

■ Outline

S-7230A2/B2 are DTMF/PULSE switchable dialers including a 32-digit redial memory. They are directly compatible with S-7230A/B.

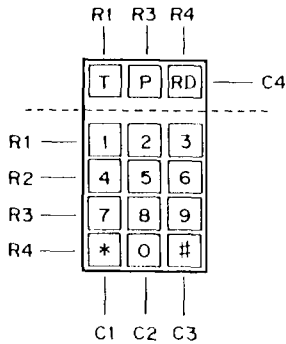
The initial mode (DTMF or PULSE) is selected by MODE SELECT input. Changing the mode from PULSE to DTMF during operation is also possible using the MODE SELECT and T keys. OPERATION SELECT decides which mode switch method will be used, MODE SELECT or T key.

■ Features

- Directly compatible with and replaceable by S-7230A/B
- 32-digit redial memory included. (31 digits in DTMF mode)
- Two mode choices: PULSE and DTMF.
- Modes can be switched during operation.
- Auto-mix redialing from PULSE to DTMF with multiple auto (TIMER) access PAUSE.
- Access PAUSE for PBX stored in redial memory as one-digit number.
Auto access pause time=4.1sec.
- Key-in tone output for valid key entry in PULSE mode.
fKT=1.8kHz, tKT=30.1ms
- Numbers dialed manually after redialing are cascable and are stored in redial memory as additional numbers for next redialing.
- Very low standby current. 0.1 μ A max, V_{DD}=3.5V
- Very low operating supply voltage and wide operating voltage range.
PULSE mode 1.5~5.5V
DTMF mode 2.0~5.5V
- Uses 3.579545 MHz crystal or ceramic resonator.
(Oscillation start-up time and start voltage depend on their characteristics. Consultation with a crystal and ceramic resonator supplier is recommended before application.)
- MAKE ratio is mask selectable. S-7230A2 for 33%
 S-7230B2 for 40%
- Uses 3×5 and 2 of 8 keyboard.

PULSE/DTMF SWITCHABLE DIALER S-7230A2/B2

■ Key Layout



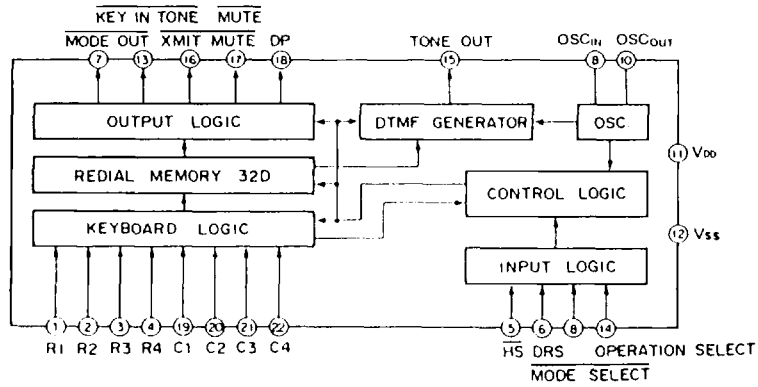
■ Key Functions

- [T]: PULSE → DTMF SWITCHING
- [P]: PAUSE
- [RD]: REDIAL
- [*]: PAUSE (PULSE mode)
- [#]: REDIAL (PULSE mode)

