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Pulse / tone dialer for telephone set
BU8307CS / BU8307CF

The BU8307CS and BU8307CF are large scale integrated circuits with a pulse dialer and tone dialer integrated on a single chip. These products are capable of dialing in either pulse or tone mode, and can redial up to 32 digits.
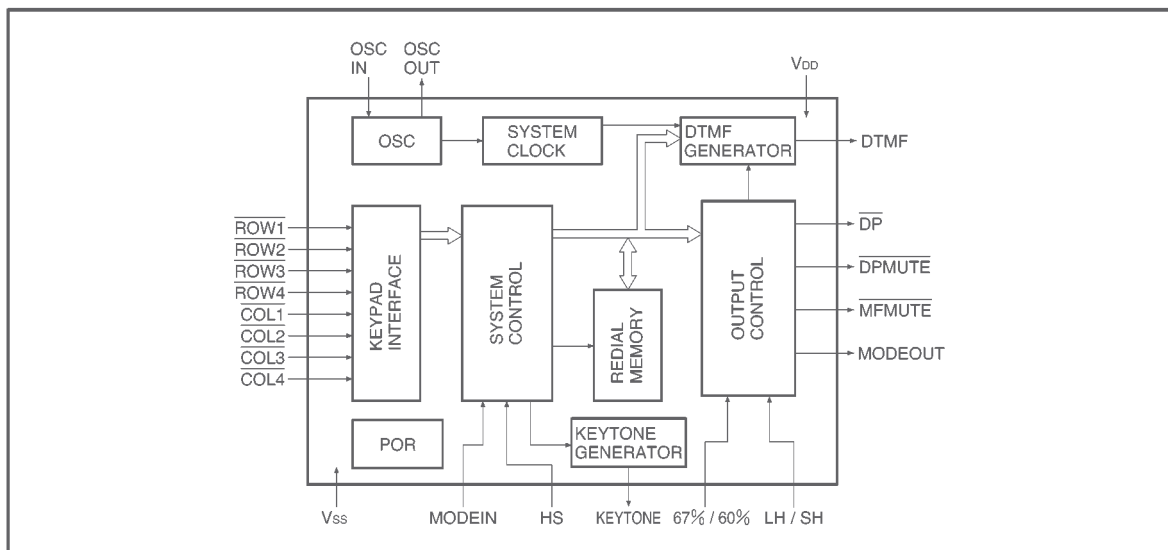
●Applications
Telephones and cordless telephones

●Features
1) The chip includes both a pulse and tone dialer, making it possible to dial in either pulse or tone mode.
2) A wide operating voltage range enables direct powering by line current. The voltage range guaranteed for both pulse and tone dialing is 2.5V to 5.5V.
3) A built-in memory enables redialing of up to 32 digits. Note: In tone mode, the memory itself uses one digit, so please be aware that a maximum of 31 digits can be redialed.
4) The chip conforms to the standards of Japan, America, Canada, England, Korea, Taiwan, and Australia.
5) The V_{DD} power supply voltage is independent of the DTMF output level.
6) There is little deviation in the frequency dividing for the DTMF output frequency. The maximum on the + side is + 0.15%, and on the - side is – 0.08%.

●Block diagram

● Absolute maximum ratings (Ta = 25°C)

Parameter		Symbol	Limits	Unit
Power supply voltage		V_{DD}	7.0	V
Input voltage		V_{IN}	$V_{SS}-0.3\sim V_{DD}+0.3$ [*1]	V
Output voltage 1		V_{OUT1}	$V_{SS}-0.3\sim V_{DD}+0.3$ [*2]	V
Output voltage 2		V_{OUT2}	$V_{SS}-0.3\sim 7.0$ [*3]	V
Power dissipation	BU8307CS	Pd	600 [*4]	mW
	BU8307CF		550 [*5]	
Operating temperature		Topr	$-10\sim+60$	℃
Storage temperature		Tstg	$-55\sim+125$	℃

[*1] Applied to the following pins: ROW1 to ROW4, COL1 to COL4, HS, MODEIN, OSCIN, 67%/60%, and LH/SH.

[*2] Applied to the OSCOUT, KEYTONE, and DTMF pins.

[*3] Applied to the MODEOUT, MFMUTE, DPMUTE, and DP pins.

[*4] Reduced by 6 mW for each increase in Ta of 1℃ over 25℃.

[*5] Reduced by 5.5 mW for each increase in Ta of 1℃ over 25℃.

● Recommended operating conditions (Ta = 25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement circuit
Power supply voltage	V_{DD}	2.5	3.0	5.5	V		—
Oscillation frequency	f_{OSC}	—	3.579545	—	MHz		Fig.8
Oscillation frequency deviation	Δf_{OSC}	-1.0	—	1.0	%	[*1]	—
Key input time	t_{KD}	40	—	—	ms	[*2]	Fig.8
Key release time	t_{KU}	5	—	—	ms	[*3]	Fig.8

[*1] Includes variation in the initial dispersion of the resonator, temperature, and voltage.

　　For more detailed information, please consult the manufacturer of the resonator being used.

[*2] Minimum time to process a key input operation is 40 ms.

[*3] Minimum time to process a key release operation is 5 ms.

