC}-0.3	—	—	V	I_{OH} = −150 μA
V_{OL2}	11–14	Digital Output Low Voltage		—	—	0.4	V	+I_{OL} = 0.8 mA
V_{OH2}	11–14	Digital Output High Voltage		2.4	—	—	V	I_{OH} = −200μA
				V_{DD}-1.2	—	—	V	I_{OH} = -20μA
V_{IL}	8–10 16–25	Digital Input Low Voltage		—	—	0.8	V	
V_{IH}	8–10 16–25	Digital Input High Voltage		2.0	—	—	V	

Dynamic Characteristics (V_{DD} = 5 ± 0.25 V, Vss = –5 ± 0.25 V, V_{CC} = 5 ± 0.25 V, Ta = 0 to +70°C)

Symbol	Item	Min	Typ	Max	Unit	Note
Fs	SYNC Frequency	7.99	8.00	8.01	kHz	
Fc	PCM Bit Clock Rate	64	—	2048	kHz	
twc	Clock Pulse Width	200	—	—	ns	
twsh	SYNC Pulse High Width	200	—	—	ns	
twsl	SYNC Pulse Low Width	8	—	—	µs	
tr	Logic Input Rise Time	5	—	50	ns	
tf	Logic Input Fall Time	5	—	50	ns	
tbcs	Previous Clock To SYNC Delay	40	—	—	ns	Note 1
tcs	Clock to SYNC Delay	—	—	100	ns	Note 1,3
tcd1	Clock to PCM MSB Delay	—	—	170	ns	Note 1,2,4
tsd	SYNC to PCM MSB Delay	—	—	170	ns	Note 1,2,4
tcd	Clock to PCMOUT Delay	—	—	180	ns	Note 1,2,5
tsu	PCMIN Setup Time	65	—	—	ns	Note 1
thd	PCMIN Hold Time	120	—	—	ns	Note 1
tmsp	M0–M7 Setup Time	50	—	—	ns	
tmhd	M0–M7 Hold Time	10	—	—	ns	
tpod	P0–P3 Data Delay	—	—	50	ns	
twrl	WR Low Width	300	—	—	ns	
twrh	WR High Width	300	—	—	ns	
trstl	RST Low Width	100	—	—	ns	

Note 1. tr, tf digital input or clock is assumed 5ns for timing measurement.

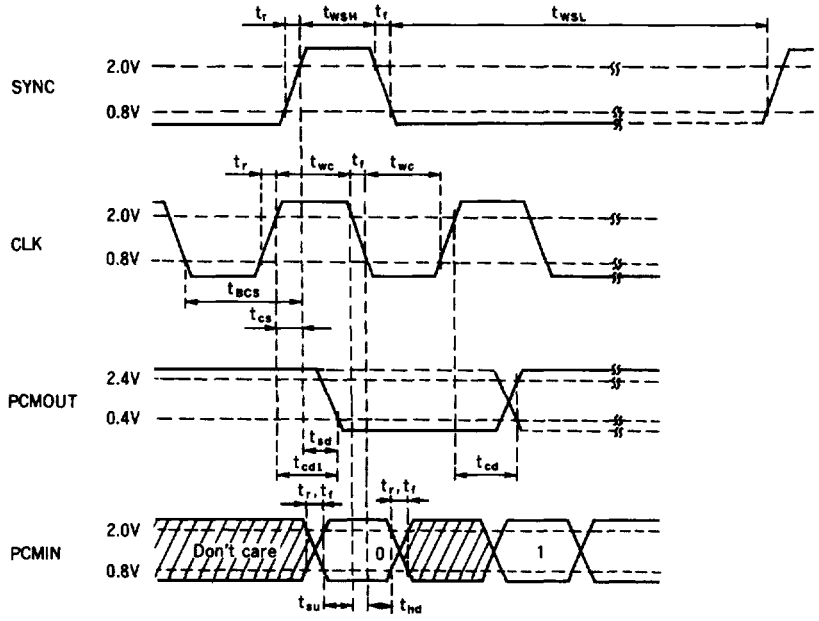
Note 2. PCMOUT Load Condition: 500 Ω + 165 pF + 2 LS – TTL Equivalent
(I_{IL} = 0.8 mA, I_{IH} = –150 µA, V_{OH} = 2.4 V, V_{OL} = 0.4 V)

Note 3. Positive value shows SYNC delay from CLOCK.

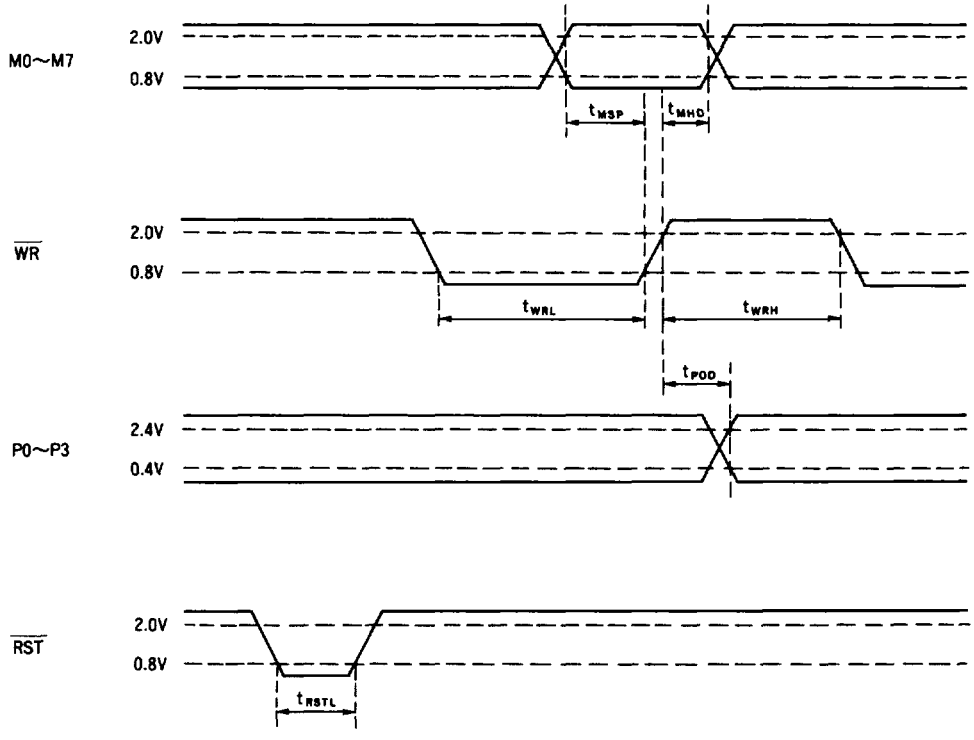
Note 4. tcd1, tsd are specified by CLOCK or SYNC which has slower rise time.