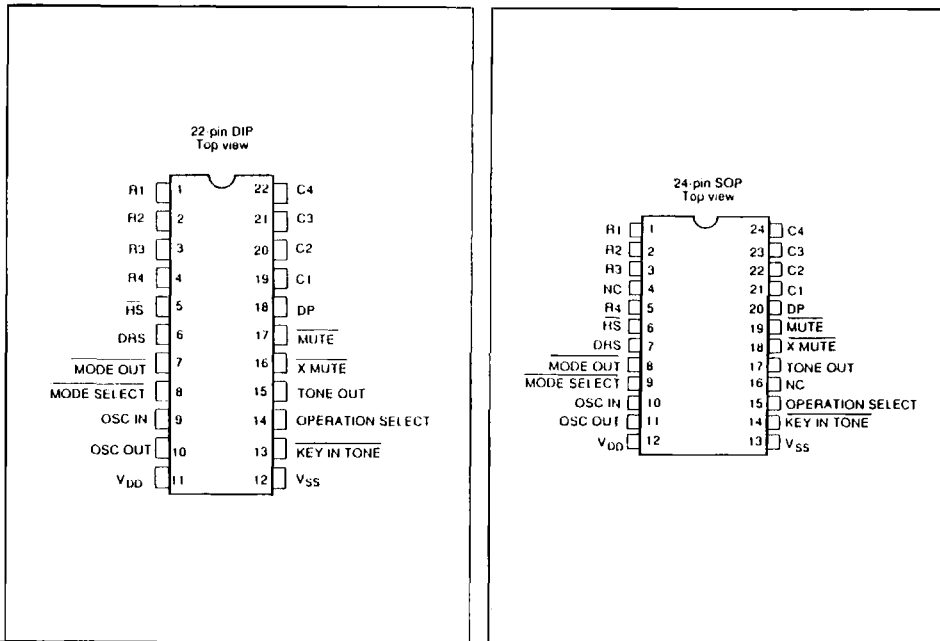
■ Key Operation Diagram

1. Manual dialing [OFF HOOK] [D1]~[Dn]
2. Manual dialing with auto access pause [OFF HOOK] [0] [P] [D1]~[Dn]
3. Redial [OFF HOOK] [RD]
4. Inhibiting redial [OFF HOOK] [D1]~[Dn] [RD] [RD]
([RD] key should be depressed after all DTMF or PULSE signals are transmitted.)
5. PULSE→DTMF dialing 1 [OFF HOOK] [D1]~[Dn] [P] [T] [Dx]~[Dy]
(OPE. SEL=MODE SELECT="H")
(Switching method is selected by [T] Redialing [OFF HOOK] [RD] [P])
- (Manual pause cancel) [P] is depressed in pause period.
[PD] is also available for cancelling pause.
6. PULSE→DTMF dialing 2 [OFF HOOK] [D1]~[Dn] [Dx]~[Dy]
(OPE. SEL="L")
(Switching method is selected by MODE SELECT input.)
MODE SELECT → "H" = "L"

■ Block Diagram



■ Pin Arrangement



■ Description of Functions

1. Normal dialing

After going OFF HOOK, the signal mode is decided with the $\overline{\text{MODE SELECT}}$ input state at the first key entry. According to the selected signal mode and key-in data, dialed numbers are stored in the redial memory. At the same time, PULSE or DTMF signals corresponding to the dialed numbers are provided to respective output terminals. Only one mode switch from PULSE to DTMF is available during key operation in OFF HOOK, and this is also stored in the redial memory.

After the DTMF signal mode is set up, $\overline{\text{MODE OUT}}$ changes the state from "OFF" to "L" (ON) and indicates the operation in DTMF mode. The switching method is selected with OPERATION SELECT input whether the mode is switched by $\overline{\text{MODE SELECT}} \rightarrow V_{ss}$ or $\overline{\text{T}}$ key in.

2. Auto Pause

Auto access pause is provided, and the pause time is 4.1sec for each $\overline{\text{P}}$ key entry. The $\overline{\text{*}}$ key can also be used as a pause key in PULSE mode. Multiple PAUSE key entries in series can be accepted and stored in the redial memory so that multiple pause time can be obtained.

The first PAUSE key entry after OFF HOOK is ignored. A valid PAUSE key entry consists of 2 to 32 digits and can be stored in the redial memory.

Pause time can be reduced or cancelled with the $\overline{\text{P}}$, $\overline{\text{T}}$ or $\overline{\text{RD}}$ keys during pause time in Redialing. When multiple pause time is written, the following continuous pauses are all reset.

