13-station repertory pulse/tone dialer for telephone set

BU8329/BU8329F/BU8330/BU8331

The BU8329, BU8330, and BU8331 are large scale integrated circuits designed for use with telephones, with all of the pulse/tone dialer functions necessary for basic telephone operation. These ICs are equipped with an internal repertory memory containing 13 stations and 16 digits.

BU8330 : For North America
BU8329/BU8331 : For Japan

●Applications
Telephones

●Features

1) The chip includes both a pulse and tone dialer, making it possible to dial in either pulse or tone mode.
2) Wide operating voltage range of 2.0V to 5.5V.
3) Internal on-hook dial control function and hold control function (BU8329).
4) A built-in memory enables redialing of up to 32 digits.
   The BU8330 and BU8331 are also equipped with an internal second redial memory of 32 digits.
5) Repertory dial function
   : 3 stations and 16 digits for 1-touch,
   : 10 stations and 16 digits for 2-touch.
6) Ceramic resonator of 3.579545MHz used.
7) Internal digital pause timer.
8) Internal flash function.
9) Compact SOP 24 pin and DIP 22 pin packages used.

●Selection guide

Model	Operating voltage	Pulse speed (PPS)	Pulse break ratio%	Redial memory	Repertory memory (stations x digits) OT: 1-touch, TT: 2-touch	DTMF	Access pause	Key-tone	Hooking	Hands-free capability	Package
BU8329 BU8329F	2.0~5.5	10 / 20	67	32	OT : 3×16, TT : 10×16	○	○	○	○	○	DIP22 SOP24
BU8330	2.0~5.5	10	60	32+32	OT : 3×16, TT : 10×16	○	○	○	○		DIP22
BU8331	2.0~5.5	10 / 20	67	32+32	OT : 3×16, TT : 10×16	○	○	○	○		DIP22

●Absolute maximum ratings (Ta=25℃)

Parameter	Symbol	Limits	Unit	Conditions
Power supply voltage	V_{DD}	7.0	V	
Input voltage	V_{IN}	$V_{SS}-0.3\sim V_{DD}+0.3$	V	* 1
Output voltage 1	V_{OUT1}	$V_{SS}-0.3\sim V_{DD}+0.3$	V	* 2
Output voltage 2	V_{OUT2}	$V_{SS}-0.3\sim 7.0$	V	* 3
Power dissipation	Pd	600 (DIP22)	mW	* 4
		450 (SOP24)		* 5
Operating temperature	Tstg	−55~125	℃	
Storage temperature	Topr	−10~60	℃	

* 1 Applied to the following pins: $\overline{R1}$ to $\overline{R4}$, $\overline{C1}$ to $\overline{C5}$, $\overline{HF1}$, MODE, OSCI, $\overline{HKS}$.

* 2 Applied to the $\overline{OSCO}$, KEYTONE, DTMF, PO, and HFO pins.

* 3 Applied to the $\overline{MUTE}$ pin.

* 4 Reduced by 6 mW for each increase in Ta of 1℃ over 25℃ (22-pin DIP).