Note 5. tcd specification is valid for the data except MSB.

Timing Chart For CODEC Part



Microcomputer Interface Timing Chart



System Characteristics (HD81019 : A-law) (V_{DD} = 5 ± 0.25 V, Vss = –5 ± 0.25 V, V_{CC} = 5 ± 0.25 V, Ta = 0 to +70°C, Aout Load = 600 Ω, PCM Bit Clock Rate = 2048 kHz, AIN Input, Measure At A_{OUT})

Symbol	Items	Conditions		Min	Typ	Max	Unit	Note
SDA	Signal to Distortion Ratio (A–A)	820 Hz Tone	–45 dBm0	23	—	—	dB	P-wgt
			–40	28	—	—		
			–30, –20, –10, 0	34	—	—		
GTA	Gain Tracking Error (A–A)	820 Hz Tone Relative to –10 dBm0	–55 dBm0	–1.0	—	1.0	dB	
			–50	–0.5	—	0.5		
			–40, –30, –20, –10, 0, 3	–0.3	—	0.3		
FRX	Frequency Response (Loss) (A–D)	Relative to 820 Hz, 0dBm0 input	0.06 kHz	24	—	—	dB	
			0.2	0	—	2.5		
			0.3–3.0	–0.3	—	0.3		
			3.4	0	—	0.8		
			3.78	6.5	—	—		
FRR	Frequency Response (Loss) (D-A)	Relative to 820 Hz 0dBm0	0–3 kHz	–0.3	—	0.3	dB	
			3.4	0	—	0.8		
			3.78	6.5	—	—		
AIL	Analog Input Level (AIN)	820 Hz 0dBm0 input	Ta = 25°C Relative to 1.231Vrms	–0.6	—	0.6	dB	Power Supply: ±5 V ±5%
AOL	Analog Output Level (AOUT)	820 Hz 0dBm0 output	Ta = 25°C Relative to 1.231 Vrms	–0.6	—	0.6	dB	
ICNX	Idle Ch. Noise	A–D	AIN = AGND	—	—	–70	dBm	
ICNR	Idle Ch. Noise	D–A	PCMIN = +0 code	—	—	–75	–0P	
XTKA	Crosstalk (AIN-AOUT)	820 Hz	0dBm0 input	—	—	–65	dB	
XTKD	Crosstalk (PCMIN-PCMOUT)	820 Hz	0dBm0 input	—	—	–65	dB	
PSRR	PSRR	A-A AIN = AGND 0.3–50 kHz	Vdd Mod. = +5 V ± 100 mVop	—	30	—	dB	
			Vss Mod. = –5 V ± 100 mVop	—	30	—	dB	

System Characteristics (HD81020 : μ-law) (V_{DD} = 5 ± 0.25 V, Vss = –5 ± 0.25 V, Vcc = 5 ± 0.25 V, Ta = 0 to +70°C, Aout Load = 600 Ω, PCM Bit Clock Rate = 2048 kHz, AIN Input, Measure At A_{OUT})

Symbol	Items	Conditions		Min	Typ	Max	Unit	Note
SDA	Signal to Distortion Ratio (A–A)	1020 Hz Tone	–45 dBm0	23	—	—	dB	C-wgt
			–40	28	—	—		
			–30, –20, –10, 0	34	—	—		
GTA	Gain Tracking Error (A-A)	1020 Hz Tone Relative to –10 dBm0	–55 dBm0	–1.0	—	1.0	dB	
			–50	–0.5	—	0.5		
			–40, –30, –20, –10, 0, 3	–0.3	—	0.3		
FRX	Frequency Response (Loss) (A–D)	Relative to 1020 Hz, 0dBm0 input	0.06 kHz	24	—	—	dB	
			0.2	0	—	2.5		
			0.3–3.0	–0.3	—	0.3		
			3.4	0	—	0.8		
			3.78	6.5	—	—		
FRR	Frequency Response (Loss) (D-A)	Relative to 1020 Hz 0dBm0	0–3 kHz	–0.3	—	0.3	dB	
			3.4	0	—	0.8		
			3.78	6.5	—	—		
AIL	Analog Input Level (AIN)	1020 Hz 0dBm0 input	Ta = 25°C Relative to 1.227Vrms	–0.6	—	0.6	dB	Power Supply: ±5 V ±5%
AOL	Analog Output Level (AOUT)	1020 Hz 0dBm0 output	Ta = 25°C Relative to 1.227 Vrms	–0.6	—	0.6	dB	
ICNX	Idle Ch. Noise	A–D	AIN = AGND	—	—	20	dBrn	
ICNR	Idle Ch. Noise	D–A	PCMIN = +0 code	—	—	15	–CO	
XTKA	Crosstalk (AIN-AOUT)	1020 Hz	0dBm0 input	—	—	–65	dB	
XTKD	Crosstalk (PCMIN-PCMOUT)	1020 Hz	0dBm0 input	—	—	–65	dB	
PSRR	PSRR	A-A AIN = AGND 0.3–50 kHz	Vdd Mod. = +5 V ± 100 mVop	—	30	—	dB	
			Vss Mod. = –5 V ± 100 mVop	—	30	—	dB	

HD81019 (A-law) : Input Frequency 820 Hz
HD81020 (μ-law) : Input Frequency 1020 Hz
(V_{DD} = 5 ± 0.25 V, Vss = –5 ± 0.25 V, Vcc = 5 ± 0.25 V, Ta = 0 to +70°C)