3. Redialing

The last number dialed can be redialed with the $\overline{\text{RD}}$ or $\overline{\text{\#}}$ key in PULSE mode ($\overline{\text{MODE SELECT}} = V_{DD}$) when entered as the first key after OFF HOOK. The number can consist of up to 32 digits. $\overline{\text{0}} \sim \overline{\text{9}}$, $\overline{\text{P}}$ and $\overline{\text{*}}$ in PULSE mode or $\overline{\text{0}} \sim \overline{\text{9}}$, $\overline{\text{*}}$, $\overline{\text{\#}}$, $\overline{\text{P}}$ and the switching mode code in DTMF mode can be stored as a one-digit number in the redial memory.

After redialing, normal dialing can be resumed after a pulse or DTMF output. This normal dialing is added to the redial memory. Up to 32 digits can be stored in the redial memory. No other input is accepted during a redial operation; however, the following can be used: the pause cancellation key during a pause, the HALT cancellation key during a halt, and key input following redial output.

4. Mode change (Mixed dialing from PULSE mode to DTMF mode)

The mode can be switched during normal dialing, and can be automatically switched during redialing. The switching method is selectable with OPERATION SELECT input from the table shown below.

Operation Select	Switch Mode Method
V_{DD}	$\overline{\text{T}}$ key, $\overline{\text{MODE SELECT}}$ defines initial mode
V_{SS}	$\overline{\text{MODE SELECT}} \rightarrow V_{SS}$, $\overline{\text{T}}$ key is disabled, $\overline{\text{MODE SELECT}}$ decides both the initial and switching modes.

- ① Mode switching with $\overline{\text{T}}$ key (OPERATION SELECT= V_{DD})
 After the PULSE mode is defined initially with $\overline{\text{MODE SELECT}}=V_{DD}$, mode switching to DTMF can be accepted by $\overline{\text{T}}$ key entry.
- a) When the $\overline{\text{T}}$ key is depressed during output of PULSE signals the DTMF mode will be set up and $\overline{\text{MODE OUT}}$ will change its state to "L" (ON) after all PULSE signals are completed.
 In this mode, the next D $\cdots\cdots$ ($\overline{0}$ – $\overline{9}$, $\overline{*}$, $\overline{\#}$) are transmitted from TONE OUT as DTMF signals by depressing the corresponding keys.
 - b) When the $\overline{\text{T}}$ key followed by \overline{D} $\cdots\cdots$ is depressed while dialing PULSE signals, the DTMF mode will be set up after all PULSE signals are output. However, $\overline{\text{MODE OUT}}$ will flash to indicate a HALT state. In a HALT state, \overline{D} $\cdots\cdots$ data are ordinarily stored in the redial memory as DTMF data and not transmitted from TONE OUT. This is because the DTMF mode is set up without any pause required for calling and accessing the telephone system.
 When \overline{D} $\cdots\cdots$ DTMF data is ready to be transmitted in the redial memory, the $\overline{\text{T}}$, $\overline{\text{RD}}$ or $\overline{\text{P}}$ key is depressed to reset the HALT state and the \overline{D} $\cdots\cdots$ data are serially transmitted.
 This reset key data is not stored in the redial memory.
 When pauses are contained serially before or after mode switching, \overline{D} $\cdots\cdots$ DTMF data are ordinarily transmitted without a HALT state.
 - c) $\overline{\text{MODE SELECT}}$ defines the initial mode after OFF HOOK and $\overline{\text{MODE SELECT}}="L"$ sets up the DTMF mode.
- ② Mode switching with $\overline{\text{MODE SELECT}}$ input (OPERATION SELECT= V_{SS})
 After the PULSE mode is defined initially, it can be switched to the DTMF mode by $\overline{\text{MODE SELECT}}$ input $\rightarrow V_{SS}$ and the next key entry.
- a) When $\overline{\text{MODE SELECT}} \rightarrow V_{SS}$ while dialing PULSE signals, the DTMF mode will be set up after the last PULSE signal is output. After the DTMF mode is set up, operation is the same as ①-a).
 - b) When $\overline{\text{MODE SELECT}} \rightarrow V_{SS}$ and \overline{D} $\cdots\cdots$ keys are depressed during PULSE dialing, the DTMF mode will be set up and $\overline{\text{MODE OUT}}$ will flash to indicate a HALT state.
 After HALT, operation is the same as ①-b).
 - c) $\overline{\text{MODE SELECT}}$ defines the initial mode after OFF HOOK and $\overline{\text{MODE SELECT}}="L"$ sets up the DTMF mode.
- ③ Mode switching with both $\overline{\text{T}}$ key and $\overline{\text{MODE SELECT}}$ input during normal dialing
 If both switching mode methods ($\overline{\text{T}}$ and $\overline{\text{MODE SELECT}}$) are needed alternately, OPERATION SELECT should be connected to $\overline{\text{MODE SELECT}}$ in order to avoid false or confused operation.
- ④ Redialing (including auto mode switching)
 When pauses exist serially before or after mode switching in the redial memory, PULSE and DTMF data are ordinarily transmitted.
 When no pause is stored before or after mode switching, the device will stop the redialing operation after the PULSE signals are completely transmitted. In this HALT state, $\overline{\text{MODE OUT}}$ will flash to indicate the mode switching without any pause and will request the HALT state to be released. This HALT state can be reset by $\overline{\text{P}}$, $\overline{\text{T}}$, or $\overline{\text{RD}}$ key-in and the rest of the redial memory data can be immediately transmitted as DTMF.
 When redialing data are transmitted, any key-in is generally ignored except for key-in to reset HALT and PAUSE.
 If a certain key is held down in DTMF mode even after redialing is completed, the last data in the redial memory are successively transmitted during key-in.

