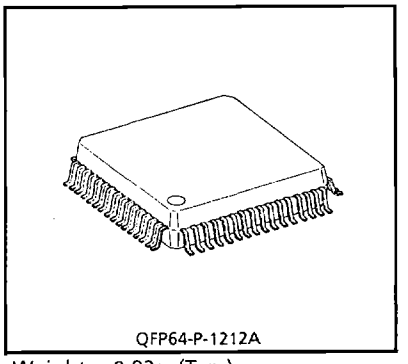
TENTATIVE DATA

VOICE PROCESSING 1CHIP IC FOR CORDLESS TELEPHONE

TB31301F is included speech network, crosspoint switch (9×7 serial data control), SPEAKER AMP, MIC AMP, answering telephone set voice processing in 1chip.

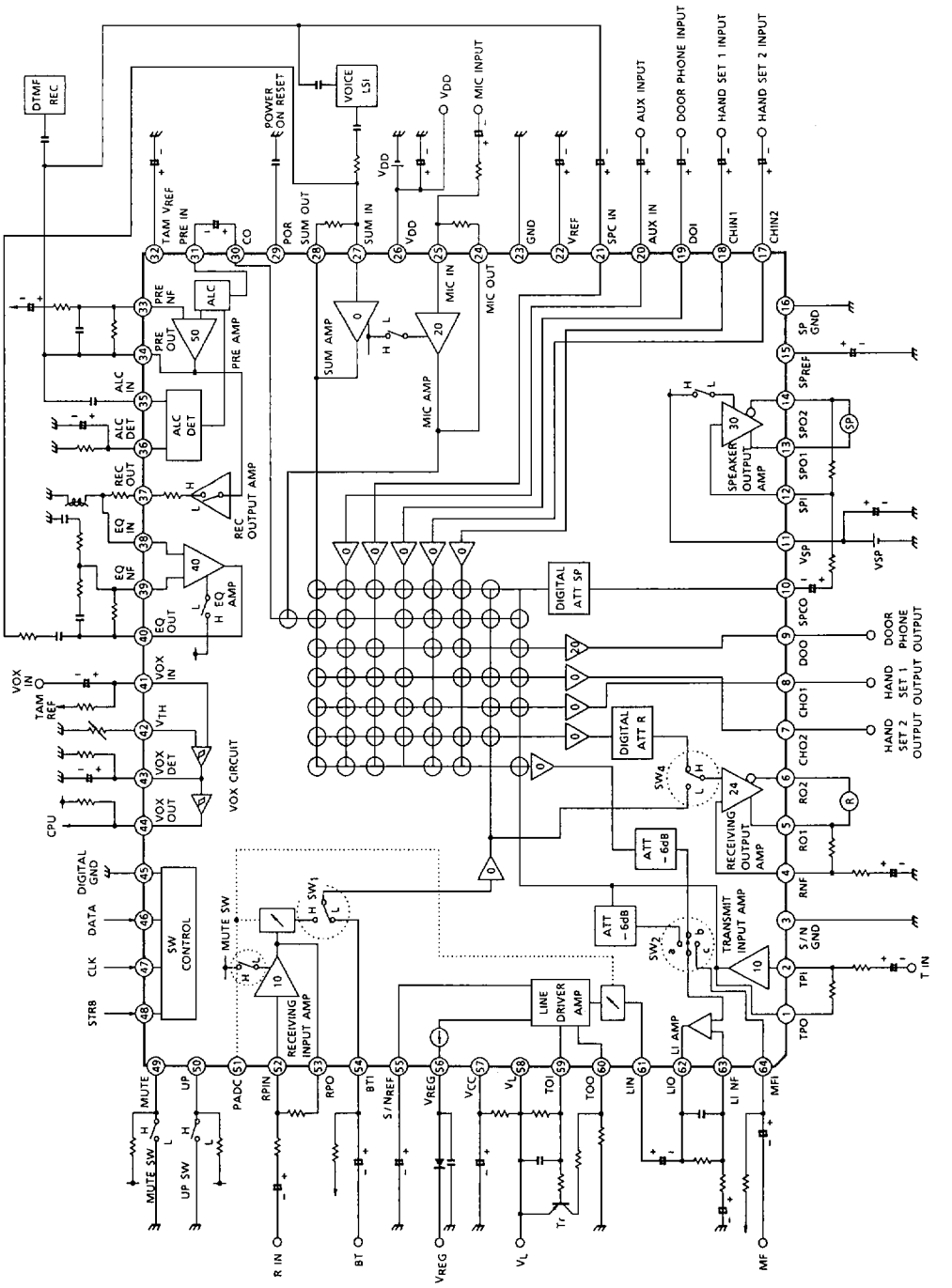


Weight : 0.82g (Typ.)

FEATURES

- This IC has supply voltage detection circuit (function of decrease power detection) preventable wrong operation of each SW at external power voltage down.
- Built-in SP AMP.
- It is possible to cut supply power for each block power switchable.
- Built-in regulator for dialer IC.
- [Communication line]

  It is possible to cut external parts because base set, hand set 2 stand, door phone, microphone, answering function, speaker each signal processing can correspond 1chip. (Built-in Aux input terminal)
- Package : QFP64pin (0.65mm pitch)