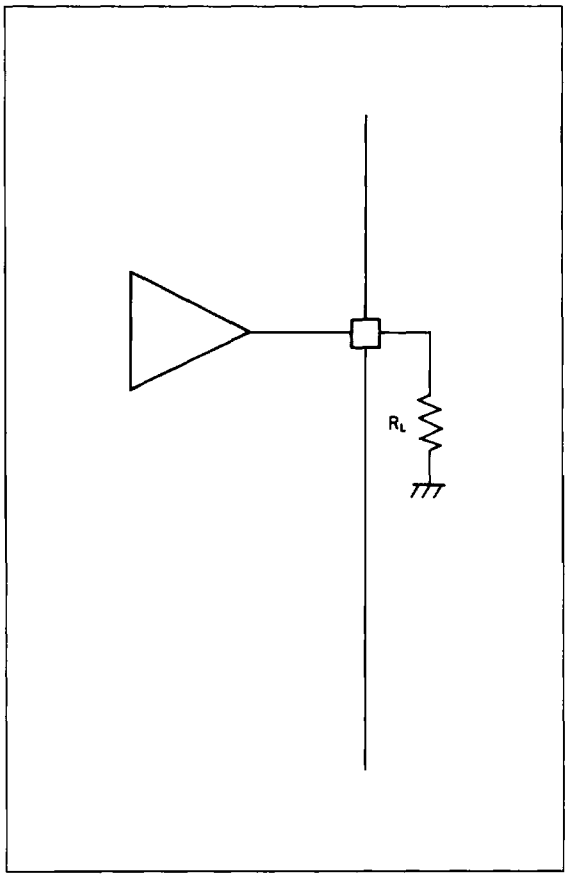
X: Setting Value

Symbol	Item	Input	Output	Conditions		Min.	Typ.	Max.	Unit	Note
G1	G1 Gain Accuracy	TI –12 dBV	AOAD1	S4 :On		X–1.5	—	X+1.5	dBV	
G2	G1 Gain Accuracy	TI 0dBV	R0+	S21, S22 :On		X–24 –1.5	—	X–24 +1.5	dBV	
G3	G1 Gain Accuracy	RINGI –14dBV	SPO	S18, S26 :On		X–3	—	X+3	dBV	
G4	G1 Gain Accuracy	AIDA1 12dBV	AOAD1	S1 :On	3dB step 6dB step	X–1.5 X–3	— —	X+1.5 X+3	dBV dBV	
G5	G1 Gain Accuracy	AIDA2 0dBV	SPO	S0, S15, S19, S28 :On		X–3	—	X+3	dBV	
G6	G1 Gain Accuracy	MI –12dBV	AOAD1	S5 :On		X–1.5	—	X+1.5	dBV	
RF	Ringing FREQ Accuracy		RINGO			–27	–24	–21	dBV	Steps Wave

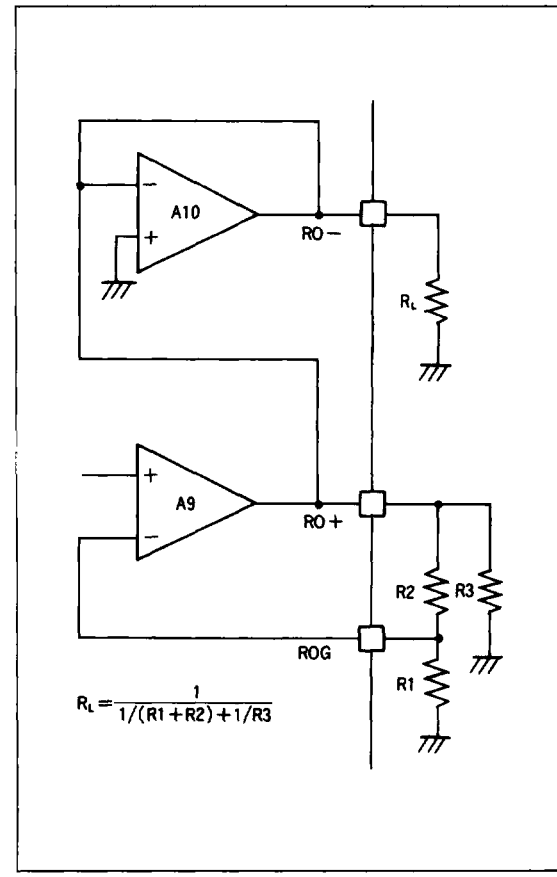
Output Amplifier Drivability

Pin Name	AMP	Condition		Max Output Level	Unit	Note
AOUT	A0		R_L = 600 Ω	4.95	dBV	(1)
AOAD1	A1		R_L = 10 kΩ	6.5	dBV	
AOAD2	A2		R_L = 10 kΩ	6.5	dBV	
MO	A4		R_L = 10 kΩ	–5.5	dBV	
HFO	A5		R_L = 10 kΩ	–5.5	dBV	(1)
SPO	A7		R_L = 10 kΩ	6.5	dBV	
RO+	A9	R1 = 1 kΩ	R_L = 600 Ω	4.95	dBV	(2)
		R2 = 17 kΩ	R_L = 150 Ω	–7.0	dBV	
RO–	A10		R_L = 600 Ω	4.95	dBV	
			R_L = 150 Ω	–7.0	dBV	
RING0	A14		R_L = 10 kΩ	–24	dBV	(1)

Note (1)



Note (2)