PULSE/DTMF SWITCHABLE DIALER
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■ Pin Description

Table 2

Pin Name	Function						
R1~R4 C1~C4	<p>Key input</p> <p>After the power supply is turned on at ON HOOK ($\overline{HS}="H"$), both C1~C4, R1~R4 are set to "L" level. At OFF HOOK ($\overline{HS}="L"$), C1~C4 key inputs are set to "L" and R1~R4 are "H" so that the key input operation becomes possible. When any one key is depressed, the oscillator starts up and a scanning signal appears at the C1~C4 and R1~R4 key input terminals in order to detect the depressed Row and Column inputs.</p> <p>When the input key is released, scanning stops. Key inputs are compatible with standard 2 of 8 format or signal-contact (A-type) keyboards.</p>						
\overline{HS}	<p>Hook Switch input</p> <p>This input detects the state of the HOOK SWITCH contact; "OFF HOOK" corresponds to the V_{SS} condition. In ON HOOK ($\overline{HS}="H"$), redial memory data is sustained and other normal operation is inhibited. In OFF HOOK ($\overline{HS}="L"$) the device operates normally and PULSE or DTMF generation is enabled.</p>						
DRS	<p>Dial Rate Select input. The rate in PULSE mode is selected by the following table.</p> <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>DRS=V_{SS}</td> <td>10pps</td> </tr> <tr> <td>DRS=V_{DD}</td> <td>20pps</td> </tr> </table> <p>The DTMF signal is independent of this input state.</p>	DRS= V_{SS}	10pps	DRS= V_{DD}	20pps		
DRS= V_{SS}	10pps						
DRS= V_{DD}	20pps						
\overline{MODE} OUT	<p>Mode output</p> <p>The mode state is indicated with this terminal, showing whether the device is operating in PULSE or DTMF mode, and is controlled with OPERATION SELECT, the \overline{T} key and \overline{MODE} SELECT input. OFF state in ON HOOK ($\overline{HS}="H"$) state. Nch open drain output.</p> <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>SELECTED MODE</td> <td>(PULSE)</td> <td>DTMF</td> </tr> <tr> <td>\overline{MODE} OUT</td> <td>OFF</td> <td>ON</td> </tr> </table>	SELECTED MODE	(PULSE)	DTMF	\overline{MODE} OUT	OFF	ON
SELECTED MODE	(PULSE)	DTMF					
\overline{MODE} OUT	OFF	ON					
OSC _{IN} OSC _{OUT}	<p>Oscillator input/output</p> <p>The internal oscillator circuit contains two capacitors and a feedback resistor, so that only a 3.58MHz crystal is connected across the OSC_{in} terminals.</p> <p>Oscillation starts by depressing any key entry in OFF HOOK and is sustained till DTMF or PULSE generation is completed.</p>						
V_{DD}	<p>Positive Voltage Supply terminal</p> <p>PULSE MODE OPERATION 1.5~5.5V DTMF MODE OPERATION 2.0~5.5V</p>						
V_{SS}	<p>Negative Voltage Supply terminal</p> <p>This terminal is normally connected to GND.</p>						