BLOCK DIAGRAM

TB31301F-2

PIN FUNCTION

PIN NO.	PIN NAME	FUNCTION
1	TPO	(Output terminal of TRANSMIT INPUT AMP) Makes negative feedback to TPI terminal (Pin 2). The gain of TRANSMIT INPUT AMP is adjustable according to external parts between TPI terminal and this terminal. Signal of this terminal is connected internal crosspoint switch input.
2	TPI	(The inversion input terminal of TRANSMIT INPUT AMP) Receives negative feedback from TPO terminal (Pin 1).
3	S/N GND	(GND terminal of speech network) Connected to negative output of diode bridge.
4	RNF	(The inversion input terminal of RECEIVING OUTPUT AMP) Receives negative feedback from RO1 terminal (Pin 5).
5	RO1	(Receiving output terminal, non-inversion output) The gain of RECEIVING OUTPUT AMP is variable according to external parts between RNF terminal (Pin 4) and this terminal. Signal, of which phase is negative of RO2 terminal (Pin 6), is output.
6	RO2	(Receiving output terminal, inversion output) This terminal is output terminal to receiver. Signal of which phase is negative of RO1 terminal (Pin 5), is output.
7	CHO2	(Hand set 2 output terminal) This terminal is crosspoint switch output terminal. Output drive current of this terminal is 100μA (Typ.), and output impedance is a few hundreds Ω.
8	CHO1	(Hand set 1 output terminal) This terminal is crosspoint switch output terminal. Output drive current of this terminal is 100μA (Typ.), and output impedance is a few hundreds Ω.
9	DOO	(Door phone output terminal) This terminal is crosspoint switch output terminal. Output drive current of this terminal is 100μA (Typ.) and output impedance is a few hundreds Ω.
10	SPCO	(Crosspoint switch output, speaker terminal) This terminal is crosspoint switch output terminal through speaker digital ATT. Output drive current of this terminal is 100μA.
11	V_{SP}	(Speaker supply voltage terminal) This terminal is feed from outside on account of independ from V_{DD} terminal at SPEAKER AMP operating.
12	SPI	(Inversion input terminal of speaker output AMP) Receives negative feedback from SPO2 terminal (Pin 14).
13	SPO1	(Speaker output terminal, non-inversion output) This terminal is output terminal to speaker. Signal of which phase is negative of SPO2 terminal (Pin 14), is output.

PIN NO.	PIN NAME	FUNCTION
14	SPO2	(Speaker output terminal, inversion output) This terminal is output terminal to speaker. Signal of which phase is negative of SPO1 terminal (Pin 13), is output. Makes negative feedback to SPI terminal (Pin 12)
15	SP REF	(SPEAKER AMP reference voltage terminal) This terminal's voltage is reference voltage (at 2.65V : V_{SP} = 6V standard) of internal SPEAKER AMP. Never use this terminal as external power.
16	SP GND	(SPEAKER AMP system GND terminal)
17	CHIN2	(Hand set 2 input amplifier inversion input terminal) Signal, this is input to this terminal, is connected to internal crosspoint switch input. Since this terminal is biased to about the same potential as V_{REF} terminal (Pin 22), avoid direct impressing of external DC voltage through capacitor at inputting external signal. Input impedance is 50kΩ (Typ.).
18	CHIN1	(Hand set 1 input amplifier inversion input terminal) Signal, which is input to this terminal, is connected to internal crosspoint switch input. Since this terminal is biased to about the same potential as V_{REF} terminal (Pin 22), avoid direct impressing of external DC voltage through capacitor at inputting external signal. Input impedance is 50kΩ (Typ.).
19	DOI	(Door phone input amplifier inversion input terminal) Signal, which is input to this terminal, is connected to internal crosspoint switch input. Since this terminal is biased to about the same potential as V_{REF} terminal (Pin 22), avoid direct impressing of external DC voltage through capacitor at inputting external signal. Input impedance is 50kΩ (Typ.).
20	AUX IN	(Aux input terminal, inversion) Signal, which is input to this terminal, is connected to internal crosspoint switch input. Since this terminal is biased to about the same potential as V_{REF} terminal (Pin 22), avoid direct impressing of external DC voltage through capacitor at inputting external signal. Input impedance is 50kΩ (Typ.).
21	SPC IN	(Crosspoint switch input amplifier inversion input terminal) This terminal can input ALC output signal to crosspoint switch according to connect PREOUT terminal. (Pin 34) Input impedance is 30kΩ (Typ.).
22	V_{REF}	(Internal reference voltage terminal) This terminal is reference voltage (V_{DD}/2) of internal V_{DD} feed operation current. Never use this terminal as external power.

PIN NO.	PIN NAME	FUNCTION
23	GND	(GND terminal)
24	MIC OUT	(MIC AMP output terminal) Makes negative feedback to MIC IN terminal (Pin 25). Signal of this terminal is connected internal crosspoint switch input terminal.
25	MIC IN	(MIC input terminal. inversion input) Receives negative feedback MIC OUT terminal (Pin 24).
26	V_{DD}	(Power voltage terminal) External power input terminal.
27	SUM IN	(SUM AMP input terminal, non-inversion input) Receives negative feedback SUM OUT terminal (Pin 28).
28	SUM OUT	(SUM AMP output terminal) Makes negative feedback to SUM IN terminal (Pin 27). Signal is connected to internal crosspoint switch input terminal.
29	POR	(Power on reset terminal) This terminal connect to GND through capacitor. Reset signal is cancelled with a delay time decided by time constant of the external capacitor. It is possible to reset IC according to connect to GND
30	CO	(Crosspoint switch signal output terminal, PRE AMP) Crosspoint switch signal output terminal. Signal of this terminal suppose to signal input to PRE AMP.
31	PRE IN	(PRE AMP input terminal) Input terminal of PRE AMP. Crosspoint output signal can be input according to correct CO terminal (Pin 30) through capacitor.
32	TAM V_{REF}	(Voice signal disposition internal reference voltage output terminal) This terminal is each amplifier reference potential (1.5V : Typ.) of internal IC (voice signal disposition). Never use this terminal as external power.
33	PRE NF	(PRE AMP inversion input terminal) This terminal is inversion input terminal of PRE AMP. Receives negative feedback from PRE OUT (Pin 34).
34	PRE	(PRE AMP output terminal) This terminal is output terminal of PRE AMP. The gain of PRE AMP is variable according to the value of external parts between PRE NF terminal (Pin 33) and PRE terminal (Pin 34).
35	ALC IN	(ALC detection input terminal) This terminal is input terminal of detection circuit for connect to PRE AMP output terminal through capacitor 0.1μF.
36	ALC DET	(ALC detection terminal) The ALC attack time and recovery time is decided by the value of external a resistance and a capacitor.
37	REC OUT	(Recording output terminal) This pin inputs the signal from PRE AMP to OGM Head through REC AMP. The output impedance is 330Ω (Typ.).
38	EQ IN	(EQ AMP input terminal) This pin inputs the signal from Head output to EQ AMP at PLAY MODE.