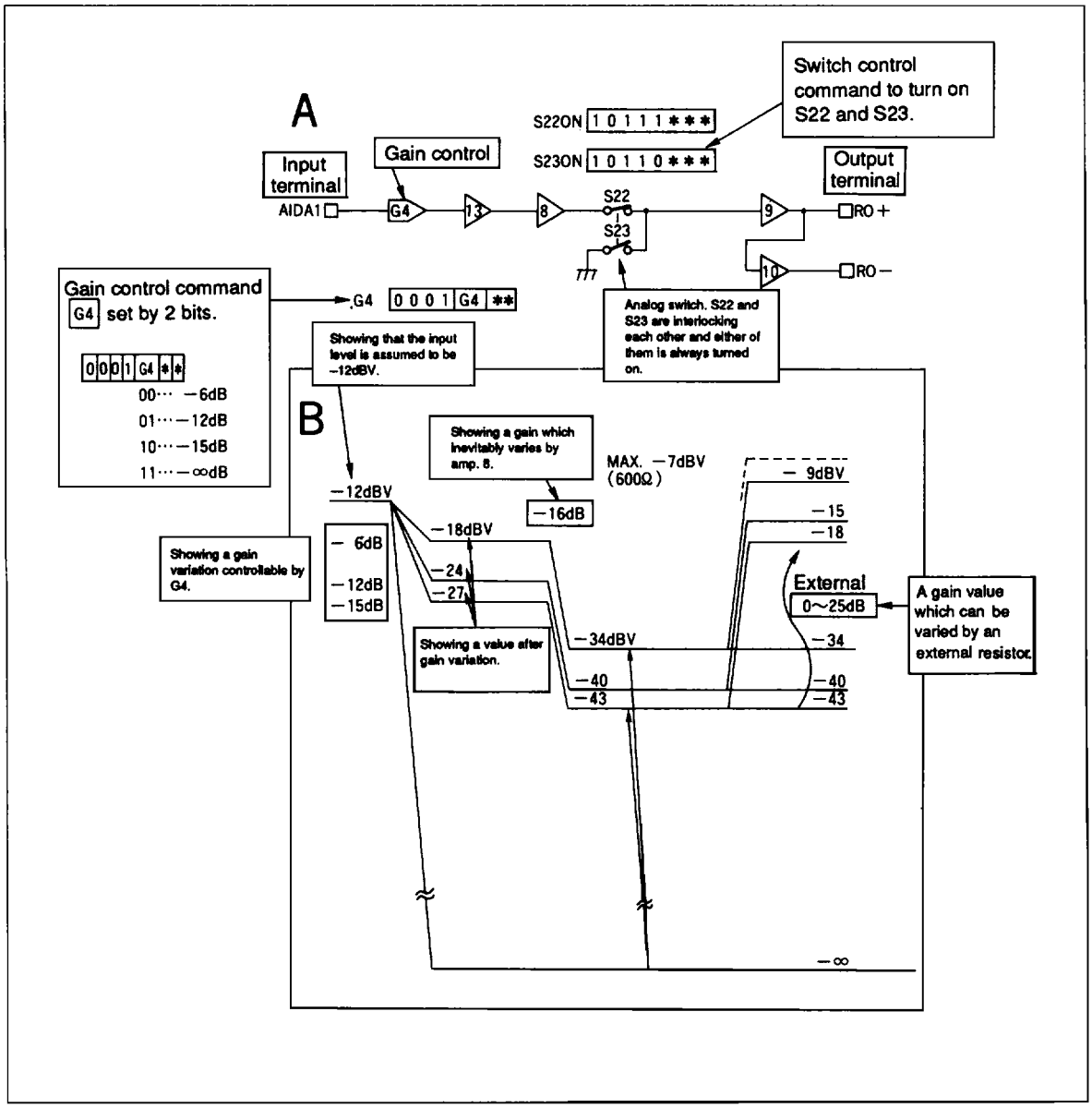


How to read a level diagram

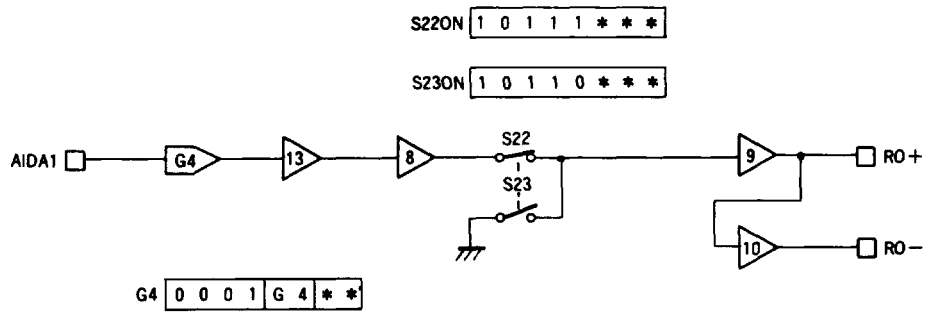
Ten examples of typical signal lines shown in "Microcomputer Interface Timing Chart" are given to show each level diagram.

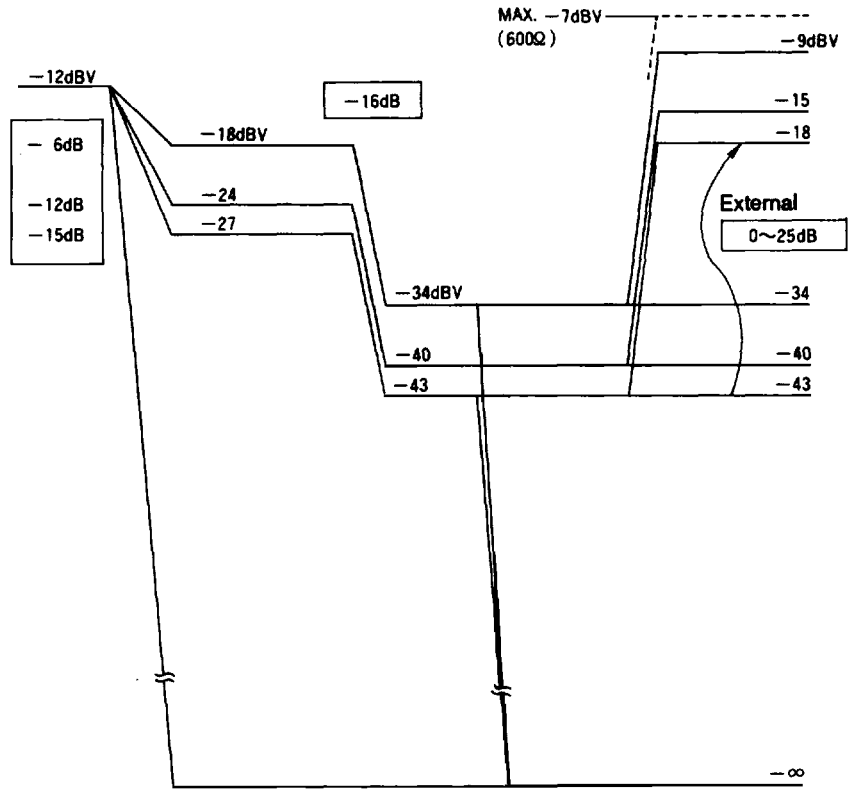
1. Receive signal line (with handset).
2. Transmit signal line (with handset).
3. Side tone adjusting line.
4. Receive signal line (with hands free).
5. Transmit signal line (with hands free).
6. Ringing signal output line (to loud speaker).
7. Ringing signal output line (to receiver).
8. Analog loopback line.
9. Second transmission/receiving line.
10. Lout speaker output line.

- Object lines are drawn out of the block diagram and shown below as A.
- The level diagram is shown as B in the form corresponding to block diagram A.
- For more information, see the remarks given below.