Pin Name	Function				
$\overline{\text{MODE SELECT}}$	PULSE/DTMF Mode Select input After going OFF HOOK ($\overline{\text{HS}} \rightarrow \text{"L"}$), the mode of operation is selected by the following table.				
	Operation Select	Mode Select	Initial Mode	Switching Mode Method	
	V_{DD}	V_{DD}	PULSE	T KEY IN	MODE SELECT defines only initial mode at first key-in after going OFF HOOK.
		V_{SS}	DTMF	-----	
V_{SS}	V_{DD}	PULSE	$\overline{\text{MODE SELECT}} \rightarrow V_{SS}$	Mode switching is latched with valid key-in after $\overline{\text{MODE SELECT}} \rightarrow V_{SS}$.	
	V_{SS}	DTMF	-----		
To use both $\overline{\text{MODE SELECT}}$ and the T key, OPERATION SELECT should be connected to $\overline{\text{MODE SELECT}}$ in order to avoid false operation.					
$\overline{\text{KT}}$	Key-in Tone output A key-in tone signal is provided for all effective key-in except for the $\overline{\text{HK}}$ key in PULSE mode. $\text{IKT}=1.8\text{kHz}$, $\text{TKT}=30.1\text{ms}$ Nch open drain output No key-in tone is output in DTMF mode or for invalid key-in.				
OPERATION SELECT	Operation Select input This selects both mode switching methods (see $\overline{\text{MODE SELECT}}$ input).				
TONE OUT	DTMF Signal output When valid key-in is detected in DTMF mode and OFF HOOK state, dual tone output consisting of the appropriate low-group and high-group tones is generated. Tone out is "OFF" state in PULSE mode. A single tone can be generated by simultaneously depressing two digit keys in the appropriate Row and Column ($\overline{\text{MODE SELECT}} = V_{SS}$). If the two digit keys are not in the same Row and Column, dual tone mode is disabled and no output is provided. Pch open drain output. When more than two digit keys are depressed while transmitting a tone, tone out is disabled.				
$\overline{\text{XMIT MUTE}}$	$\overline{\text{XMIT MUTE}}$ output Nch open drain output	$\overline{\text{HS}}$	$\overline{\text{XMIT MUTE}}$		
		V_{DD}	"Low"		
		V_{SS}	"L" during PULSE or DTMF dialing		
$\overline{\text{MUTE}}$	$\overline{\text{MUTE}}$ output Nch open drain output	$\overline{\text{HS}}$	$\overline{\text{MUTE}}$		
		V_{DD}	"Low"		
		V_{SS}	"H" in DTMF mode "L" during PULSE dialing		
DP	Dial Pulse output "OFF" during BREAK and "L" during MAKE. "L" in ON HOOK ($\overline{\text{HS}} = V_{DD}$) or DTMF mode. Nch open drain output.				