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●Electrical characteristics (unless otherwise noted, Ta = 25°C, V_{DD} = 3.0V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement circuit
Operating current 1	I_{DDP}	—	0.27	0.5	mA	Pulse mode, no output load	Fig.7
Operating current 2	I_{DDT}	—	0.66	1.0	mA	Tone mode, output load of 20 kΩ	
Memory retention current	I_{MR}	—	0.01	0.5	μA		
Memory retention voltage	V_{MR}	1.0	—	—	V		
Input high level voltage	V_{IH}	$0.9V_{DD}$	—	V_{DD}	V	V_{DD}=2.5~5.5V *1	
Input low level voltage	V_{IL}	V_{SS}	—	$0.1V_{DD}$	V	V_{DD}=2.5~5.5V *1	
Input high level current	I_{IH}	—	—	0.05	μA	V_{DD}=5.5V *2	
Input low level current	I_{IL}	—	—	0.05	μA	V_{DD}=5.5V *2	
Key pull-up resistance	R_{KU}	—	48	—	kΩ	$\overline{ROW1}$~$\overline{ROW4}$ $\overline{COL1}$~$\overline{COL4}$ pins	
Key pull-down resistance	R_{KD}	—	5.8	—	kΩ	$\overline{ROW1}$~$\overline{ROW4}$ $\overline{COL1}$~$\overline{COL4}$ pins	
Keytone sink current	I_{KTL}	250	—	—	μA	V_{DD}=2.5V V_0=0.3V	
Keytone source current	I_{KTH}	−250	—	—	μA	V_{DD}=2.5V V_0=2.2V	
Output sink current	I_{OS}	250	—	—	μA	V_{DD}=2.5V V_0=0.3V *3	
Output leakage current	I_{OLKG}	—	—	0.05	μA	V_{DD}=5.5V *3	

*1 Applied to the following pins: $\overline{ROW1}$ to $\overline{ROW4}$, $\overline{COL1}$ to $\overline{COL4}$, HS, MODEIN, OSCIN, 67%/60%, and LH/SH.

*2 Applied to the HS, MODEIN, 67%/60%, and LH/SH pins.

*3 Applied to the MODEOUT, $\overline{MFMUTE}$, $\overline{DPMUTE}$, and $\overline{DP}$ pins.

●Electrical AC characteristics (unless otherwise noted, Ta = 25°C, V_{DD} = 3.0V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement circuit
Oscillation start time	t_{OS}	—	0.8	2.0	ms	$t_{OS}=t_1-t_2$ *1	
Key debounce time	t_{DB}	—	30	—	ms		
Output pulse rate 1	PR1	—	9.9	—	pps	MODEIN＝Z（OPEN）	
Output pulse rate 2	PR2	—	19.9	—	pps	MODEIN＝H	
Pulse break ratio 1	BR1	—	66.7	—	％	67％/60％＝H	
Pulse break ratio 2	BR2	—	60	—	％	67％/60％＝L	
Inter-digital pause 1 HIGH	t_{IDP1H}	—	838	—	ms	MODEIN＝Z（10pps）67％/60％＝H	
Inter-digital pause 1 LOW	t_{IDP1L}	—	845	—	ms	MODEIN＝Z（10pps）67％/60％＝L	
Inter-digital pause 2 HIGH	t_{IDP2H}	—	469	—	ms	MODEIN＝H（20pps）67％/60％＝H	
Inter-digital pause 2 LOW	t_{IDP2L}	—	473	—	ms	MODEIN＝H（20pps）67％/60％＝L	
Tone output time	t_{MF}	—	101	—	ms	*2	
Tone inter-digital pause	t_{IDPM}	—	101	—	ms	*2	
Tone output cycle variation	$\|\Delta f\|$	—	—	0.15	％		
Tone output voltage, ROW	V_{OR}	144	178	216	mV_{P-P}		
Tone output voltage, COL	V_{OC}	198	243	295	mV_{P-P}		
High-band pre-emphasis	P_{EHB}	2.0	2.7	3.5	dB		Fig.8
Tone output distortion	DIS	—	5.0	10.0	％		
Pause time	t_{PA}	—	3.6	—	sec		
Hooking time 1	t_{HK1}	—	607	—	ms	LH/SH＝H	
Hooking time 2	t_{HK2}	—	84	—	ms	LH/SH＝L	
Hooking pause time 1	t_{HKPA1}	—	1.0	—	sec	LH/SH＝H	
Hooking pause time 2	t_{HKPA2}	—	406	—	ms	LH/SH＝L	
Mute overlap time	t_{MO}	—	1.7	—	ms		
On-hook time	t_{OH}	1	—	—	ms	*3	
Keytone frequency	f_{KT}	—	1193	—	Hz		
Keytone output time	t_{KT}	—	34	—	ms		
Pre-pause time 1 HIGH	t_{PP1H}	—	334	—	ms	MODEIN＝Z（10pps）67％/60％＝H	
Pre-pause time 1 LOW	t_{PP1L}	—	340	—	ms	MODEIN＝Z（10pps）67％/60％＝L	
Pre-pause time 2 HIGH	t_{PP2H}	—	168	—	ms	MODEIN＝H（20pps）67％/60％＝H	
Pre-pause time 2 LOW	t_{PP2L}	—	171	—	ms	MODEIN＝H（20pps）67％/60％＝L	
Tone pre-pause time	t_{PPM}	—	256	—	ms	MODEIN＝L（TONE）	

*1 t_1: elapsed time between application of LOW on COL1 pin and appearance of LOW level at COL2 pin.

t_2: elapsed time between triggering of the internal division counter by the OSCOUT pin waveform and the appearance of a LOW level at COL2 pin.

*2 In normal dialing, a dial tone is output for as long as the key is held down. The minimum hold time for both tone output and inter-digit pause, is 101 ms. When redialing, tone output and inter-digit pause is 101 ms.

*3 To signal an on-hook state, the HS pin must remain HIGH for more than 1 ms.