PIN NO.	PIN NAME	FUNCTION
39	EQ NF	(EQ AMP NF terminal) Receives negative feedback from output terminal of EQ.
40	EQ OUT	(EQ AMP output terminal) The gain of EQ AMP is variable according to the value of external parts between EQ NF terminal (Pin 39) and this terminal.
41	VOX IN	(Signal detection input terminal) This is input terminal of VOX circuit. Suppose to connect ALC IN terminal (Pin 35).
42	V_{TH}	(Signal detection level adjustment terminal) Connect to GND through resistance. Signal detection level is variable according to the value of this resistance.
43	VOX DET	(Signal detection terminal) Connect to capacitor and resistance for detection.
44	VOX OUT	(Signal detection output terminal) Detect to signal of input from VOX IN terminal (Pin 41) and output as follows. When signal detect ..... "L" state When no signal ..... "OPEN" state Connect to V_{DD} terminal (Pin 26) through resistance because of output is open collector system.
45	DIGITAL GND	(Digital GND terminal)
46	DATA	(Syrial data DATA signal input terminal) This terminal input syrial data, DATA signal.
47	CLK	(Syrial data CLK signal input terminal) This terminal input syrial data, CLK signal.
48	STRB	(Syrial data STRB signal input terminal) This terminal input syrial data, STRB signal.
49	MUTE	(MUTE terminal) Switching terminal of transmit signal with MFI input signal in transmit system. Switching terminal of receiving signal with BTI input signal in receiving system. (MUTE SW control system refer to another sheet)
50	UP	(Direct impedance control terminal) When this terminal is connected to S/N GND terminal (Pin 3) directly or through resistance, DC potential of V_L terminal (Pin 58) can be increased up to max. 1.0V (Typ.) in the same line current. This function has no relation with state of MUTE terminal (Pin 49).
51	PADC	(Pad control terminal) When this terminal is connected to S/N GND terminal (Pin 3) or V_{CC} terminal (Pin 47) through resistance, operation current of gain control (auto-pad) performed by line current can be controlled.
52	RPIN	(Inversion input terminal of receiving input amplifier) Receives negative feedback from RPO terminal (Pin 53).

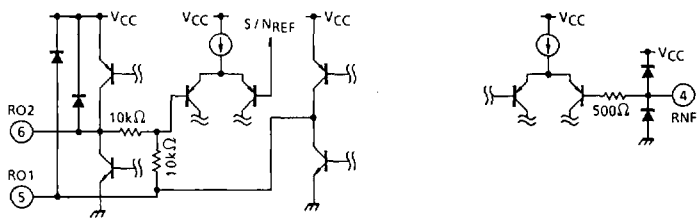
PIN NO.	PIN NAME	FUNCTION
53	RPO	(Output terminal of receiving input terminal) Makes negative feedback to RPIN terminal (Pin 52).
54	BTI	(Dial confirmation sound (Beep Tone), monitor sound input terminal) Signal, which is input to this terminal, is connect to crosspoint system only when internal switch is in "L" state. Since this terminal is biased to about the same potential as S/N_{REF} terminal (Pin 55), avoid direct impressing of external DC voltage through capacitor at inputting external signal.
55	S/N_{REF}	(Speech network internal reference voltage output terminal) Voltage of this terminal is used as reference voltage (0.65V : I_L = 20mA Typ.) of internal (speech network) pre-amplifier. Never use this terminal as an external power supply.
56	V_{REG}	(External power supply terminal) This terminal can supply voltage to external DIALER IC from current (V_L) through diode for back current prevention. Connect to capacitor about 1000pF between this terminal and GND terminal (Pin 3) because of oscillate no-load state.
57	V_{CC}	(Speech network internal power supply voltage terminal) Power of internal speech network section pre-amplifier.
58	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.
59	TOI	(Current flow-in terminal of transmit output) Connected to V_L terminal (Pin 58) through radiation transistor or resistance R_{41}, connected to TOO terminal (Pin 60) through radiation transistor or resistance R_1. Since almost all the line currents are flowed radiation transistor, set allowable power of resistance R_1 to be connected to radiation transistor considering the maximum current of line current expected to be used.
60	TOO	(Current output terminal of transmit output) Connected to S/N GND terminal (Pin 3) through R_4. Since almost all the line currents are flowed from this terminal, set allowable power of resistance R_4 to be connected to S/N GND terminal (Pin 3) 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 R_4, and makes it be output at V_L terminal.
61	LIN	(Line driver amplifier input terminal) Connect from LIO terminal (Pin 62) through capacitor.

PIN NO.	PIN NAME	FUNCTION
62	LIO	(LI AMP output terminal) It is possible to control gain of LI AMP according to external parts between LI NF terminal (Pin 63) and this terminal.
63	LI NF	(LI AMP inversion input terminal) Receives negative feedback from LIO terminal (Pin 63).
64	MFI	(Input terminal of DTMF or external input signal) Signal, which is input to this terminal, is output V_L terminal only when internal switch is in "C" state. Since this terminal is biased to almost the same potential as S/N_{REF} terminal (Pin 55), avoid direct impress of external DC potential by using capacitor at inputting external signal.