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■ Absolute Maximum Ratings

Table 3

Topr=25°C

Parameter	Symbol	Conditions	Min.	Max.	Unit.
Power supply voltage	V _{DD}			6.0	V
Input voltage	V _{in}		V _{SS} -0.3	V _{DD} +0.3	
Output voltage 1	V _{OUT 1}		V _{SS} -0.3	V _{DD} +0.3	
Output voltage 2	V _{OUT 2}	DP, MUTE, XMITMUTE, MODE OUT, KT		12	
Tone output current	I _{tone}			50	mA
Power dissipation	P _D			500	mW
Operating ambient temperature	T _{opr}		-20	+70	°C
Storage temperature	T _{stg}		-40	+125	

■ DC Electrical Characteristics

Table 4

V_{DD}=3.5V, V_{SS}=0V,
f_{osc}=3.579545MHz, Ta=25°C

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
Power supply voltage	V _{DD P}	PULSE mode		1.5		5.5	V
	V _{DD T}	DTMF mode		2.0		5.5	
Memory retention voltage	V _{in}					1.0	V
Operating supply current	I _{DDOP}	At [i] key input	PULSE mode		200	500	μA
	I _{DDOT}	All output unloaded	DTMF mode		0.3	1.0	
Standby supply current	I _{DDs1}	No key input	HS=V _{DD}		0.01	0.1	μA
	I _{DDs2}	All output unloaded	HS=V _{SS}			10.0	
Output current	I _{OL1}	DP, MUTE	V _{OL} =0.4V	V _{DD} =3.5V	1.7	5.0	mA
	I _{OL2}	XMITMUTE		V _{DD} =1.5V	0.5	1.5	
Output leakage current	I _{LO}	MODE OUT, KT	V _{OUT} =10V			1.0	μA
Input voltage	V _{R1}	R1~R4, C1~C4, HS, DRS		0.8×V _{DD}		V _{DD}	V
	V _{Ri}	OPE SELECT, MODE SELECT		V _{SS}		0.2×V _{SS}	
Input current	I _{in}	R1~R4,	V _{DD} =3.5V V _{in} =V _{DD}		27	65	μA
		C1~C4	V _{DD} =1.5V V _{in} =V _{DD}		3.0	7.0	
	I _{in}	R1~R4,	V _{DD} =3.5V V _{Ri} =V _{SS}	200	450		
		C1~C4,	V _{DD} =1.5V V _{Ri} =V _{SS}	20	60		
Input leakage current	I _{in}	HS, DRS	V _{DD} =5.5V, V _{in} =V _{DD}		0.001	1.0	μA
	I _{in}	OPE SELECT, MODE SELECT	V _{DD} =5.5V, V _{Ri} =V _{SS}		0.001	1.0	

■ AC Electrical Characteristics

($f_{OSC} = 3.579545\text{MHz}$, $V_{DD} = 2.0 \sim 5.5\text{V}$)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Valid key entry time	t_{KIN}		40			ms
Key scan frequency	f_{CR}			300		Hz
Key-in tone duration	t_{KT}			30.1		ms
Key-in tone frequency	f_{KT}			1.8		kHz
Auto access pause time	t_{AP}			4.1		sec
Tone output	V_{OR}	Only for ROW TONE $V_{DD} = 2.5\text{V}$, $R_L = 5\text{k}\Omega$	-15.0		-13.0	dBm*
		$V_{DD} = 3.5\text{V}$, $R_L = 5\text{k}\Omega$	-14.5		-10.5	
Ratio of C to R tone	dBcr	$V_{DD} \geq 3.5\text{V}$	2.2		3.2	dB
Total harmonic distortion	%DIS	$V_{DD} \geq 3.5\text{V}$		5.0	10	%
Tone output delay time	t_{psd}			3.1		ms
ON HOOK initialize time	t_{INT}		0.20	10		ms

*0dBm = 0.775Vrms

■ Tone Frequencies

($f_{OSC} = 3.579545\text{MHz}$)