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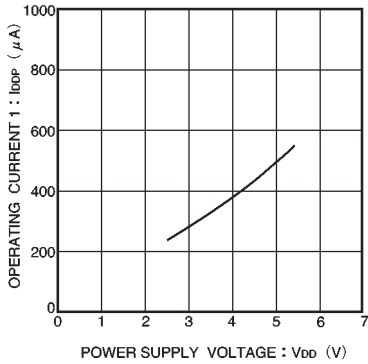
●Electrical characteristic curves

Fig. 1 Pulse mode, operating
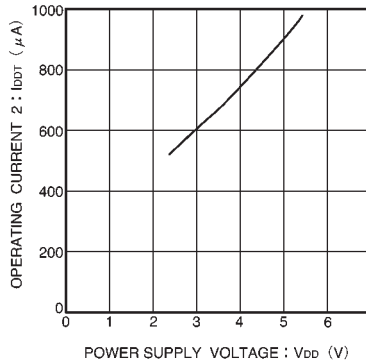current vs.
power supply voltage

Fig. 2 Tone mode, operating
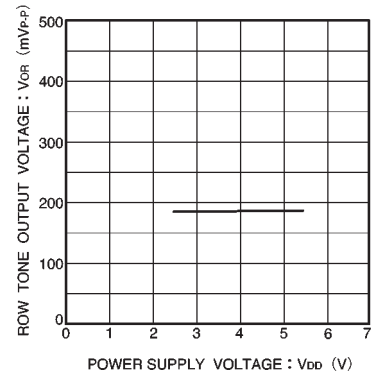current vs.
power supply voltage

Fig. 3 ROW tone output
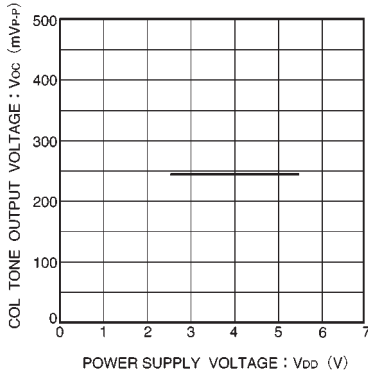voltage vs.
power supply voltage

Fig. 4 COL tone output voltage
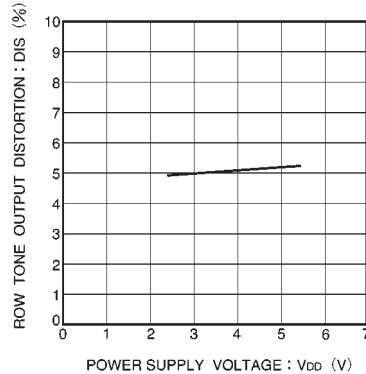vs. power supply voltage

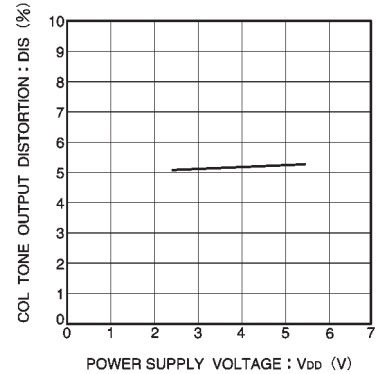Fig. 5 ROW tone output distortion
vs. power supply voltage

Fig. 6 COL tone output distortion
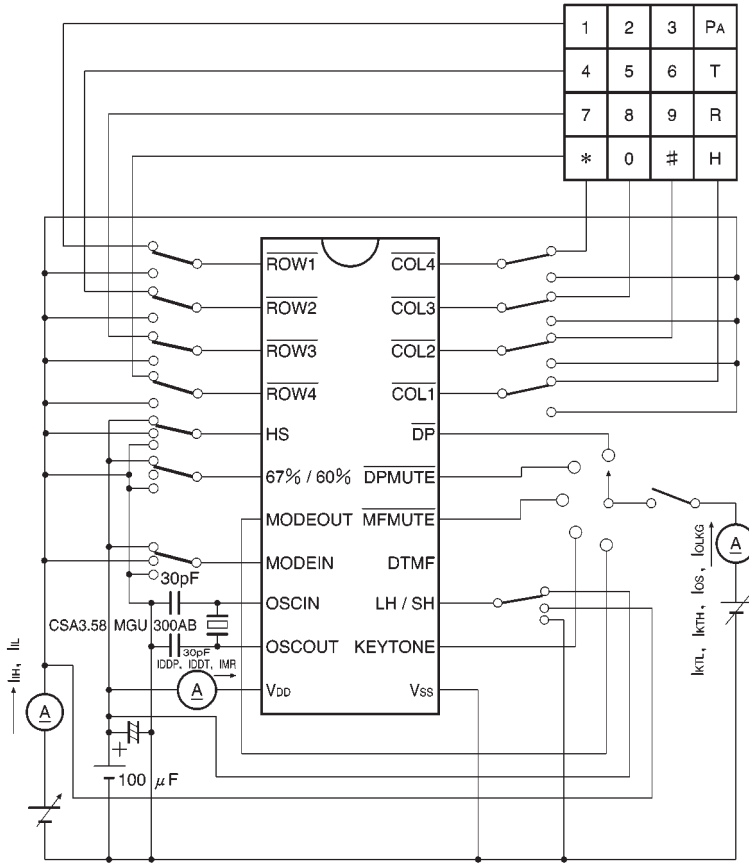vs. power supply voltage

●Measurement circuit
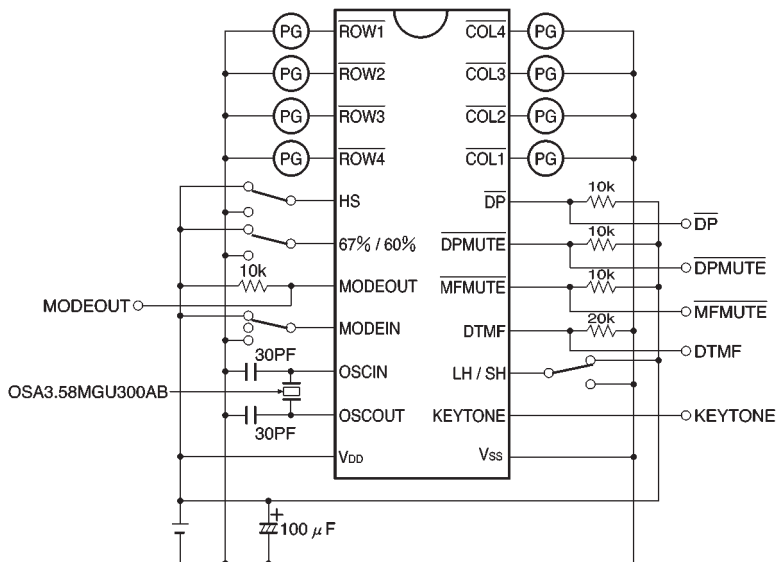

Fig. 7 DC characteristics measurement circuit

Fig. 8 AC characteristics measurement circuit

●Circuit operation

Keypad functions

[0] to [9]   These are numeric keys, and dial signals are sent when one of these keys is pressed.