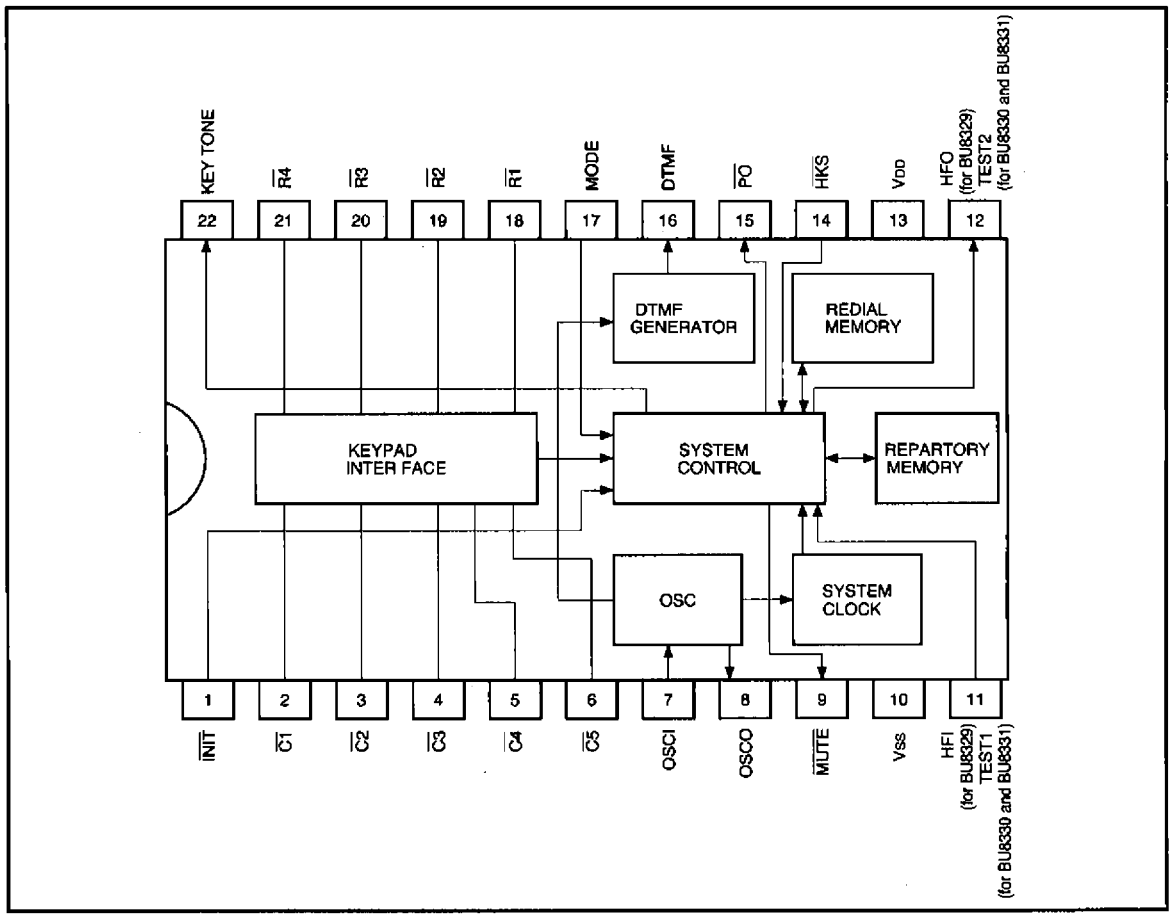
* 5 Reduced by 4.5 mW for each increase in Ta of 1℃ over 25℃ (24-pin SOP).

●Recommended operating conditions (Ta=25℃)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Power supply voltage	V_{DD}	2.0	−	5.5	V	
Power supply voltage	V_{DD}	1.0	−	5.5	V	When memory retention
Oscillation frequency	fosc	−	3.579545	−	MHz	*
"H" Input voltage	V_{IH}	0.8 V_{DD}	−	V_{DD}	V	
"L" Input voltage	V_{IL}	0	−	0.2 V_{DD}	V	
DTMF pin load resistance	R_{MF}	10	−	−	kΩ	Load resistance connected between DTMF and Vss
Key contact resistance	R_{KC}	−	−	10	kΩ	Keypad contact resistance
Key contact capacitance	C_{KC}	−	−	470	pF	Capacitance connected between $\overline{Rx}$, $\overline{Cx}$ and Vss
MODE IN pin resistance	R_{MI}	10	−	−	kΩ	

* Recommended product: CST3.58MGW300GAB by Murata

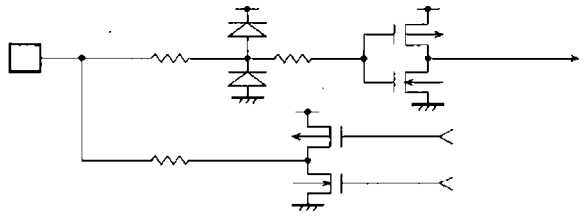
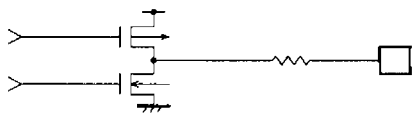
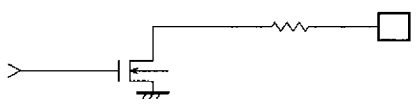
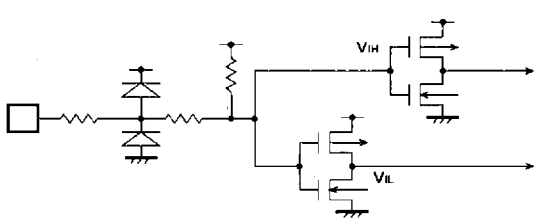
●Block diagram