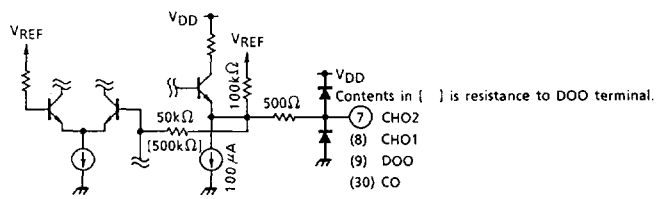
INTERNAL EQUIVALENT CIRCUIT (The values of resister and current in the finger are typical)

1 TPO
2 TPI

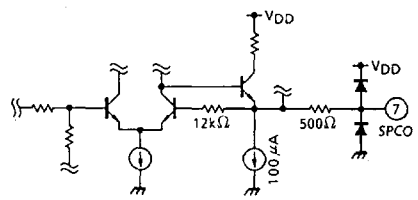
4 RNF
5 RO1
6 RO2



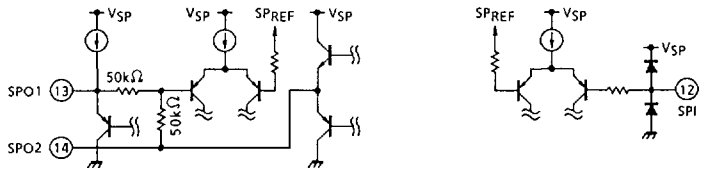
7 CHO2
8 CHO1
9 DOO
30 CO



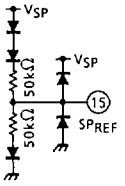
10 SPCO



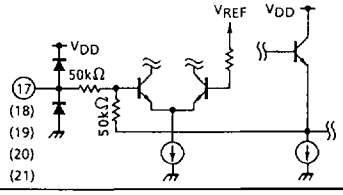
12 SPI
13 SPO1
14 SPO2



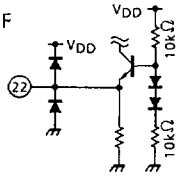
15 SPREF



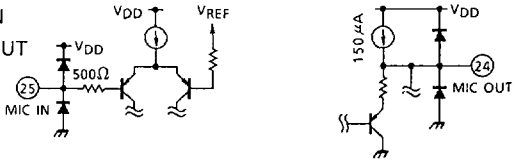
⑰ CH IN2
⑱ CH IN1
⑲ DOI
⑳ AUX IN
㉑ SPC IN



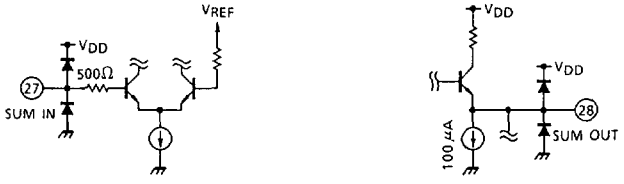
22 VREF



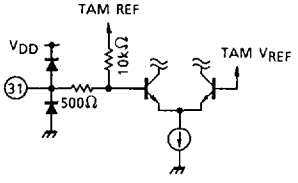
25 MIC IN
24 MIC OUT



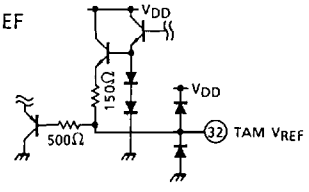
27 SUM IN
28 SUM OUT



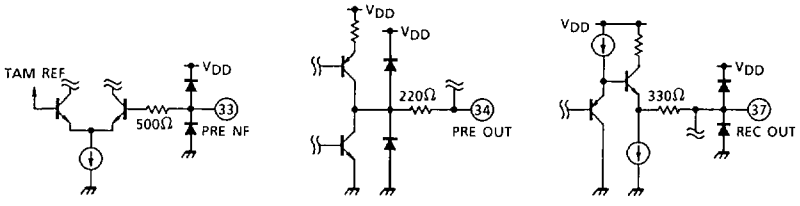
31 PRE IN



32 TAM VREF



33 PRE NF
34 PRE OUT
37 REC OUT



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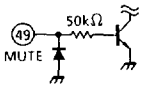
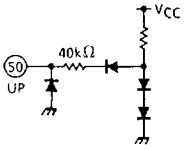
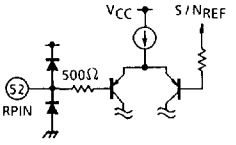
49 MUTE