[✳], [#]   In tone mode, when these keys are pressed, the corresponding DTMF signals are sent. In pulse mode, if the [#] is the first key to be pressed after going off-hook, the redial operation is executed. The [✳] key switches the unit from pulse mode to tone mode.

[PA]   When this key is pressed, a 3.6-second pause is generated. It also serves as a "break pause" key when redialing.

[T]   This is used to switch from pulse mode to tone mode. It also serves as a "break pause" key when redialing.

[R]   This is used in both redial and inhibit redial operations. When redialing, it also serves as a "break pause" key.

[H]   Pressing this key initiates on-hook operation.

Fig. 9 Keypad matrix

DTMF frequency cycle deviation

Standard frequency (Hz)		BU8307CS / BU8307CF	
		Frequency (Hz)	Frequency deviation (%)
Low	697	696.41	−0.08
	770	769.79	−0.03
	852	852.27	0.03
	941	941.99	0.10
High	1209	1209.31	0.03
	1336	1335.65	−0.03
	1477	1479.15	0.15

Note: The frequency variation of the resonator itself is not included.

Key operations   ↑: Off-hook
                                  ↓: On-hook

(1)   Normal dialing
↑D_1 to D_n
After going off-hook, the dial data from the key input is written to the redial memory, and the dial signals are sent based on the specified mode (pulse or tone). There is no upper limit on the number of digits that can be dialed. Key input can also be entered during dial output. To inhibit subsequent redialing, press the R key twice after the dial signals have been sent.

(2)   Access pause
↑D_1 P_A D_2 to D_n
Pressing the P_A key automatically initiates a 3.6-second pause. Pauses can be stacked by simply pressing the P_A key the required number of times, each time being one 3.6-second pause.
During a pause, dialing input is allowed, just as during dial signal transmission. When redialing, if a pause is being executed, it can be canceled by pressing the P_A, T, or R key during the pause. Multiple causes being executed in succession can also be canceled by pressing the P_A, T, or R key one time during the cumulative pause.

(3)   Redial
↑R
↑$#$ (MODEIN = H or Z)
Redial is only accepted if the redial key is pressed immediately after going off-hook. After going off-hook, pressing the R key in tone mode or the $#$ key in pulse mode causes the last number dialed to be redialed. Key input is not accepted when a redial signal is being output. After the redial digits have been transmitted, any number of valid key inputs are accepted and transmitted. The redial memory holds up to 32 digits. Redial is inhibited if more than 32 digits are dialed in pulse mode, or more than 31 digits are dialed in tone mode. In pulse mode, the following can be written to the redial memory : 0 to 9, P_A and T. In tone mode, the following can be written to the redial memory 0 to 9, $\times$, $#$, and P_A.
Further redialing is inhibited following completion of the redial output by pressing the R key twice in succession.
Note: In tone mode, because one digit of memory is used to store the mode, the maximum number of valid digits available for redialing is 31.

(4)   Mode switching (mixed mode dialing)
↑D_1 to D_i T (or $\times$) D_{i+1} to D_n (MODEIN = H or Z)
Switching from pulse mode to tone mode can be done only once when in an off-hook state. Setting the mode switching pin to the pulse mode (MODEIN = HIGH or Z) and pressing the T (or $\times$) key writes the data required to switch to tone mode into memory.
In pulse mode, pressing the T (or $\times$) key while the dial signal is being sent automatically inserts a 3.6-second pause after all digits up to that key have been transmitted, and all subsequent dial signals are transmitted as tones. In this case, the $\times$ signal is sent out as a DTMF signal. Also, because the information required to switch to the tone mode is written to the memory, mixed dialing is possible when redialing. When doing this, the mode setting will match that at the time of key input, regardless of the position of the MODEIN pin.

(5)   Hooking
↑H
This initiates the hooking operation. After the operation has been completed, a hooking pause is inserted automatically. If a dial signal is being transmitted when the H key is pressed, the dial sequence is immediately interrupted, and the hooking operation is initiated. The hooking time can be selected as either 607ms or 84ms, depending on the setting of the LH/SH pin. Pressing the H key initiates the following sequence: off-hook → on-hook (hooking time) → off-hook pause (hooking pause time) → off-hook operation.
Internal state of the IC when the H key is pressed
① The input mode is reset, and the circuit goes to standby state in the pulse mode.
If the MODEIN pin is LOW, however, the state is recognized as tone mode.
② The line pointer is reset, enabling redialing.
③ After the H key has been pressed, other subsequent key input is enabled. The hooking operation is not written to the memory. While the hooking operation is in progress, the only key input which is not accepted is the H key. All other key input is accepted.