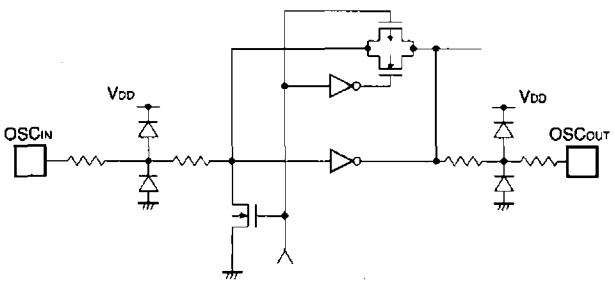
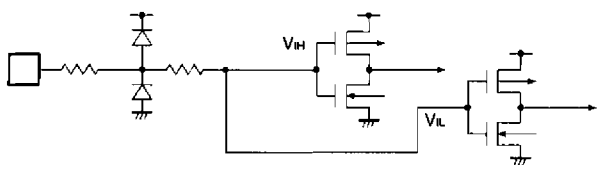
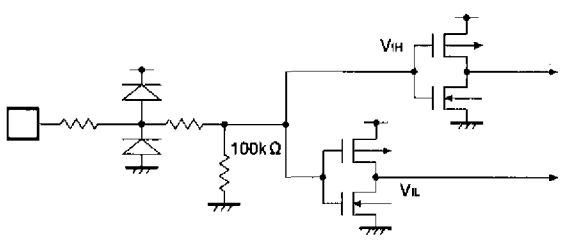
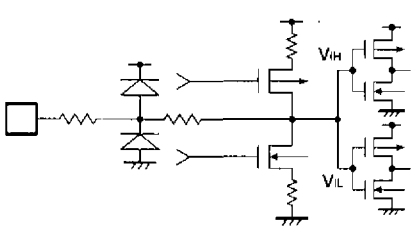


●Pin descriptions

Pin No.		Pin name	Function
DIP package	SOP package		
18~21 2~6	1, 2 4, 5 8~12	$\overline{R1}$~$\overline{R4}$ $\overline{C1}$~$\overline{C5}$	Keypad input pins. 5 × 4 keypad can be connected.In order to enable keypad input, single - $\overline{Rx}$ and single - $\overline{Cx}$ must be short-circuited, or set at "L" level simultaneously. Keypad input will be disabled when two keys or more are pressed simultaneously. When $\overline{HKS}$ is H, both $\overline{Rx}$ and $\overline{Cx}$ will output "L" level. When $\overline{HKS}$ is stopped at "L," $\overline{Rx}$ will output "L" level and $\overline{CX}$ output "H" level.
7, 8	13, 15	OCSI OSCO	Input and output pins of the built-in oscillatorConnect a ceramic oscillator of 3.579545 MHz between OSCI and OCSO. When using ceramics other than capacity built-in types, connect the oscillator of 30 pF to each V_{SS}.
9	16	$\overline{MUTE}$	Mute output pin. Nch open drain.When dial pulses or DTMF signals are output, "L" level is attained, otherwise remains at "Z" level.
14	21	$\overline{HKS}$	Hook switch input terminal. On hook state at "H" level, hook off state at "L" level.
15	22	$\overline{PO}$	Pulse output pin. CMOS output.Outputs dial pulse in response to key input done in pulse mode.Goes to "L" level when brake, brush, or standby mode.Otherwise goes to "H" level.
16	23	DTMF	DTMF signal output pin. Outputs DTMF signal in response to key input done in tone mode. With memory dial, redial, and fast key input, correction is carried out between 100 ms output time and 106 ms interdigital pause. Real time transfer continues while key is pressed down. Goes to "L" level except during DTMF signal output.
17	24	MODE	Mode switch input terminal.With BU8330Goes to tone mode at "L" level, and to pulse mode at "H" level (10 pps).Goes to tone mode even at "H" level when ＊/T is input. With BU8329, BU8331Goes to tone mode at "L" level, to pulse mode at "H" level (10 pps), and pulse mode at "Z" level.Goes to tone mode even at "H" or "Z" level when ＊/T is input.
22	6	KEY TONE	Key tone output pin.Ouputs 1.16 KHz (duty 50%), 30 ms key tone in response to effective key input. Does not produce ouput in tone mode.
11	18	HFI (with BU8329)	Hands-free input terminal. Toggle between HFI ON and HFI OFF by rise edge input. Employs Schmidt trigger, so external resistance pull-down resistor (100 kΩ) is built in.
		TEST1 ((with BU8330, BU8331)	Test pin. Do not connect anything to this pin.
12	19	HF0 (with BU8329)	Hands-free output terminal.Goes to "L" level with HFO off, and to "H" level with HFO on.For further information, see "On-Hook Dial Control Function, Hold Control Function".
		TEST2 (with BU8330, BU8331)	Test pin. Do not connect anything to this pin.
1	7	$\overline{INIT}$	Reset input pin. Should generally be used open.Is reset when "L" level is input.Built-in pull-up resistor (80 kΩ)
13	20	V_{DD}	V_{DD} input terminal.
10	17	V_{SS}	V_{SS} input terminal.
—	3, 14	NC	Not connected internally.