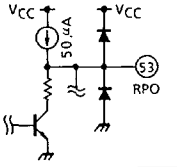


50 UP

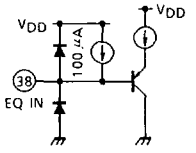


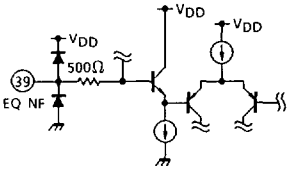
52 RPIN
53 RPO



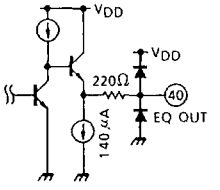


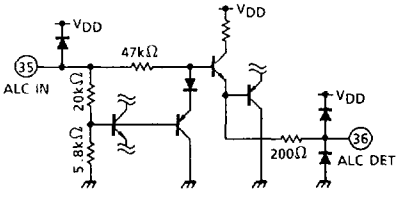
38 EQ IN
39 EQ NF



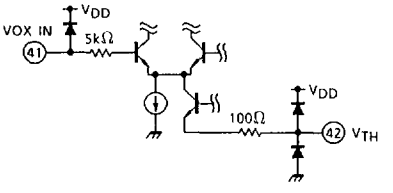


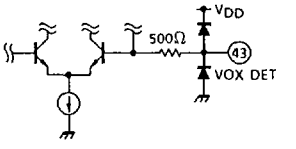
40 EQ OUT
35 ALC IN
36 ALC DET



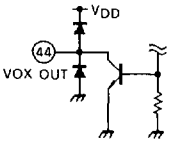


41 VOX IN
42 V_{TH}
43 VOX DET

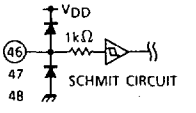




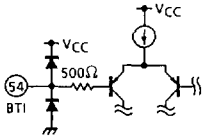
44 VOX OUT



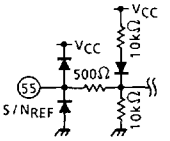
46 DATA
47 CLK
48 STRB



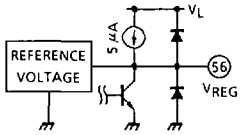
54 BTI



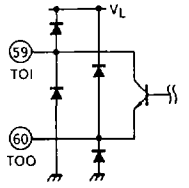
55 S/NREF



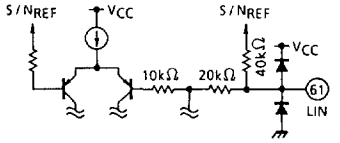
56 VREG



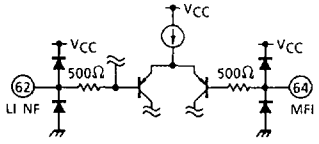
59 TOI
60 TOO

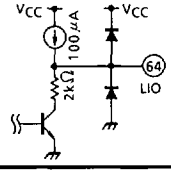


61 LIN



62 LIO
63 LI NF
64 MFI





5

LOGIC SECTION OPERATION EXPLANATION

1) Syrial data for control IC is input from three terminals CLK, DATA, STRB.

   (1) Input data is 8bit.

   (2) When clock pulse is rising, data is sent shift resister internal IC in order.

   (3) When data all sent, strobe signal is "H" state.

   Pulse duration of strobe signal (duration to next signal build up from strobe signal build up) is necessary at intervals of 8bit (CLOCK) or more.

   (4) Shift resister accumulating data A0~A6 is forward decoder according to strobe signal "H" level is sent, and IC is controlled by "D" bit data send latch circuit of selected in this decoder.

2) LOGIC address table

A = Address D = Data * = Optional

A0	A1	A2	A3	A4	A5	A6	D	LSB input data, 8bit	
0	0	0	0	0	0	0	0	All reset	
0	0	0	0	0	0	0	1	Crosspoint reset	
0	*	*	*	*	*	*	D	Crosspoint SW control (refer to an another sheet)	
1	0	0	0	0	0	0	0	S/N (Txin, Rxout) V_{DD} feed (*1)	OFF
1	0	0	0	0	0	0	1		ON
1	0	0	0	0	0	1	0	Power supply (B/S Block) (*2)	OFF
1	0	0	0	0	0	1	1		ON
1	0	0	0	0	1	0	0	Power supply (SP)	OFF
1	0	0	0	0	1	0	1		ON
1	0	0	0	0	1	1	0	Power supply (MIC)	OFF
1	0	0	0	0	1	1	1		ON
1	0	0	0	1	0	*	0	TAM Power supply	OFF
1	0	0	0	1	0	*	1		ON
1	0	0	0	1	1	0	0	TAM REC AMP	OFF
1	0	0	0	1	1	0	1		ON
1	0	0	0	1	1	1	0	TAM EQ AMP	OFF
1	0	0	0	1	1	1	1		ON
1	0	0	1	0	*	*	0	Digital MUTE	H
1	0	0	1	0	*	*	1		L

(Note) (*1) When connect LINEs, DATA bit is certainly "0".

(*2) B/S block : When B/S block "0", TAM power supply "0" (SP "0"), consumption current is min.

When V_{DD} feed ($V_{DD} \geqq 3.0V$), outside service, B/S block is certainly "1".

A0	A1	A2	A3	A4	A5	A6	D	LSB input data, 8bit	
1	1	0	0	0	0	0	*	Receiving Amp ATT	0dB
1	1	0	0	0	0	1	*	Receiving Amp ATT	−6dB
1	1	0	0	0	1	0	*	Receiving Amp ATT	6dB
1	1	1	0	0	0	0	*	SP Amp ATT	0dB
1	1	1	0	0	0	1	*	SP Amp ATT	−1.5dB
1	1	1	0	0	1	0	*	SP Amp ATT	−3.0dB
1	1	1	0	0	1	1	*	SP Amp ATT	−4.5dB
1	1	1	0	1	0	0	*	SP Amp ATT	−6.0dB
1	1	1	0	1	0	1	*	SP Amp ATT	−7.5dB
1	1	1	0	1	1	0	*	SP Amp ATT	−9.0dB
1	1	1	0	1	1	1	*	SP Amp ATT	−10.5dB
1	1	1	1	0	0	0	*	SP Amp ATT	−12.0dB
1	1	1	1	0	0	1	*	SP Amp ATT	−13.5dB
1	1	1	1	0	1	0	*	SP Amp ATT	−15.0dB
1	1	1	1	0	1	1	*	SP Amp ATT	−16.5dB
1	1	1	1	1	0	0	*	SP Amp ATT	−18.0dB
1	1	1	1	1	0	1	*	SP Amp ATT	−19.5dB
1	1	1	1	1	1	0	*	SP Amp ATT	−21.0dB
1	1	1	1	1	1	1	*	SP Amp ATT	REF Pull up (OFF)

- Each ATT control is mode appointed A0~A2, decide to ATT level by data indicated A3~A6 4bit. At that time data which is set before, is clear.
- Crosspoint or SW control appoint each SW by address data (A0~A6), latch contents of D bit.

3) Pre-set state table

It is the following state when "A0~D" is all "0" (all reset state), or POWER ON RESET.

A0	A1	A2	A3	A4	A5	A6	D	LSB input data, 8bit	
1	0	0	1	0	*	*	0	Digital MUTE H	
1	1	0	0	0	0	0	*	Receiving ATT level	0dB
1	1	1	0	0	0	0	*	SP ATT level	0dB

- Crosspoint SW section or power supply SW is all reset.