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●Circuit operation

Operating example: 4 ✕ 4 keypad   ↑ Off-hook

     ↓ On-hook

Item	Key sequence	Dial output	Redial memory contents
Normal dialing (1) MODEIN＝H	↑ [1][2][3][4]	1 2 3 4 Pulse 20PPS	[1][2][3][4]
Normal dialing (2) MODEIN＝Z	↑ [1][2][3][4]	1 2 3 4 Pulse 10PPS	[1][2][3][4]
Normal dialing (3) MODEIN＝L	↑ [1][2][3][4]	1 2 3 4 DTMF	[T][1][2][3][4]
Access pause	↑ [0][PA][1][2][3]	0 1 2 3 3.6S	[0][PA][1][2][3]
Cancel pause in progress	↑ [0][PA][1][2][3] ↓	0 1 2 3 3.6S	[0][PA][1][2][3]
	↑ [R]▲[PA]	0 1 2 3 ≦3.6S ↑ [PA] to interrupt	[0][PA][1][2][3]
Redial (1)	↑ [1][2][3][4] ↓ ↑ [R]	1 2 3 4 1 2 3 4	[1][2][3][4] [1][2][3][4]
Redial (2)	↑ [1][2][3]…[2][3] ↓ ↑ [R]	1 2 3 … 2 3 No output	□□□…□□ □□□…□□
Inhibit redial (1)	↑ [1][2][3][4]△[R][R] ↓ ↑ [R]	1 2 3 4 ↑ [R][R] pressed twice No output	□□□□ □□□□
Inhibit redial (2)	↑ [1][2][3][4] ↓ ↑ [R]△[R][R] ↓ ↑ [R]	1 2 3 4 1 2 3 4 ↑ [R][R] pressed twice No output	[1][2][3][4] □□□□
Mode switched using [T] key (MODEIN＝HorZ)	↑ [1][2][T][3][4] ↓ ↑ [R]	1 2 3 4 Pulse 3.6S DTMF 1 2 3 4 Pulse 3.6S DTMF	[1][2][T][3][4] [1][2][T][3][4]
Hooking	↑ [H]	Hooking operation	

▲ : Follow-on key pressed during pause

△ : Follow-on key pressed after previous input has been sent

Operating example: 3 ✕4 (2 of 7) keypad   ↑ Off-hook

     ↓ On-hook

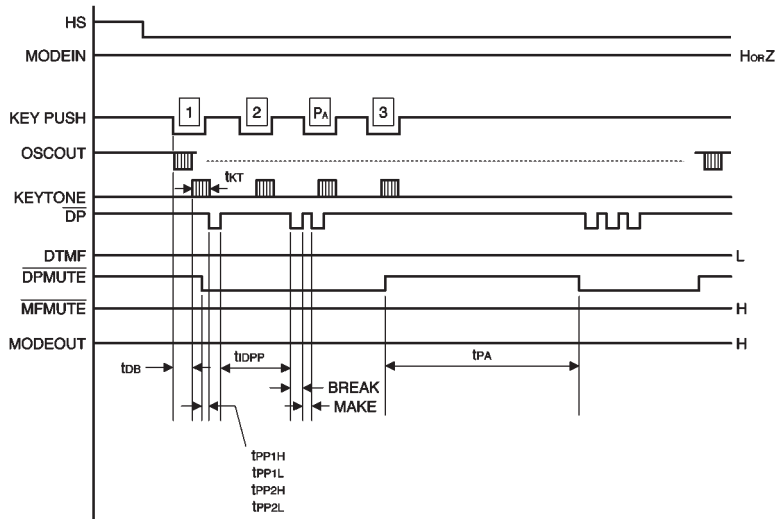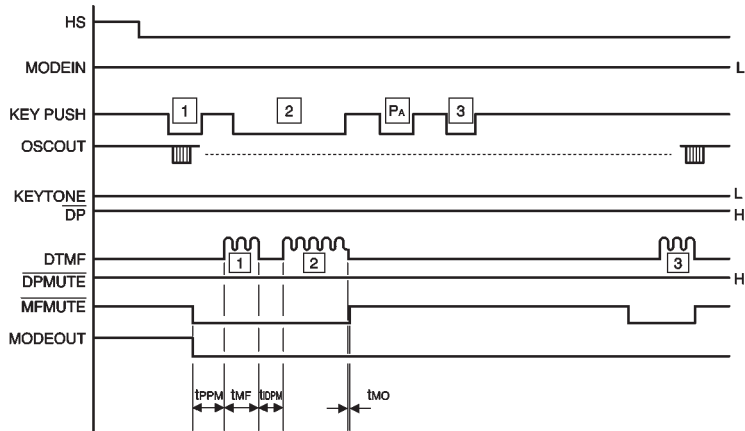| Item	Key sequence	Dial output	Redial memory contents
Redial (MODEIN＝HorZ)	↑ [1][2][3][4] ↓ ↑ [#]	1 2 3 4 1 2 3 4	[1][2][3][4] [1][2][3][4]
Switch modes using [✕] key (MODEIN＝HorZ)	↑ [1][2][✕][#][✕] ↑ [#]	1 2 # ✕ PULSE 3.6S DTMF 1 2 # ✕ PULSE 3.6S DTMF	[1][2][T][#][✕] [1][2][T][#][✕]