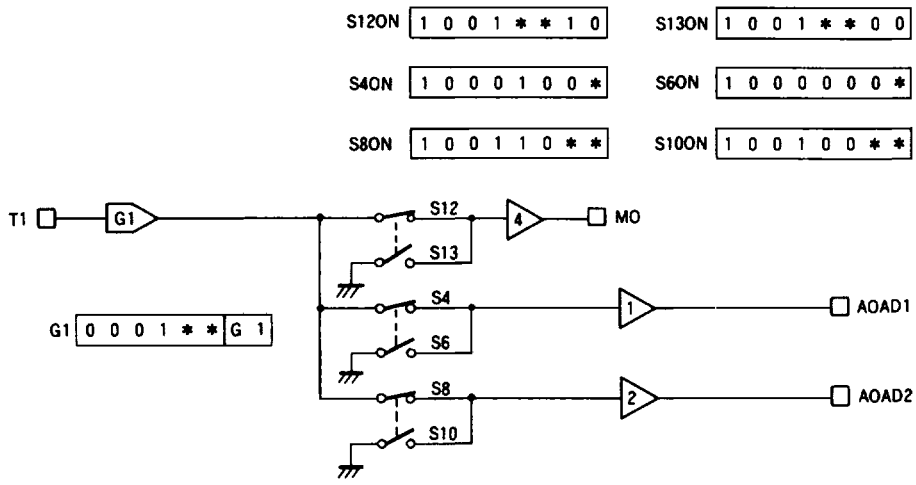


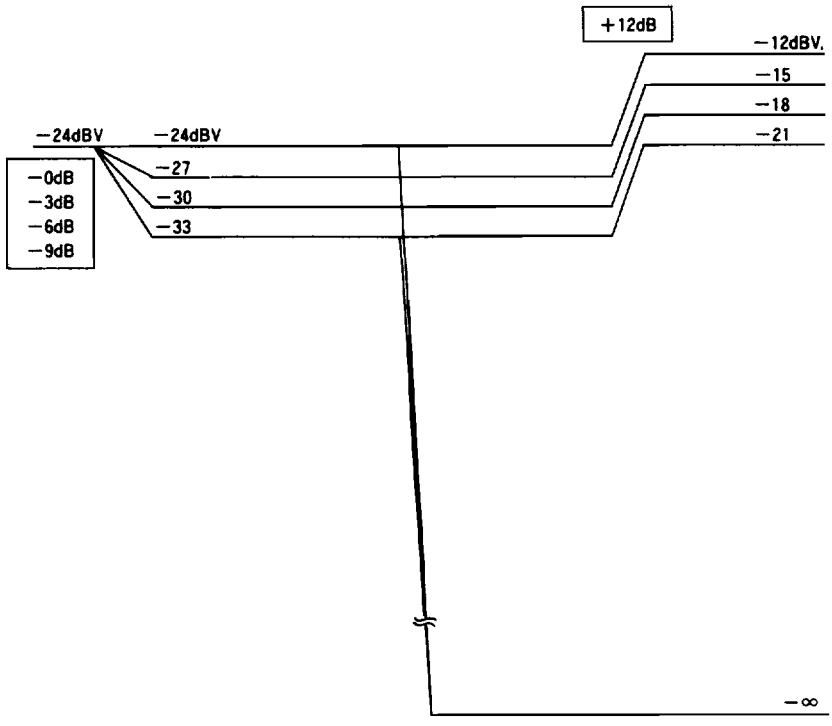
1. Receiving Signal Line (with handset)