4) Crosspoint SW address table

	V_L (CURRENT) OUTPUT	RECEIVING OUTPUT	HAND SET 1 OUTPUT	HAND SET 2 OUTPUT	DOOR PHONE OUTPUT	CO TERMINAL OUTPUT	SPEAKER OUTPUT
MIC Input	—	—	—	—	—	01	—
SUM AMP Input	08	09	0A	0B	0C	0D	0E
AUX Input	0F	10	11	12	13	14	15
SPC IN Input	16	17	18	19	1A	—	1C
Doorphone Input	—	1E	1F	20	—	22	23
Hand Set 2 Input	24	25	26	—	28	29	2A
Hand Set 1 Input	2B	2C	—	2E	2F	30	31
Current Receiving Input	—	33	34	35	—	37	38
Transmit Input	39	—	3B	3C	3D	3E	—

The above-mentioned numerical value (hexadecimal number) correspond syrial data A1~A6 indicate binary.
And blank space is unused to crosspoint switch.

A0	A_1	A_2	A_3	A_4	A_5	A_6	D
0	Hexadecimal : first bit		Hexadecimal : second bit				*

5) LOGIC operation example

○ After external feed insertion (After reset)

Current receiving signal input → REC AMP output
→ SP ATT (−6dB) →SPEAKER AMP output

a) Power supply insertion (V_{DD} = 5V)

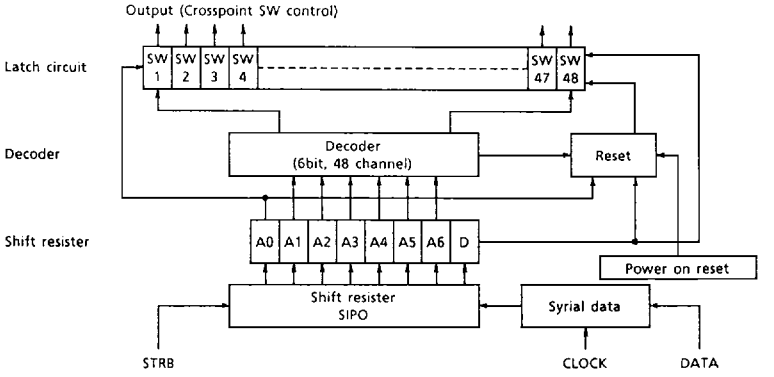
b) Speaker power supply insertion (V_{SP} = 6V)

c) Syrial data input (Refer to the following table)

	A0	A1	A2	A3	A4	A5	A6	D	
Battery saving mode cancellation	1	0	0	0	0	0	1	1	This data input is a must. In case of power supply insertion.
Telephone answering circuit operation	1	0	0	0	1	0	*	1	This data input is a must. In case of telephone answering circuit operation.
SPEAKER AMP operation	1	0	0	0	0	1	0	1	This data input is a must. In case of Speaker amplifier operation.
MIC AMP operation	1	0	0	0	1	1	0	1	—
SPEAKER ATT quantity selection	1	1	1	0	1	0	0	*	—
Crosspoint SW "37" ON	0	1	1	0	1	1	1	1	Refer to another sheet address table.
Crosspoint SW "38" ON	0	1	1	1	0	0	0	1	Refer to another sheet address table.

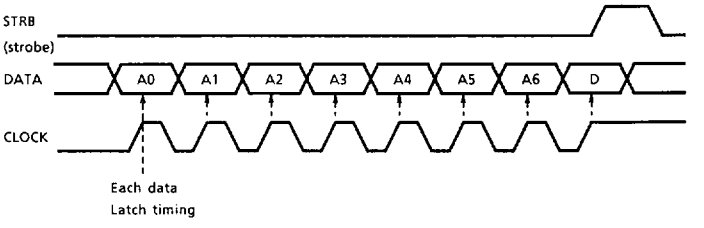
6) Reference block diagram

ex : Crosspoint switch

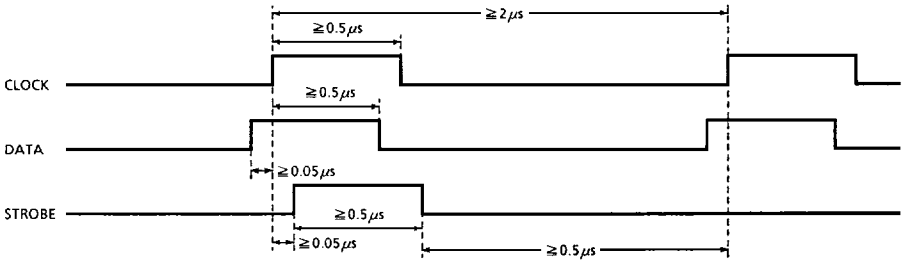


(1) When A0 = "0" (L), indicate crosspoint control mode.
(2) Latch is set when "D" bit data is "1", is reset when "0".
(3) When external power supply rising, all latch is reset. (Power on reset)

TIMING CHART DIAGRAM (1)



TIMING CHART DIAGRAM (2)



7) Serial data control (except for crosspoint)

Power supply of each block is operation block by V_L or V_{DD} feed operation, serial data control. Circuit which is included each block, indicate the following table.

OPERATION POWER SUPPLY		CIRCUIT	
V_L operation		RECEIVING INPUT AMP RECEIVING PAD circuit TRANSMIT PAD circuit V_{REG} circuit	LINE DRIVER AMP LI AMP MF INPUT BUFF
V_L or external feed (*1)		TRANSMIT INPUT AMP	RECEIVING OUTPUT AMP
External feed operation (*2)	(1) SP	SPEAKER AMP	
	(2) TAM	ALC AMP circuit EQ AMP REC AMP	PRE-AMP VOX circuit SUM AMP
	(3) MIC	MIC AMP	
	(4) B / S	Hand set 1 input-output, Hand set 2 input-output, C/P SW output BUFF Doorphone input-output, SPC BUFF SP ATT AUX BUFF R ATT	
	(5) Always ON	SW control	Crosspoint

(*1) When extension service current cut, is V_{DD} feed.
(*2) (1)~(4) block is power supply switching by serial data control.