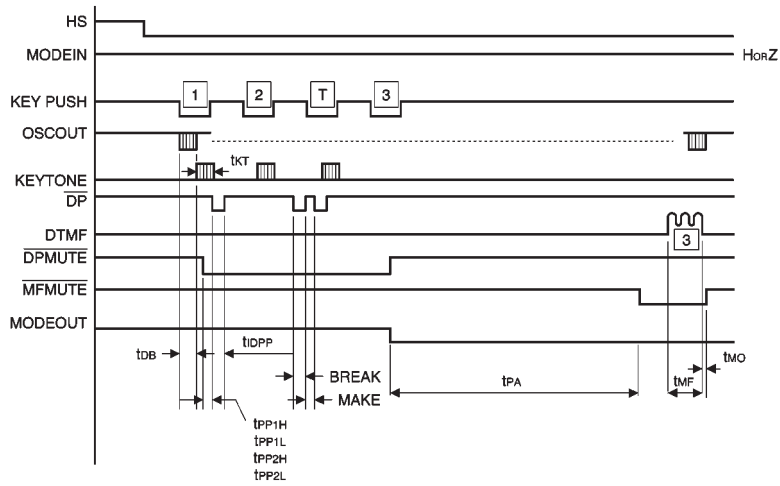Fig. 10 （a） Pulse dial timing chart

Fig. 10 （b） Hooking and redial timing chart
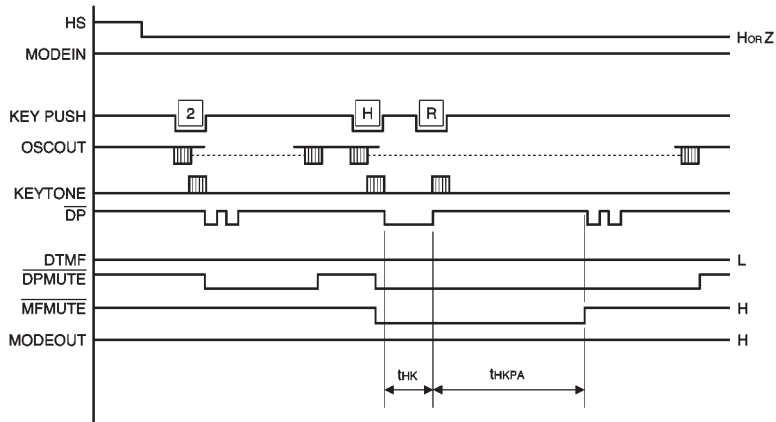
Fig. 10 (c) Pulse → tone mixed dial timing chart

Fig. 10 (d) Hooking and redial timing chart

●Pin descriptions
(1) $\overline{\text{ROW1}}$ to $\overline{\text{ROW4}}$ and $\overline{\text{COL1}}$ to $\overline{\text{COL4}}$

These are the keyboard input pins. They can be connected to a 3 × 4 (2 of 7) standard keypad, or a 4 × 4 keypad. Key input becomes valid by either shorting a single $\overline{\text{ROW}}$ input and a single $\overline{\text{COL}}$ input, or setting a single $\overline{\text{ROW}}$ and a $\overline{\text{COL}}$ input to LOW at the same time. If two keys are pressed at the same time, the key input is ignored. In tone mode, a single tone can be generated by pressing two or more keys in the same row or column of the $\overline{\text{ROW1}}$ to $\overline{\text{ROW4}}$ and $\overline{\text{CL1}}$ to $\overline{\text{COL3}}$ matrices. If the two keys are not in the same row or column, the key input will be ignored.

(2) HS

This is the hook switching input pin. When this pin is LOW, the state is perceived as off-hook, and when HIGH, as on-hook. The pin is set to the off-hook state during a dial signal transmission, and to the on-hook state during memory hold.

(3) 67% / 60%

This switches the dial pulse break ratio. In LOW state, the ratio is 60%, and in HIGH state, 67%.

(4) MODEOUT

This is the output pin for the mode state. When the output mode is set to the pulse mode, this pin is Z level, and when the output mode is set to the tone mode, this pin is LOW. It goes to Z level when on-hook. The output is Nch open drain output.

(5) MODEIN

This is the input pin for the mode state. When LOW, the tone mode is effective, and when Z, the pulse mode at 10pps is effective, and when HIGH, the pulse mode at 20pps is effective.

If the $\boxed{\text{T}}$ key is input, however, the mode switches to the tone mode, even if this pin is HIGH or Z state.

If this pin is set to HIGH or LOW level by applying resistance, the resistance level should be 10kΩ or less.

(6) OSCIN and OSCOUT

These are the input and output pins for the internal oscillator. A crystal resonator or ceramic resonator (CSA3.58MGU300AB or CST3.58MGWU300AB) is connected between OSCIN and OSCOUT. If CSA3.58 MGU300AB is connected, a CH-type 30 pF capacitor should be connected between each of these pins and V_{SS}.

(7) KEYTONE

This is the pin which outputs keytones. It has a CMOS output. When off-hook, this pin outputs a key-press confirmation tone for all valid key input in pulse mode, and for valid input of the $\boxed{\text{P}_A}$, $\boxed{\text{R}}$, and $\boxed{\text{H}}$ keys in tone mode. The output frequency f_{KT} is 1193Hz and the output time t_{KT} is 34ms. When there is no output, this pin is LOW.

(8) LH / SH

This pin switches the hooking time. When LOW, the hooking time is 84ms, and when HGH, 607 ms.

(9) DTMF

In tone mode, this pin outputs the corresponding DTMF signal when a key is pressed. It is LOW level except when a DTMF signal is being sent. This has CMOS output. A 20kΩ resistor should be connected between this pin and V_{SS}.

(10) $\overline{\text{MFMUTE}}$

This goes LOW when a DTMF signal is sent. When there is no output, and when on-hook, it goes to Z level. This is Nch open drain output.

(11) $\overline{\text{DPMUTE}}$

When a dial pulse is being sent, and when an on-hook sequence is in progress, this goes LOW. In tone mode, when there is no output, and in on-hook state, this goes to Z level. The output is Nch open drain output.

(12) $\overline{\text{DP}}$

In pulse mode, this pin outputs the corresponding dial pulse when a key is pressed. It goes to Z level for a contact make and to LOW level for a contact break. It remains at Z level unless a dial pulse is being output. The output is Nch open drain output.
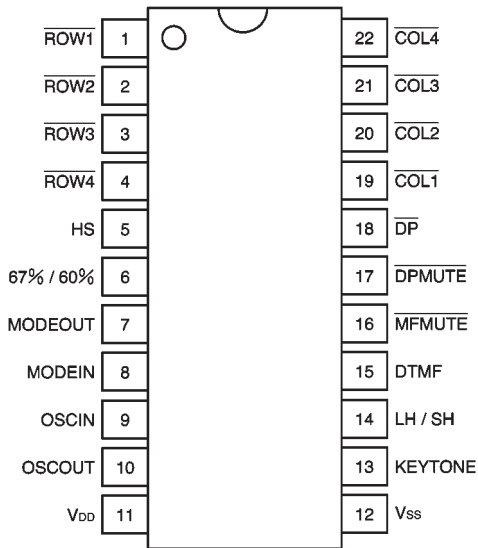
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ROW1	1		22	COL4
ROW2	2		21	COL3
ROW3	3		20	COL2
ROW4	4		19	COL1
HS	5		18	DP
67% / 60%	6		17	DPMUTE
MODEOUT	7		16	MFMUTE
MODEIN	8		15	DTMF
OSCIN	9		14	LH / SH
OSCOUT	10		13	KEYTONE
VDD	11		12	Vss