●Pin descriptions

Pin Name	I/O	I/O Circuit	Notes
$\overline{R1}$~$\overline{R4}$	Input/output		
$\overline{C1}$~$\overline{C5}$	Input/output		
HFO	Output		
$\overline{PO}$	Output		
KEYTONE	Output		
$\overline{MUTE}$	Output		
DTMF	Output		
$\overline{INIT}$	Input		Hysteresis input; internal pull-up resistance of 80kΩ

Pin Name	I/O	I/O Circuit	Notes
OSCI	Input		
OSCO	Output		
$\overline{HKS}$	Input		Hysteresis input
HFI	Input		Hysteresis input; internal pull-down resistance of 100kΩ
MODE	Input		Tertiary input

* There are no HFI or HFO pins in the BU8330 or BU8331.

●Electrical characteristics (Unless otherwise noted : Ta=25℃, V_{DD}=2.5V)

Parameter		Symbol	Min.	Typ.	Max.	Unit	Conditions
Operating current 1		I_{DD1}	—	0.2	0.5	mA	Pulse mode, no output load
Operating current 2		I_{DD2}	—	0.7	2.0	mA	Tone mode, no output load
Operating current 3		I_{DD3}	—	—	2.0	μA	Memory retention time
$\overline{HKS}$	Input current HIGH	I_{IH}	—	—	1.0	μA	
	Input current LOW	I_{IL}	—	—	−1.0	μA	
Keypad input	Sink current	I_{SIK}	0.2	0.4	—	mA	$V_I=V_{DD}$
	Source current	I_{SOK}	—	−10	−30	μA	$V_I=V_{SS}$
$\overline{PO}$	Sink current	I_{SIP}	0.2	—	—	mA	V_O=0.5V
	Source current	I_{SOP}	−0.2	—	—	mA	V_O=2.0V
HFO	Sink current	I_{SIH}	1.0	—	—	mA	V_O=0.5V
	Source current	I_{SOH}	−1.0	—	—	mA	V_O=2.0V
$\overline{MUTE}$	Sink current	I_{SIM}	1.0	—	—	mA	V_O=0.5V
	Source current	I_{LKM}	—	—	1.0	μA	V_O=7.0V
KEY TONE	Sink current	I_{SIT}	0.2	—	—	mA	V_O=0.5V
	Source current	I_{SOT}	−0.2	—	—	mA	V_O=2.0V
HFI pull-down resistance	BU8329	R_{HFI}	—	100	—	kΩ	
Key debounce time		t_{DB}	—	20	—	ms	
Pulse rate	ALL TYPE	PR1	—	10	—	pps	MODE=H
	BU8330, BU8331 only	PR2	—	20	—	pps	MODE=Z
Make break ratio	BU8329	MB	—	40 : 60	—	%	MODE=H
	BU8330, BU8331		—	33 : 66	—		
Pre-digital pause		t_{PDP}	—	40	—	ms	MODE=H
Inter-digital pause	BU8329	t_{IDP}	—	800	—	ms	MODE=H
	BU8330, BU8331	t_{IDP1}	—	800	—	ms	MODE=H
		t_{IDP2}	—	500	—	ms	MODE=Z
Tone output time		t_T	—	100	—	ms	MODE=L
Tone inter-digital pause		t_{ITP}	—	108	—	ms	MODE=L
Pause time		t_{PA}	—	3.6	—	sec	
P→T wait time		t_{PT}	—	3.6	—	sec	
Flash time		t_F	—	600	—	ms	
Flash pause time		t_{FP}	—	0.2	—	sec	
Tone output cycle variation		$\|\Delta f\|$	—	—	0.15	%	MODE=L
Tone output voltage, ROW		V_{OR}	130	155	180	mV_{rms}	MODE=L
Tone output voltage, COL		V_{OC}	163	195	227	mV_{rms}	MODE=L
High band pre-emphasis		P_{EHB}	1.0	2.0	3.0	dB	MODE=L
Tone output distortion		DIS	—	5.0	10.0	%	MODE=L
Pre-tone pause		t_{PTP}	—	20	—	ms	MODE=L