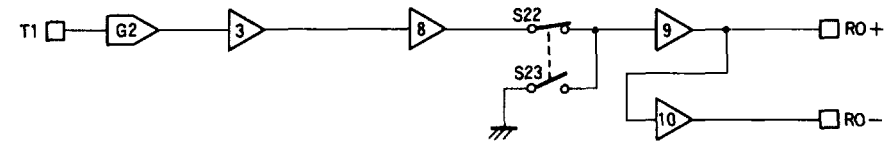


2. Transmit Signal Line (with handset)





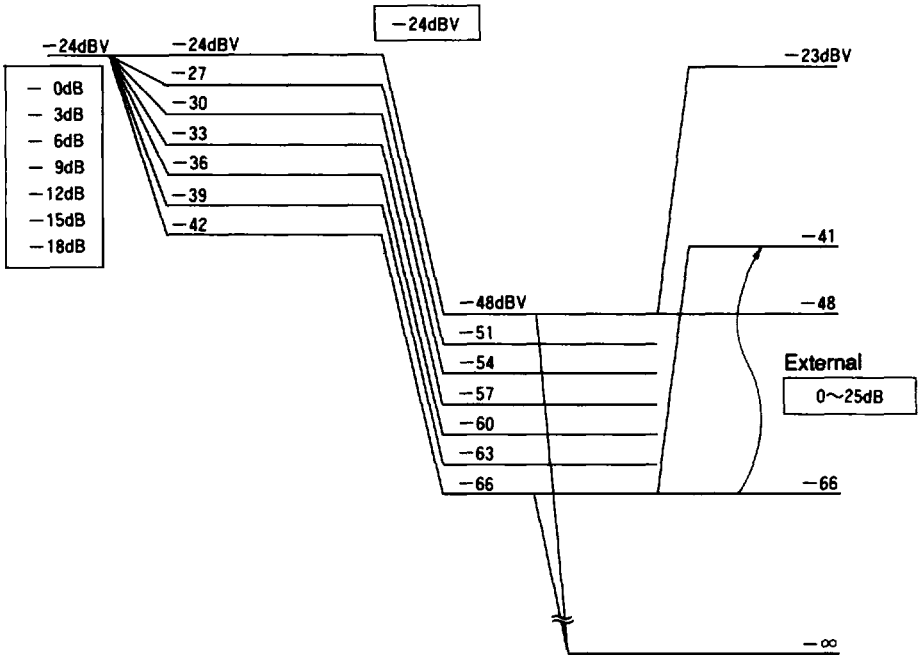
3. Side Tone Adjustment Line



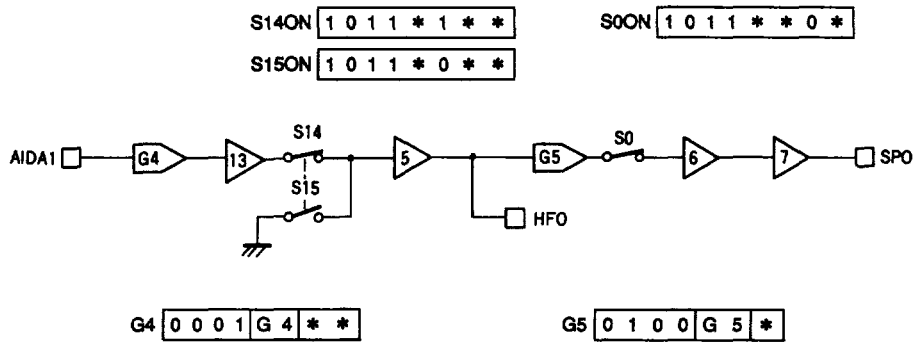
G2	0	0	1	0	G	2	*

S22ON	1	0	1	1	1	*	*	*

S23ON	1	0	1	1	0	*	*	*

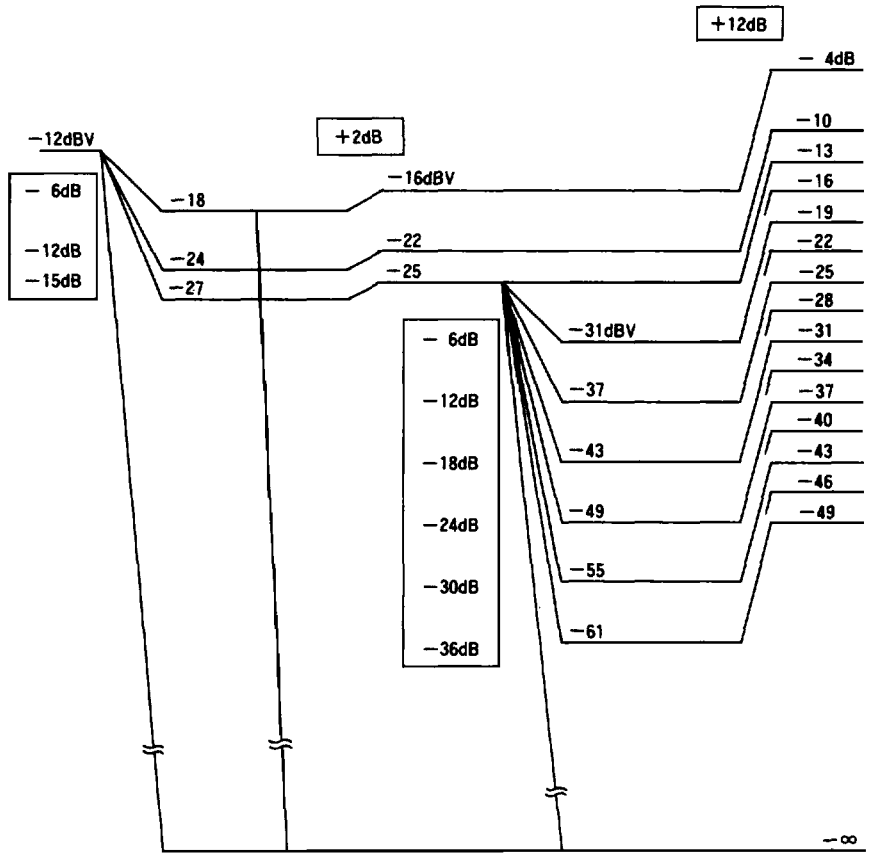


4. Receive Signal Line (with hands free)

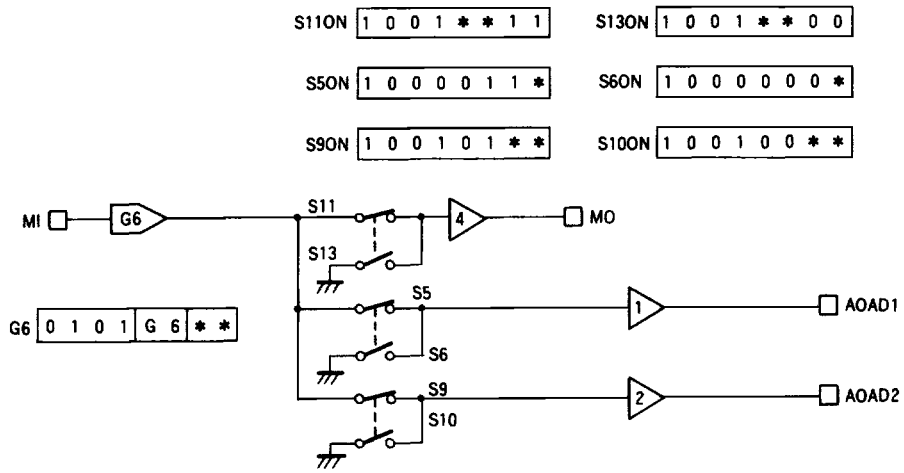