Fig. 11 （a）Pin assignments for the BU8307CS
(22-pin SDIP)

ROW1	1		24	COL4
ROW2	2		23	COL3
N.C.	3		22	N.C.
ROW3	4		21	COL2
ROW4	5		20	COL1
HS	6		19	DP
67% / 60%	7		18	DPMUTE
MODEOUT	8		17	MFMUTE
MODEIN	9		16	DTMF
OSCIN	10		15	LH / SH
OSCOUT	11		14	KEYTONE
VDD	12		13	Vss

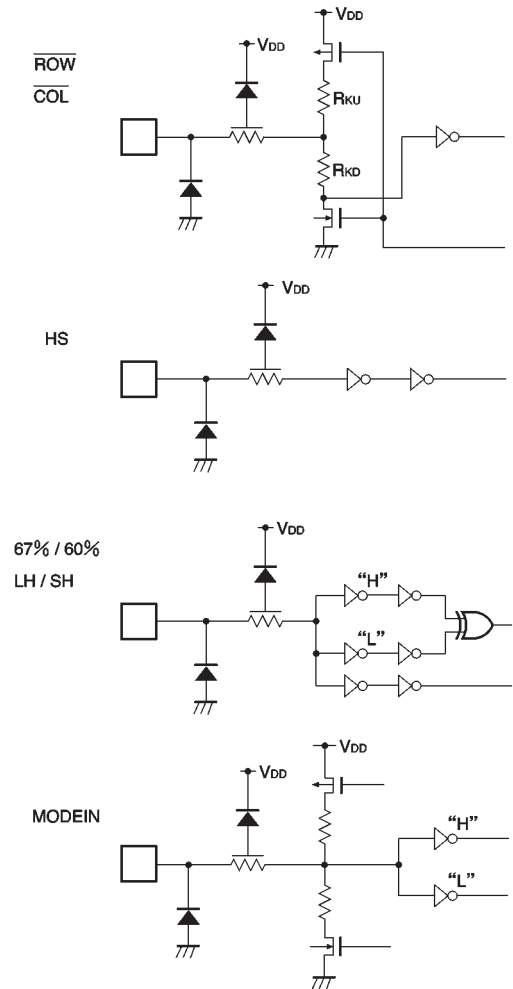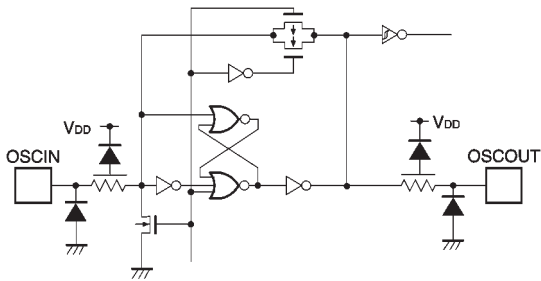Fig. 11 （b）Pin assignments for the BU8307CF
(24-pin SOP)

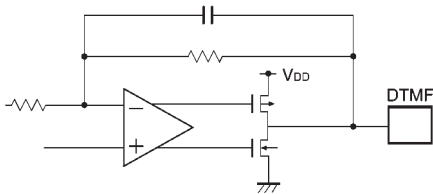Fig. 12 Input interface circuit

Fig. 13 Oscillation circuit

Fig. 14 DTMF output circuit
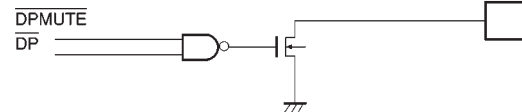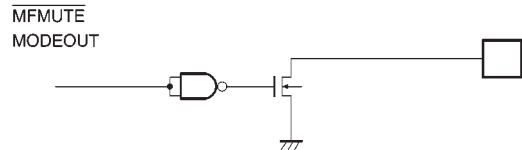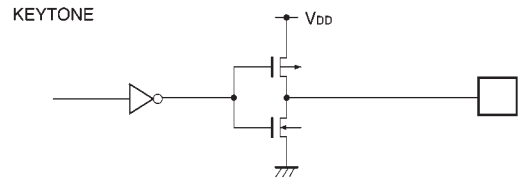

Fig. 15 Output interface circuit

Logic input

	H	Z	L	Input format
HS	On-hook	*1	Off-hook	CMOS
67% / 60%	Pulse break ratio 67%	*1	Pulse break ratio 60%	CMOS
MODEIN	Pulse mode 20 pps	Pulse mode 10 pps	Tone mode	CMOS
LH / SH	Hooking time: 607 ms Hooking pause time: 1.0 sec	*1	Hooking time: 84 ms Hooking pause time: 406 ms	CMOS

*1 Should not be used at Z level.