●Measurement circuit

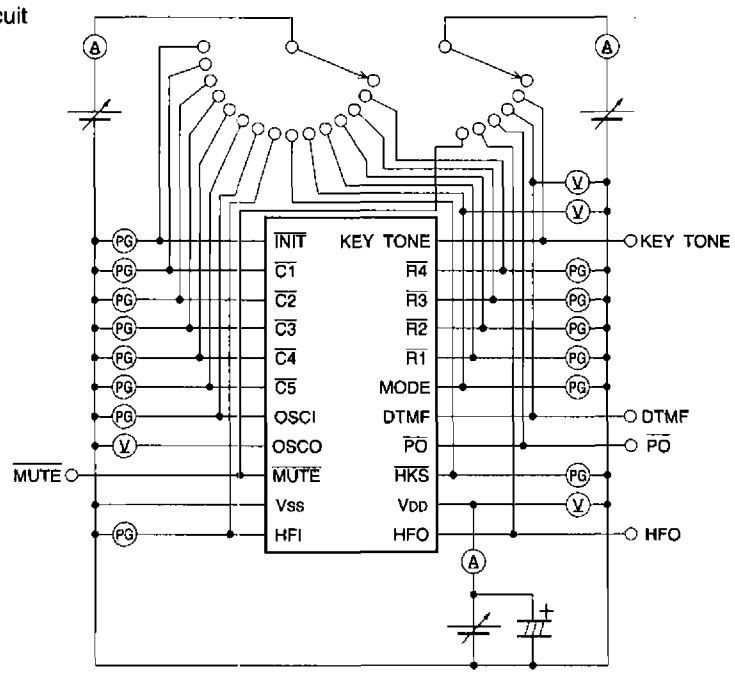


Fig. 1

●Circuit operation

Keypad matrix

R1	1	2	3	SAVE	EM1
R2	4	5	6	F	EM2
R3	7	8	9	AUTO	EM3
R4	* / T	0	#	RD / P	ST
	C1	C2	C3	C4	C5

Keyboard funtions

[0] to [9] These are numeric keys, and dial signals are sent when one of these keys is pressed.
When these are used in combination with the [ST] and [AUTO] keys, they can be used to specify a location in the 2-touch memory.

[#] In tone mode, when this key is pressed, the corresponding DTMF signal is sent.

[RD/P] This is the redial pause key. If it is the first key pressed after redialing, the last number dialed is redialed, and when it is the second or subsequent key pressed after redialing, it serves as a pause key.

[SAVE] This is the save key. It is used to write data to and read data from the memory.

[*/T] This is used to switch from pulse mode to tone mode. In tone mode, pressing the * key causes the corresponding DTMF signal to be transmitted.

[ST] This is used to write data to the 1-touch and 2-touch memories.

AUTO	This is used to read data from the 2-touch memory.
F	This is the flash key.
EM1 to EM3	These are used to write data to and read data from the 1-touch memory.

The BU8239 does not have a SAVE key.

●Key operation : Example 1 (BU8330 and BU8331)