8) MUTE state table

Muting can control by external MUTE terminal input level and syrial data. Indicate each MUTE in the following table.

MUTE SW STATE TABLE

		DIGITAL MUTE	
		H "0"	L "1"
External MUTE	H	H	H
	L	L	H

MUTE SW OUTPUT TABLE

	OUTPUT AT V_L TERMINAL	RECEIVING OUTPUT
H	Transmit input	Receiving input
L	DTMF	BEEP

But operating only external MUTE terminal when external no feed.

9) Operating block of syrial data control is distinguished by DATA A0~A2 3bit, as following table.

A0	A1	A2	CONTROL BLOCK
0	*	*	Crosspoint SW control
1	0	0	SW control (except crosspoint)
1	1	0	Receiving ATT control
1	1	1	SP ATT control

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Line Voltage	V_L	15	V
Line Current	I_L	150	mA
Power Dissipation	P_D	*1) 1050	mW
		*2) 1400	
Operation Temperature	T_{opr}	−20~75	°C
Storage Temperature	T_{stg}	−50~150	°C

*1) No PCB
*2) This value is obtained by 50 × 50 × 1.6mm PCB mounting occupied in excess of 10% of copper area.

MAXIMUM RATINGS EXTERNAL POWER SYSTEM

CHARACTERISTIC	SYMBOL	RATING	UNIT
Power Supply Voltage	V_{DD}	7	V
SP Power Supply Voltage	VSP	12	V

Recommendable power supply voltage (V_{DD}) : 5V
Operation power supply voltage limit : 4.5~5.5V
SP operation power supply voltage limit : 4.5~8.5V

Handle with care to prevent devices from deterioration by static electricity.

ELECTRICAL CHARACTERISTICS (Unless otherwise specified : Ta = 25°C, f = 1kHz, V_{DD} = 5V)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Line Voltage	VL	—	I_L = 20mA	2.9	3.6	4.3	V
		—	I_L = 120mA	7.5	10.5	13.5	
V_L Internal Supply Voltage	V_{CC}	—	I_L = 20mA	1.5	1.9	2.4	V
		—	I_L = 120mA	5.1	5.8	6.8	
V_{DD} Operation Supply Voltage	V_{DD}	—		4.5	5	5.5	V
V_{DD} Internal Reference Voltage	V_{REF}	—	At battery saving mode cancellation	—	2.5	—	V
Quiescent Current Characteristics 1	IDD1	—	BS block + TAM (REC + EQ AMP) : ON	—	12	20	mA
Quiescent Current Characteristics 2	IDD2	—	At battery saving	—	2	4.5	mA
V_{CC} Internal Reference Voltage	VS / NREF	—	I_L = 20mA	—	0.6	—	V
		—	I_L = 120mA	—	2.5	—	
External Power Supply Voltage (V_{REG})	V_{REG}	—	I_L = 30~120mA	2.9	3.3	3.7	V
External Power Supply Current (I_{REG})	I_{REG}	—	I_L = 30~120mA	3	—	—	mA
Power On Reset Detection Voltage	VOFF	—	V_{DD} (H→L)		3		V
Transmit PRE-AMP Gain	GTPRE	—	I_L = 20mA	7	10	13	dB
		—	I_L = 120mA	7	10	13	
Transmit Total Gain	GTA	—	I_L = 20mA	31.5	34	38	dB
		—	I_L = 120mA	26	29.5	33	
DTMF Total Gain	GMF	—	I_L = 20mA	27.5	31	34.5	dB
		—	I_L = 120mA	22.5	26	29.5	
Transmit Dynamic Range	DRT	—	I_L = 20mA	2	4.5	—	V_{p-p}
		—	I_L = 120mA	4	6.3	—	
Transmit Auto-Pad Quantity	ΔTPAD	—		—	6	—	dB
Receiving PRE-AMP Gain	GRPRE	—	I_L = 20mA	7	10	13	dB
		—	I_L = 120mA	7	10	13	
BEEP Total Gain	GBT	—	I_L = 20mA : Load = 55nF	19	22.5	26	dB
		—	I_L = 120mA : Load = 55nF	19	22.5	26	
Receiving Total Gain	GRA	—	I_L = 20mA : Load = 55nF	28.5	32	35.5	dB
		—	I_L = 120mA : Load = 55nF	23.5	27	30.5	
Receiving Dynamic Range	DRR	—	I_L = 20mA	0.9	2.4	—	V_{p-p}
		—	I_L = 120mA	4	11.2	—	
Receiving Auto-Pad Quantity	ΔRPAD	—		—	4.9	—	dB
Receiving Digital ATT.1	GRAGC1	—		4	6	8	dB
Receiving Digital ATT.2	GRAGC3	—		—	0	—	dB

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Receiving Digital ATT.3	GRAGC5	—		−8	−6	−4	dB
Cordless 1 Input PRE-AMP Gain	GCO1	—	No Load	−2.5	0	2.5	dB
Cordless 1 Dynamic Range	DCO1	—	No Load	0.6	2.8	—	V_{p-p}
Cordless 2 Input PRE-AMP Gain	GCO2	—	No Load	−2.5	0	2.5	dB
Cordless 2 Dynamic Range	DCO2	—	No Load	0.6	2.8	—	V_{p-p}
DOOR PHONE OUTPUT AMP Gain	GDH	—	No Load	17	20	23	dB
Door Phone Dynamic Range	DOH	—	No Load	0.6	2.7	—	V_{p-p}
MIC AMP Gain	GMIC	—	V_{in} = −25dBV	17	20	23	dB