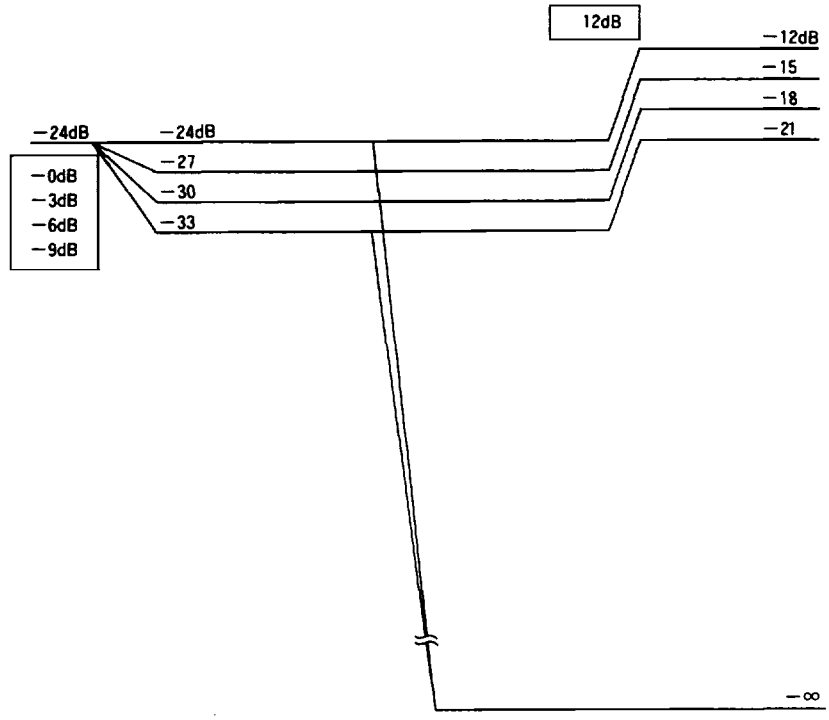
G4 | 0 0 0 1 | G 4 | * * |

G5 | 0 1 0 0 | G 5 | * |

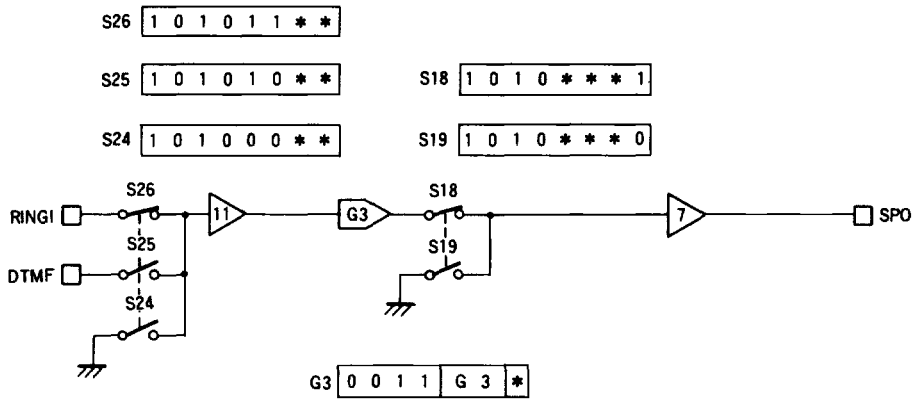


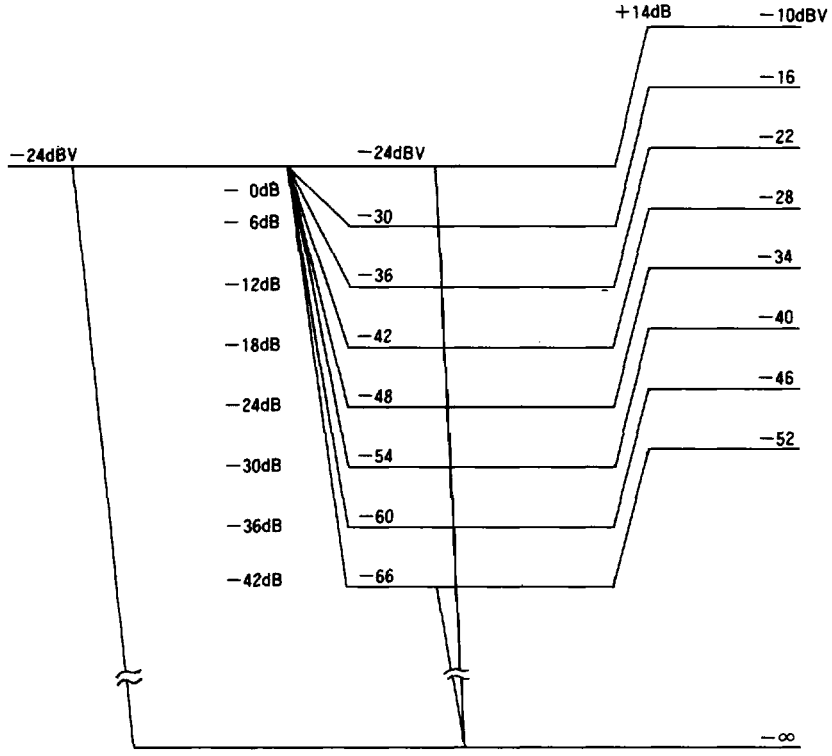
5. Transmit Signal Line (with hands free)



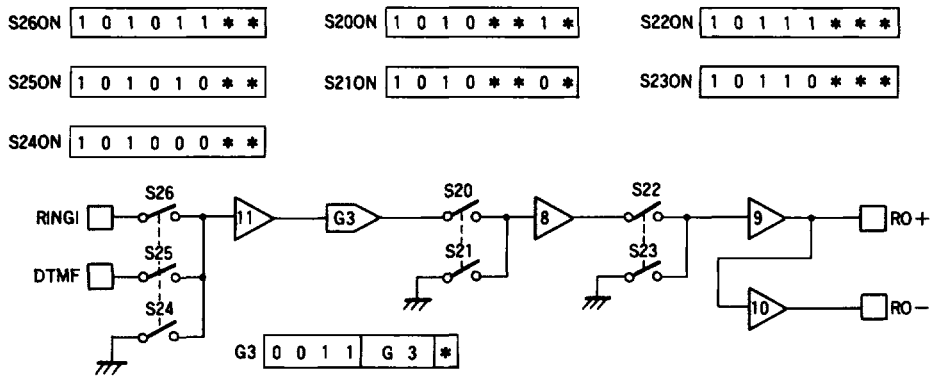


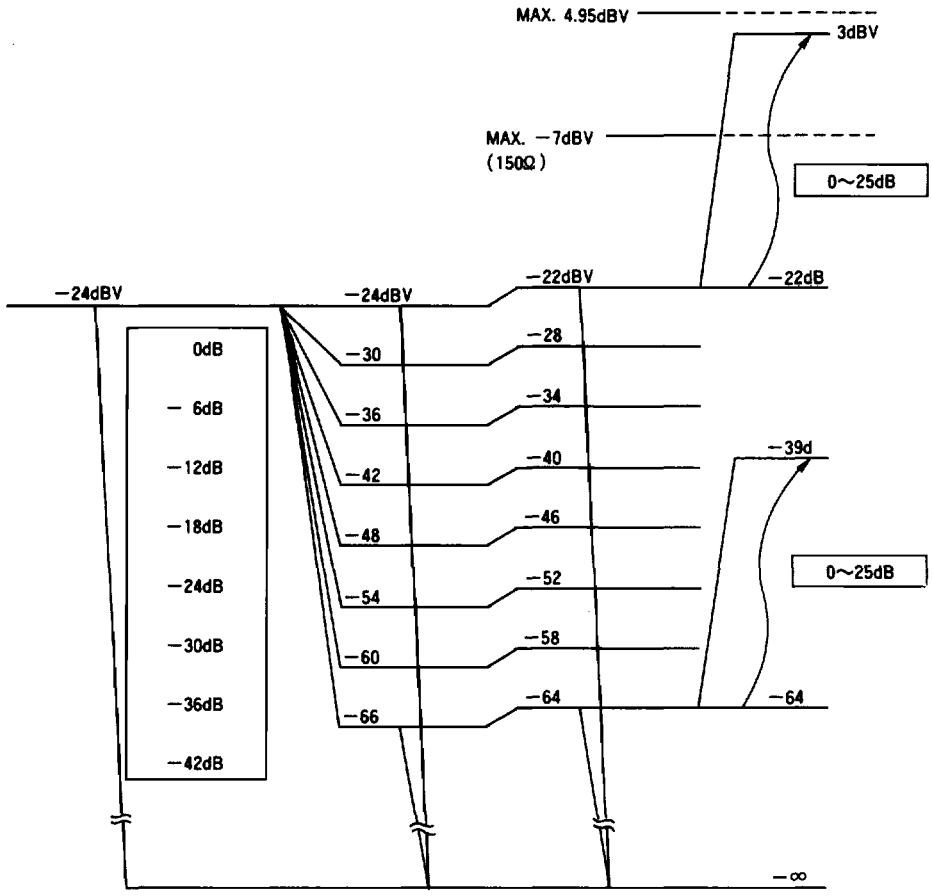
6. Ringing Signal Output Line (to loud speaker)