Item	Key sequence	Dial output	Memory contents
Normal dialing			
Pulse mode	MODE=H ↑ D1 ··· Dn ↓	D1 ··· Dn	Redial = D1 ··· Dn
Tone mode	MODE=L ↑ D1 ··· Dn ↓	D1 ··· Dn	Redial = T D1 ··· Dn
Mixed dialing	MODE=H		
MODE pin	↑ D1 ··· Di (MODE ↓) Di+1···Dn ↓	D1 ··· Di (t_{PT}) Di+1 ··· Dn	Redial = D1 ··· Di T Di+1 ··· Dn
T/* key	MODE=H ↑ D1 ··· Di T / * Di+1 ··· Dn ↓	D1 ··· Di (t_{PT}) Di+1 ··· Dn	Redial = D1 ··· Di T Di+1 ··· Dn
Redial	↑ D1 ··· Di T / * Di+1 ··· Dn ↓ ↑ RD / P	D1 ··· Di (t_{PT}) Di+1 ··· Dn D1 ··· Di (t_{PT}) Di+1 ··· Dn	Redial=D1 ···Di T Di+1 Redial=D1 ···Di T Di+1
Memory writing			
1-touch memory	↑ ST D1 ··· Dn (ST) EMi ↓	—	EMi=D1 ··· Dn
2-touch memory	↑ ST D1' ··· Dn' ST Ln ↓	—	Ln=D1' ··· Dn'
Memory reading	(Memory contents for memory writing)		
1-touch memory	↑ EMi ↓	D1 ··· Dn	Redial = D1 ··· Dn
2-touch memory	↑ AUTO Ln ↓	D1' ··· Dn'	Redial = D1' ··· Dn'
Continuous reading	↑ EMi AUTO Ln ↓	D1 ··· Dn • D1' ··· Dn'	Redial = D1 ··· Dn / D1' ··· Dn'
Flash	↑ D1 ··· Dn F D1' ··· Dn' ↓	D1 ··· Dn (t_F , t_{FP}) D1' ··· Dn '	Redial = D1' ··· Dn'
Pause			
Normal dialing	↑ D1 ··· Di RD / P Di+1 ··· Dn ↓	D1 ··· Dn (t_{PA}) Di+1 ··· Dn	Redial=D1 ··· Di • P Di+1 ··· Dn
Writing	↑ ST D1 ··· Di RD / P Di+1 ··· Dn ST Ln ↓	—	Ln=D1 ··· Di P Di+1 ··· Dn

Legend	↑	: Off-hook	~~~	: DTMF output	t_{PA} : Pause time
	↓	: On-hook	EMi	: 1-touch memory (i = 1, 2, 3)	t_F : Flash time
	(MODE ↓)	: MODE pin H → L	Ln	: 2-touch memory (n = 0 to 9)	t_{FP} : Flash pause time
	------	: Pulse output	t_{PT}	: P →T wait time	

●Key operation : Example 2 (BU8330 and BU8331)

Item		Key sequence	Dial output	Memory contents
Save				
	Write 1	↑ D1 ··· Dn ↓ ↑ D1'··· Dn' SAVE ↓	D1 ··· Dn D1'··· Dn'	Redial = D1 ··· Dn Save =D1'···Dn'
	Write 2	↑ D1 ··· Dn ST D1'··· Dn' SAVE ↓ (writing while communication is in progress)	D1 ··· Dn	Redial = D1 ··· Dn Save =D1'···Dn'
	Write 3	↑ D1 ··· Dn ↓ ↑ ST SAVE ↓	D1 ··· Dn —	Redial = D1 ··· Dn Save =D1 ···Dn
	Read	↑ D1 ··· Dn SAVE ↓ ↑ SAVE ↓	D1 ··· Dn D1 ··· Dn	Save =D1 ···Dn

Legend ↑ : Off-hook ↓ : On-hook

●On-hook dial control function and hold control function (BU8329)