R/C	Spec.	Actual	% Error
R1	697	699.1	+0.31
R2	770	766.2	-0.49
R3	852	847.4	-0.54
R4	941	948.0	+0.74
C1	1209	1215.7	+0.57
C2	1336	1331.7	-0.32
C3	1477	1471.9	-0.35

Parameter	Symbol	Typ. (ms)
Tone duration	t_{tone}	79.2
Minimum pause	t_{dpT}	74.4
Cycle time	t_{cycl}	153.6
Mute overlap time	t_{moT}	73.0

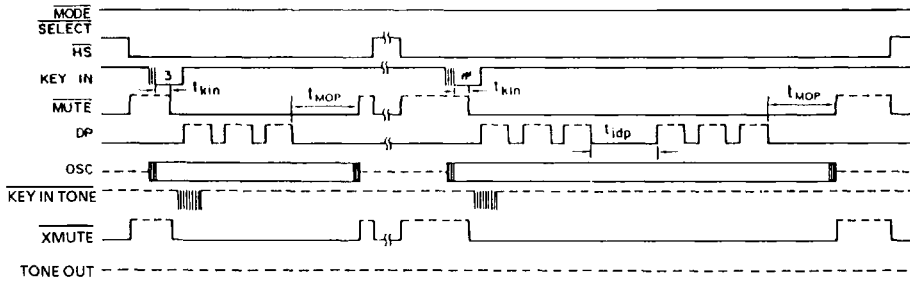
Cycle time in DTMF mode is independent from DRS input state.

■ Dial Signal in PULSE Mode

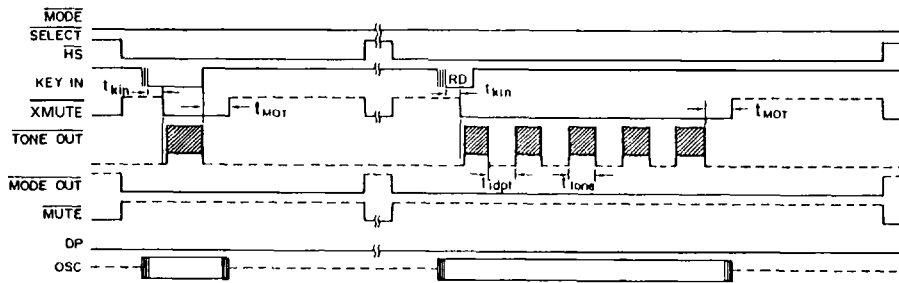
Type	Make Ratio (%)	DRS	Dial Rate (pps)	t_{dp} (ms)	Break Time (ms)	t_{dpP} (ms)	t_{nop} (ms)
S-7230A2	33	V_{SS}	10	33.8	67.6	844.7	811.2
		V_{DD}	20	16.9	33.8	827.9	811.2
S-7230B2	40	V_{SS}	10	40.6	60.8	851.8	811.2
		V_{DD}	20	20.3	30.4	831.6	811.2

**PULSE/DTMF SWITCHABLE DIALER
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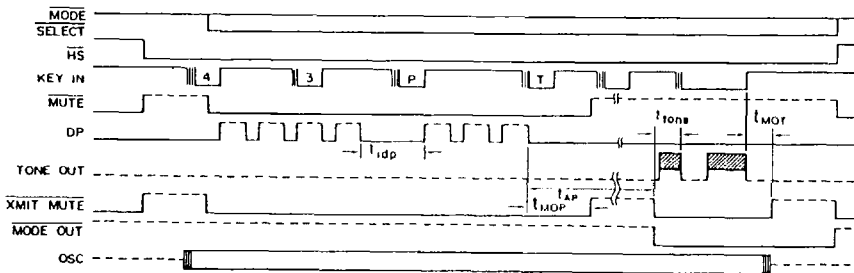
■ Timing Chart in PULSE Mode