Output pin format

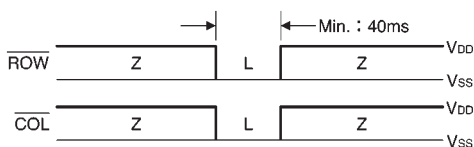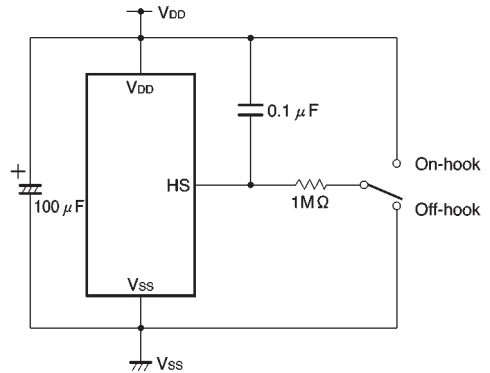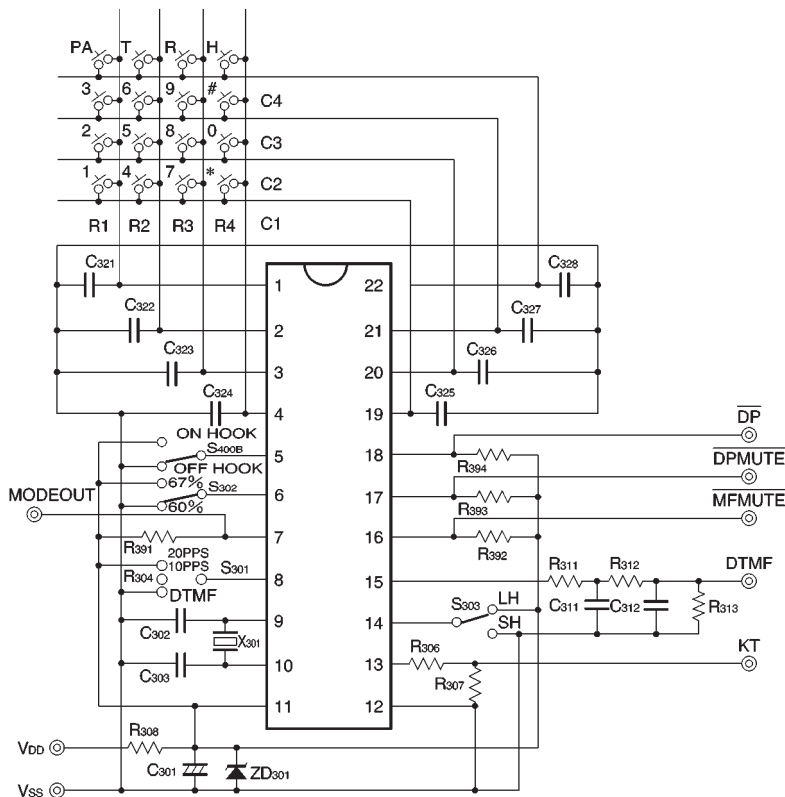| Output pin	Output format
MODEOUT	N MOS open drain
KEYTONE	C MOS
DTMF	C MOS
MFMUTE	N MOS open drain
DPMUTE	N MOS open drain
DP	N MOS open drain

Fig. 16 External logic interface waveform

●Operation notes

The reset circuits in the IC could fail to operate properly, depending on the way the supply voltage rises when power is applied. To avoid problems, we recommend adding a circuit to the HS pin, as shown in the diagram below. (There is no need for this circuit, however, if the HS pin momentarily goes HIGH by some other means, for example, by CPU control.)

＊ If the rise of the power supply takes an extremely long time because of the method by which power is supplied, the CR time constant for the above circuit should be set to a sufficiently large value.

●Application example

If noise or electromagnetic interference is a problem with the input pins ($\overline{ROW1}$ to $\overline{ROW4}$ and $\overline{COL1}$ to $\overline{COL4}$), connect a capacitor of about 470 pF (C_{321} to C_{328}) between each of the pins and the GND.

Fig. 17

●Attached components

Part no.	Component	Model/Specification	Description
C_{301}	Electrolytic capacitor	100 μF6.3V	Power supply bypass capacitor
C_{302}	Ceramic capacitor	30pF	
C_{303}	Ceramic capacitor	30pF	Resonator load capacitance (CH type)
C_{311}	Film capacitor	15nF	Capacitance for configuration of DTMF output distortion correction low-pass filter
C_{312}	Film capacitor	33nF	
$C_{321}\sim C_{328}$	Ceramic capacitor	470pF	Capacitance which prevents key input noise and electromagnetic interference from being mixed with signals
R_{304}	Carbon resistor	10kΩ 1 / 8W	When a shorting-type switch is used with S301, there is a momentary short-circuit between V_{DD} and GND when the switch slides. This is a resistor which prevents a drop in supply voltage when this occurs.
R_{306}	Carbon resistor	100kΩ 1 / 8W	These two resistors form an attenuator to reduce the key tone output level.
R_{307}	Carbon resistor	100kΩ 1 / 8W	
R_{308}	Carbon resistor	510kΩ 1 / 8W	Current limiting resistor
R_{311}	Carbon resistor	5.1kΩ 1 / 8W	Resistor for configuration of DTMF output distortion correction low-pass filter
R_{312}	Carbon resistor	5.1kΩ 1 / 8W	
R_{313}	Carbon resistor	5.1kΩ 1 / 8W	Resistor which divides DTMF output level
R_{391}	Carbon resistor	10kΩ 1 / 8W	NMOS open drain output pull-up resistors. Pull-ups are required for waveform monitoring only; they are not required for actual use.
R_{392}	Carbon resistor	10kΩ 1 / 8W	
R_{393}	Carbon resistor	10kΩ 1 / 8W	
R_{394}	Carbon resistor	10kΩ 1 / 8W	
ZD_{301}	Zener diodes	5.1V	Prevents the power supply voltage from exceeding the rated value (5.5 V max.).
X_{301}	Resonator	Crystal or ceramic, 3.579545MHz	Dialer master oscillator. If using a ceramic resonator, use the CSA3.58MGU300AB.
$S_{11}\sim S_{44}$	Pushbutton switch	16pcs	Keypad switches; these should have a maximum contact resistance of 2 kΩ.
S_{400B}	Toggle switch	2 contact points per line	Switch for providing hooking information to the dialer IC
S_{301}	Toggle switch	2 contact points per line	Dial mode selector switch (20pps / 10pps / DTMF)
S_{302}	Slide switch	3 contact points per line	Dial pulse break ration selector switch (67% / 60%)
S_{303}	Toggle switch	2 contact points per line	Hooking time selector switch (LH / SH)

(Note) If shorting-type switches are used for any of the switches, always use a resistor on the V_{DD} side of the switch to prevent the switch from shorting out the power supply, as is done with S_{302}.

ROHM

●External dimensions (Units: mm)

BU8307CS

BU8307CF

SDIP22

SOP24