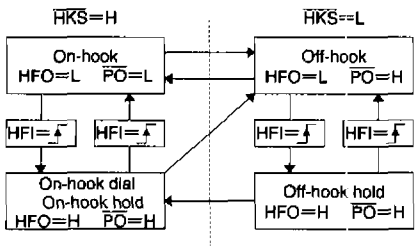


Fig. 2 Change in states

●Timing charts

1. Pulse mode timing chart

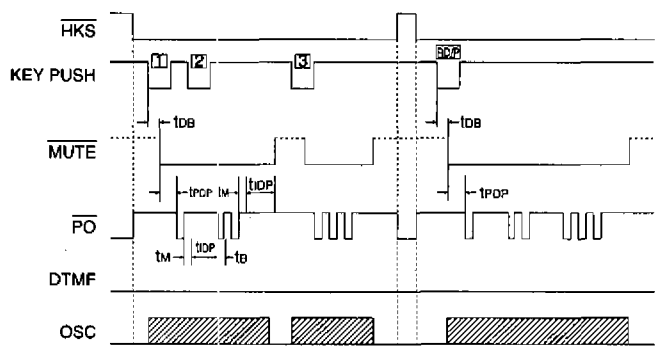


Fig. 3

●Timing charts

2. Tone mode timing chart

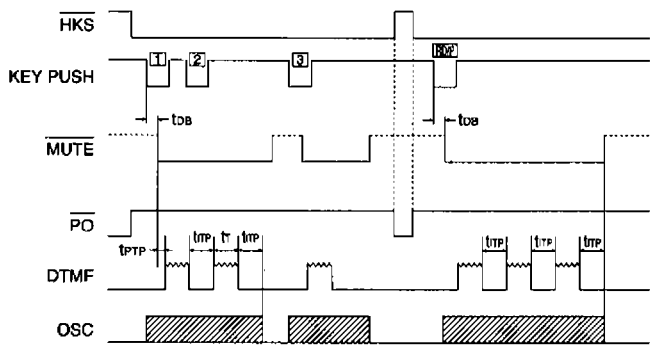


Fig. 4

3. Timing when mode is switched

3-1. Using [*/T]