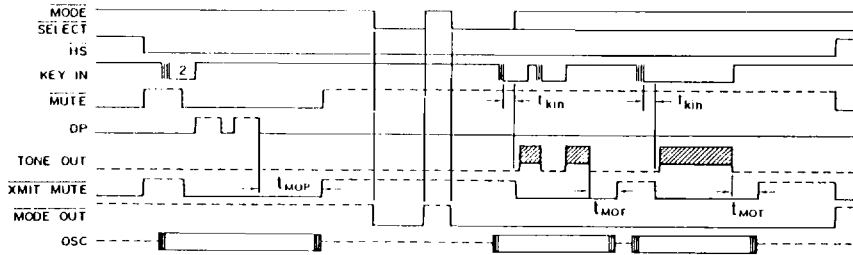
■ Timing Chart in DTMF Mode



■ Timing Chart for Switching Mode Operation by [T] Key Entry (OPERATION SELECT= V_{DD})

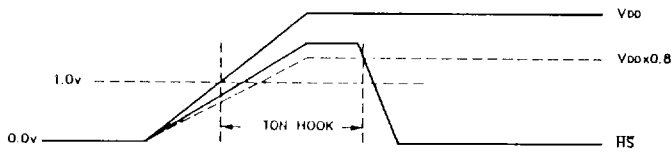


■ Timing Chart for Switching Mode Operation by Changing MODE SELECT Input State (OPERATION SELECT= V_{SS})



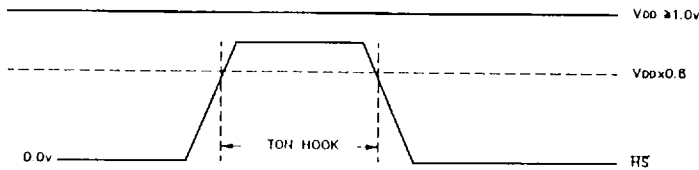
■ Initialization by HS

1. Initialization during POWER ON



- (1) In order for the power-on reset circuit to operate correctly, the time during which operation voltage changes from 0.0V to more than 1.0V (t_r) should be set within 10ms.
- (2) Other circuits are initialized by \overline{HS} , $t_{ON HOOK}$ should be set within the range shown above.

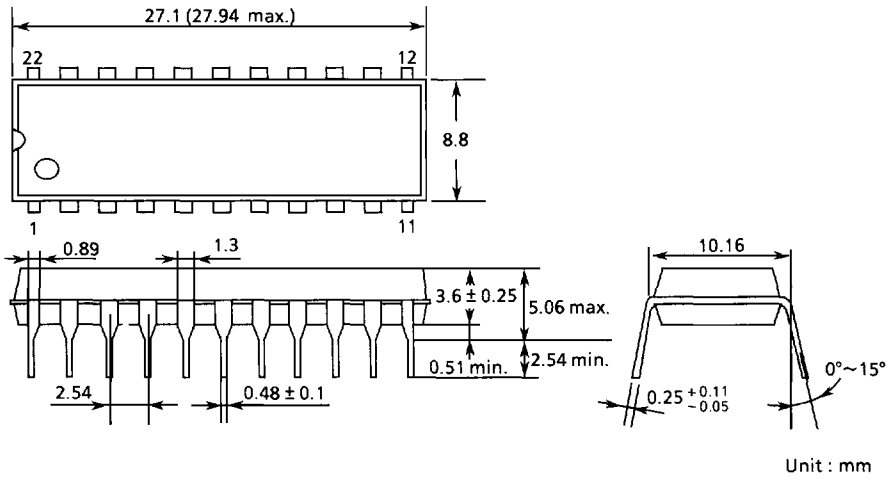
2. Initialization Post-POWER ON



PULSE/DTMF SWITCHABLE DIALER
S-7230A2/B2

■ **Dimensions**

1. S-7230A2/B2 (22-pin DIP)



2. S-7230A2/B2 (24-pin SOP)