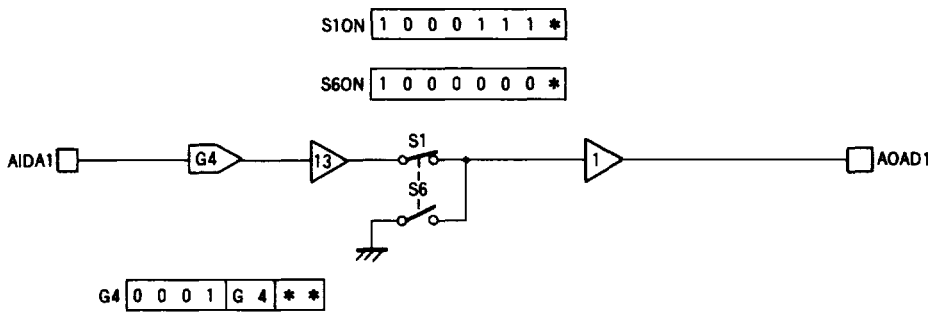


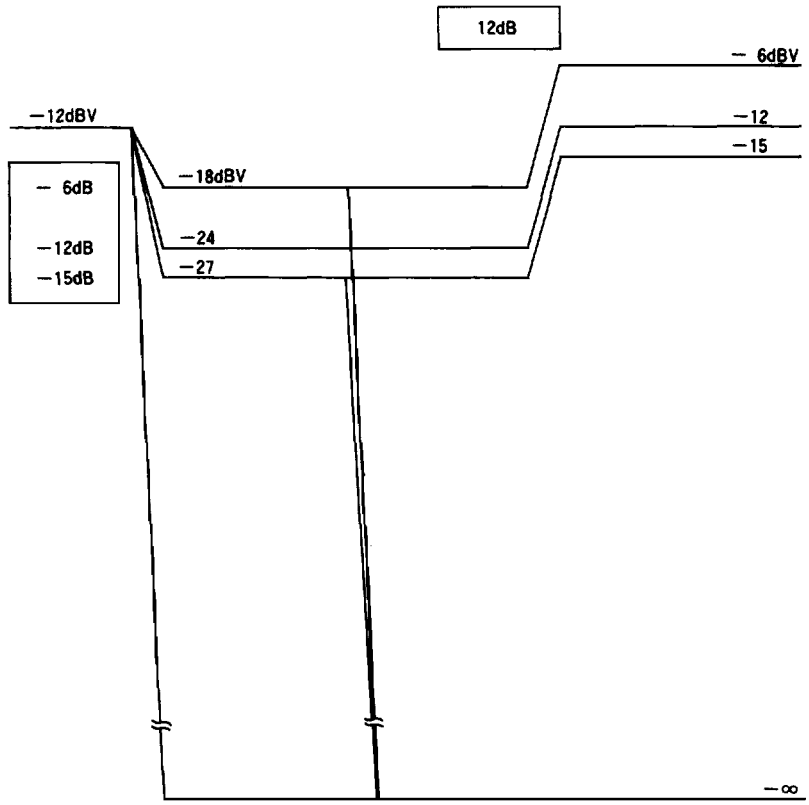
7. Ringing Signal Output Line (to receiver)





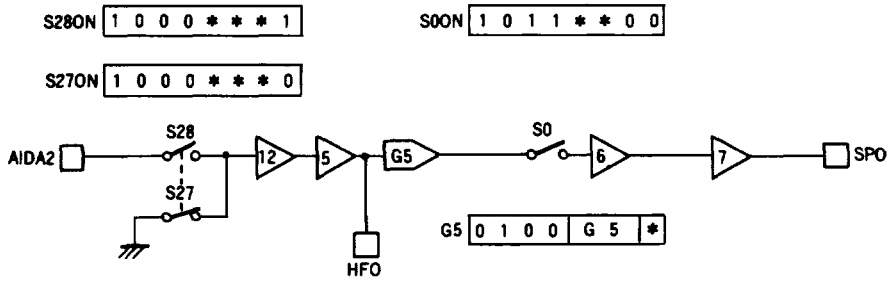
8. Analog Loopback Line

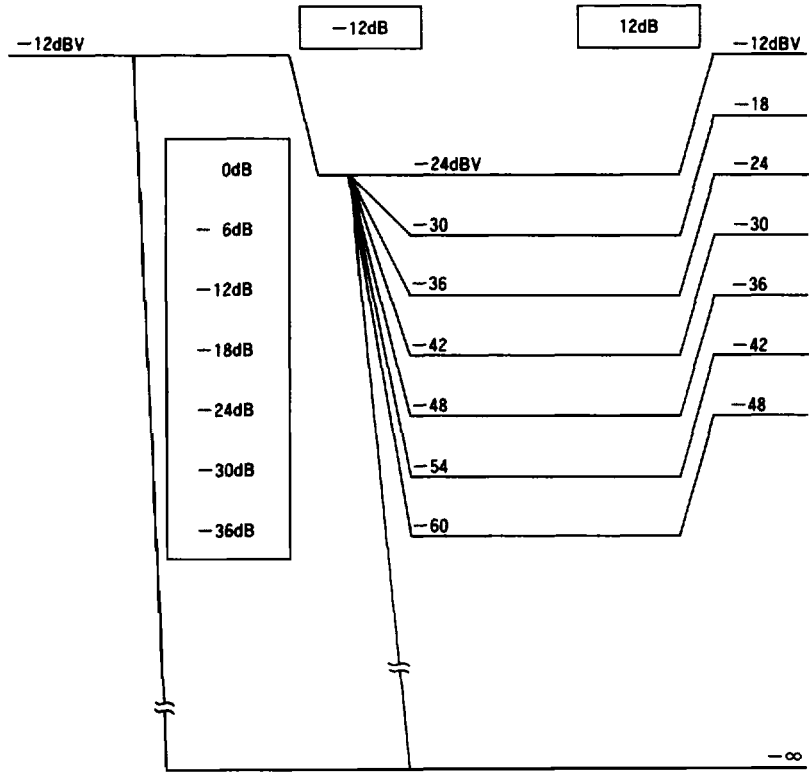




9. Second Transmission/Receiving Line

The second receive signal cannot be output from the handset. An outgoing call can be sent from both handset and handsfree. The same is true with what is shown on 2 and 5. Details are omitted herein.





10. Loud Speaker Output Line