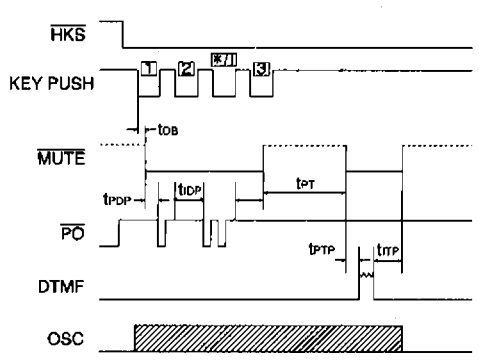


Fig. 5

3-2. Using MODE pin

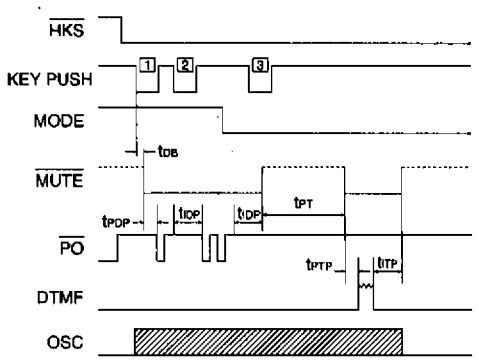


Fig. 6

4. Pause function timing chart

4-1. Pulse mode

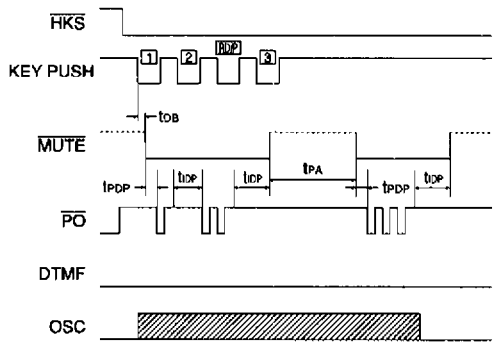


Fig. 7

4-2. Tone mode

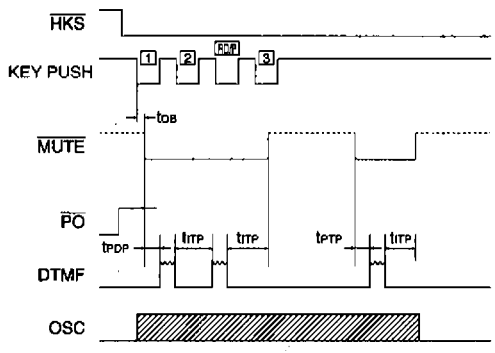


Fig. 8

●Timing charts

5. Flash function timing chart

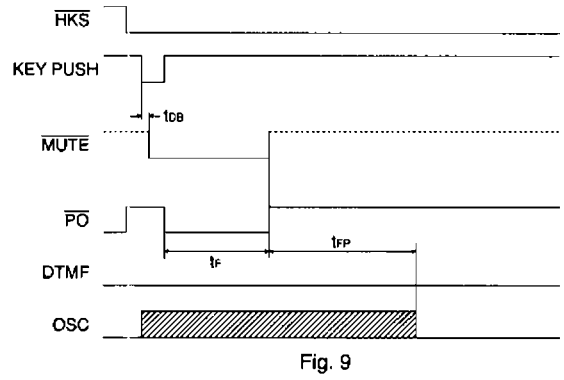


Fig. 9

●Electrical characteristic curves

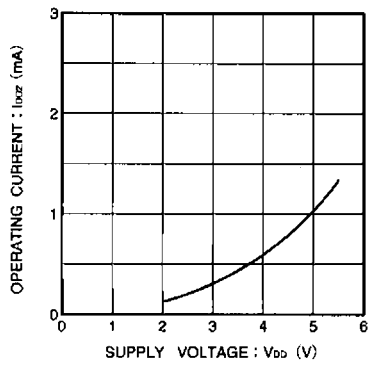


Fig. 10 Tone mode, operating current vs. supply voltage characteristic

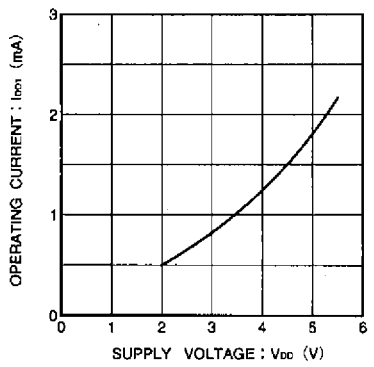


Fig. 11 Pulse mode, operating current vs. supply voltage characteristic

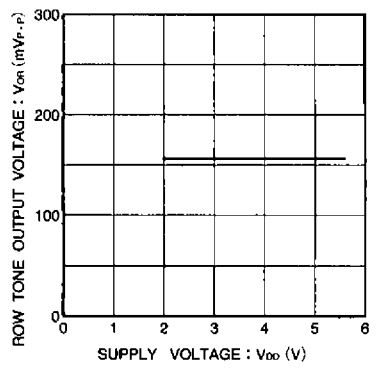


Fig. 12 ROW tone output voltage vs. supply voltage characteristic

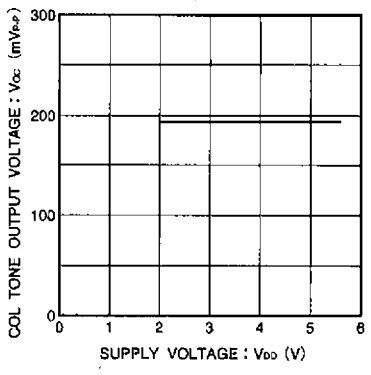
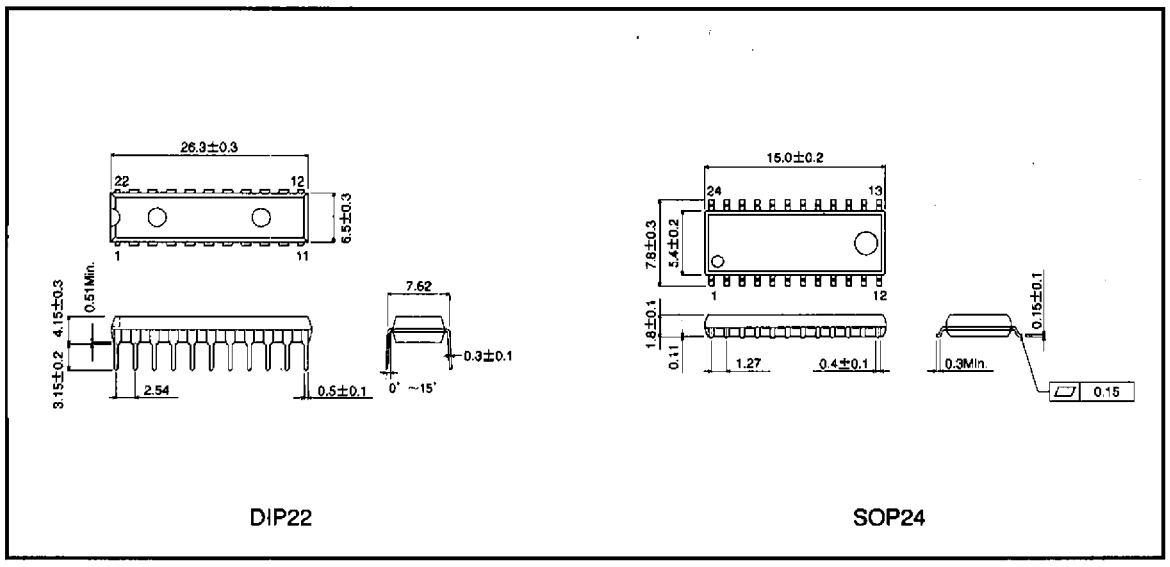


Fig. 13 COL tone output voltage vs. supply voltage characteristic

●External dimensions (Units: mm)



DIP22 SOP24

Notes

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