Voice processing block

Internal Reference Voltage	V_{REF} TAM	—		—	1.64	—	V

PRE-AMP block

PRE-AMP Gain	G_{PRE}	—	V_{in} = −70dBV	46.5	50	54	dB
Total Harmonic Distortion	THD_P	—	V_{in} = −35dBV	—	0.5	—	%
Output Noise Voltage	V_{NP}	—	EQ AMP : ON, Rg = 600Ω	—	1.5	4	mV_{rms}
ALC ON. Dynamic Range	V_{ALC}	—	Rg = 600Ω, R_L = 20kΩ, EQ AMP : ON		649		mV_{rms}
ALC Effect Voltage	ALCP1	—	V_{in} = −50~−10dBV, EQ AMP : ON	—	2.9	5.5	dB
ALC Range	ALCP2	—	THD≦1% EQ AMP : ON	45	54	—	dB

REC AMP block

Output Impedance	RO_R	—		—	330	—	Ω
REC AMP Gain	G_{REC}	—	V_{in} = −50dBV (PRE IN input)	46.5	50	54	dB

EQ AMP block

EQ AMP Gain	G_{EQ}	—		35	39	42.5	dB
Output Noise Voltage 1	V_{NEP}	—	EQ AMP : ON, REC : OFF	—	0.5	3	mV_{rms}
Output Noise Voltage 2	VNER	—	EQ AMP : ON	—	—	3	mV_{rms}
Total Harmonic Distortion	THD_{EQ}	—		—	0.6	—	%
SUM AMP Gain	G_{SUM}	—		−2	0	2	dB

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
VOX block							
Minimum Defection Level	V_{XL}	—		—	—	−16.5	dBV
Maximum Sink Current	I_{si}	—		4	7.2	—	mA
SPEAKER AMP block (V_{SP} = 6.0V)							
SPEAKER AMP Quiecent Current 1	ISP1	—		—	7.5	13	mA
SPEAKER AMP Quiecent Current 2	ISP2	—	At Battery-Saving Mode	—	0	1	mA
PRE-AMP Gain	G_{SP}	—	At BTL	27	30	33	dB
Total Hormonic Distortion	THD_{SP}	—	Load : 32Ω, V_{in} = −30dBV, At BTL	—	0.5	—	%
Dynamic Range	D_{RSP}	—	At BTL	2.5	6.5	—	V_{p-p}
Output Noise Voltage	V_{NSP}	—		—	1	3	mV_{rms}
SPO1 Output Voltage (L)	$V_{SPO1\ (L)}$	—	I_{sink} = 100mA	—	1.2	1.7	V
SPO1 Output Voltage (H)	$V_{SPO1\ (H)}$	—	I_{sorce} = −100mA	3.7	4	—	V
SPO2 Output Voltage (L)	$V_{SPO2\ (L)}$	—	I_{sink} = 100mA	—	1.2	1.7	V
SPO2 Output Voltage (H)	$V_{SPO2\ (H)}$	—	I_{sorce} = −100mA	3.7	4	—	V
Digital block							
Input Voltage (H)	V_{IH}	—	STRB, DATA, CLK	$0.8V_{DD}$	—	V_{DD}	V
Input Voltage (L)	V_{IL}	—		0	—	$0.2V_{DD}$	V
Input Freguency	f_{CK}	—	CLK, V_{DD} = 4.5~5.5V	—	—	500	kHz

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT

At external supply voltage no feed (V_{DD} = 0V)

Line Voltage	V_{L2}	—	I_L = 20mA	2.9	3.6	4.3	V
		—	I_L = 120mA	7.5	10	13.5	
V_L Internal Voltage	V_{CC2}	—	I_L = 20mA	1.5	1.9	2.4	V
		—	I_L = 120mA	5.1	5.7	6.8	
V_{CC} Internal Reference Voltage	VS / N_{REF2}	—	I_L = 20mA	—	0.6	—	V
		—	I_L = 120mA	—	2.5	—	
External Power Supply Voltage (V_{REG})	V_{REG2}	—	I_L = 30~120mA	2.9	3.3	3.7	V
External Power Supply Current (I_{REG})	I_{REG2}	—	I_L = 30~120mA	3	—	—	mA
Transmit PRE-AMP Gain	GTPRE2	—	I_L = 20mA	7	9.9	13	dB
		—	I_L = 120mA	7	10	13	
Transmit Total Gain	GTA2	—	I_L = 20mA	31.5	34.5	38	dB
		—	I_L = 120mA	26	29.5	33	
DTMF Total Gain	GMF2	—	I_L = 20mA	27.5	31	34.5	dB
		—	I_L = 120mA	22.5	26	29.5	
Transmit Dynamic Range	DRT2	—	I_L = 20mA	2	4.5	—	V_{p-p}
		—	I_L = 120mA	4	6.4	—	
Transmit Auto-Pad Quantity	ΔTPAD2	—		—	6	—	dB
Receiving PRE-AMP Gain	GRPRE2	—	I_L = 20mA	7	10	13	dB
		—	I_L = 120mA	7	10	13	
BEEP Total Gain	GBT2	—	I_L = 20mA	19	22.5	26	dB
		—	I_L = 120mA	19	22.5	26	
Receiving Total Gain	GRA2	—	I_L = 20mA	28.5	32	35.5	dB
		—	I_L = 120mA	23.5	27	32.5	
Receiving Dynamic Range	DRR2	—	I_L = 20mA	0.9	2.45	—	V_{p-p}
		—	I_L = 120mA	4	10.6	—	
Receiving Auto-Pad Quantity	ΔRPAD2	—		—	5	—	dB

BLOCK DIAGRAM AND EXAMPLE OF APPLICATION CIRCUIT