## TONE/PULSE DIALER WITH REDIAL

The KS5820 is a DTMF/PULSE switchable dialer with a 32-digit redial memory. Through pin selection, switching from pulse to DTMF mode can be done using a slide switch. All necessary dual-tone frequencies are derived from a 3.579545MHz TV crystal, providing very high accuracy and stability. The required sinusoidal wave form for each individual tone is digitally synthesized on the chip. The wave form so generated has very low total harmonic distortion (7% Max). A voltage reference is generated on the chip which is stable over the operating voltage and temperature range and regulates the single levels of the dual tone to meet telephone industry specifications. CMOS technology is applied to this device, for very low power requirements high noise immunity, and easy interface to a variety of telephones requiring external components.
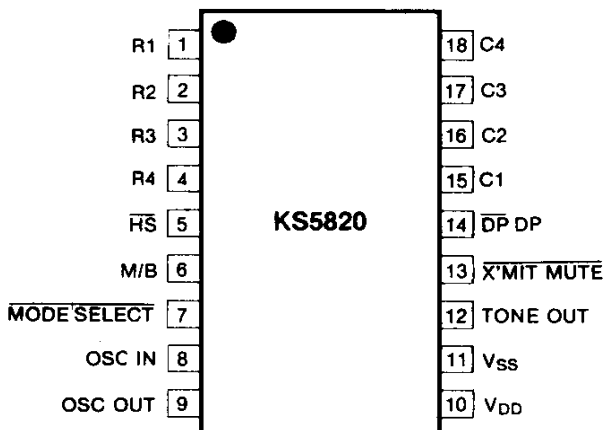
18 DIP
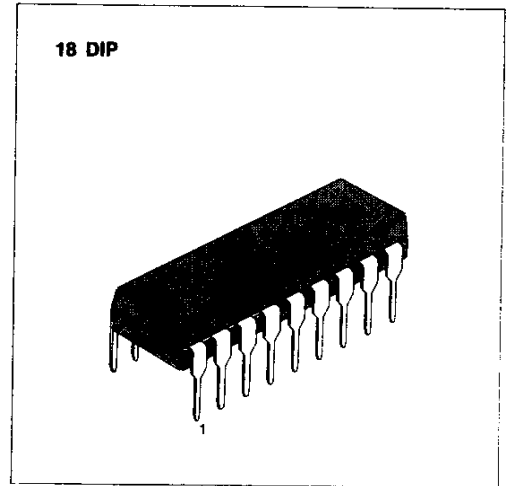
FEATURES

- Tone/Pulse switchable (slide switch).
- 32 digit capacity for redial
- Automatic mix redialing (last number dial) of PULSE→DTMF with multiple auto access pause
- PABX auto-pause for 3.5 sec.
- 4 x 4 or (2 of 8) keyboard available
- Low power CMOS process (2.0 to 5.5V)
- Numbers dialed manually after redial are cascadable and stored as additional numbers for next redialing
- Uses inexpensive TV crystal (3.579545MHz)
- Make/Break ratio (33 1/3 ~ 66 2/3 or 40/60) pin selectable
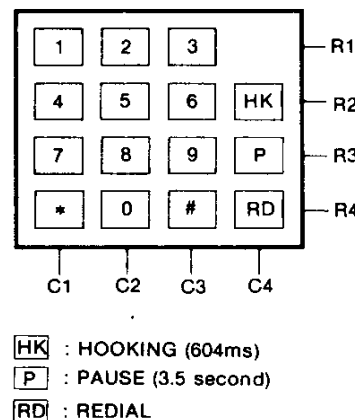- Touch key hooking (604ms)
- Low standby current

ORDERING INFORMATION

Device	Dial Pulse	PPS	Make/Break Ratio	
KS58A20N	DP	10	V_{DD}: 33.3/66.6	
			V_{SS}: 40/60	
KS58B20N	DP	20	V_{DD}: 33.3/66.6	
			V_{SS}: 40/60	
KS58C20N	$\overline{DP}$	10	V_{DD}: 33.3/16.6	
			V_{SS}: 40/60	
KS58D20N	$\overline{DP}$	20	V_{DD}: 33.3/66.6	
			V_{SS}: 40/60	

PIN CONFIGURATION

Pin		KS5820		Pin
R1	1		18	C4
R2	2		17	C3
R3	3		16	C2
R4	4		15	C1
$\overline{HS}$	5		14	$\overline{DP}$ DP
M/B	6		13	X'MIT MUTE
$\overline{MODE\ SELECT}$	7		12	TONE OUT
OSC IN	8		11	V_{SS}
OSC OUT	9		10	V_{DD}

ARRANGEMENT OF KEYBOARD

1	2	3		— R1
4	5	6	HK	— R2
7	8	9	P	— R3
*	0	#	RD	— R4

C1 C2 C3 C4

HK : HOOKING (604ms)
P : PAUSE (3.5 second)
RD : REDIAL

BLOCK DIAGRAM
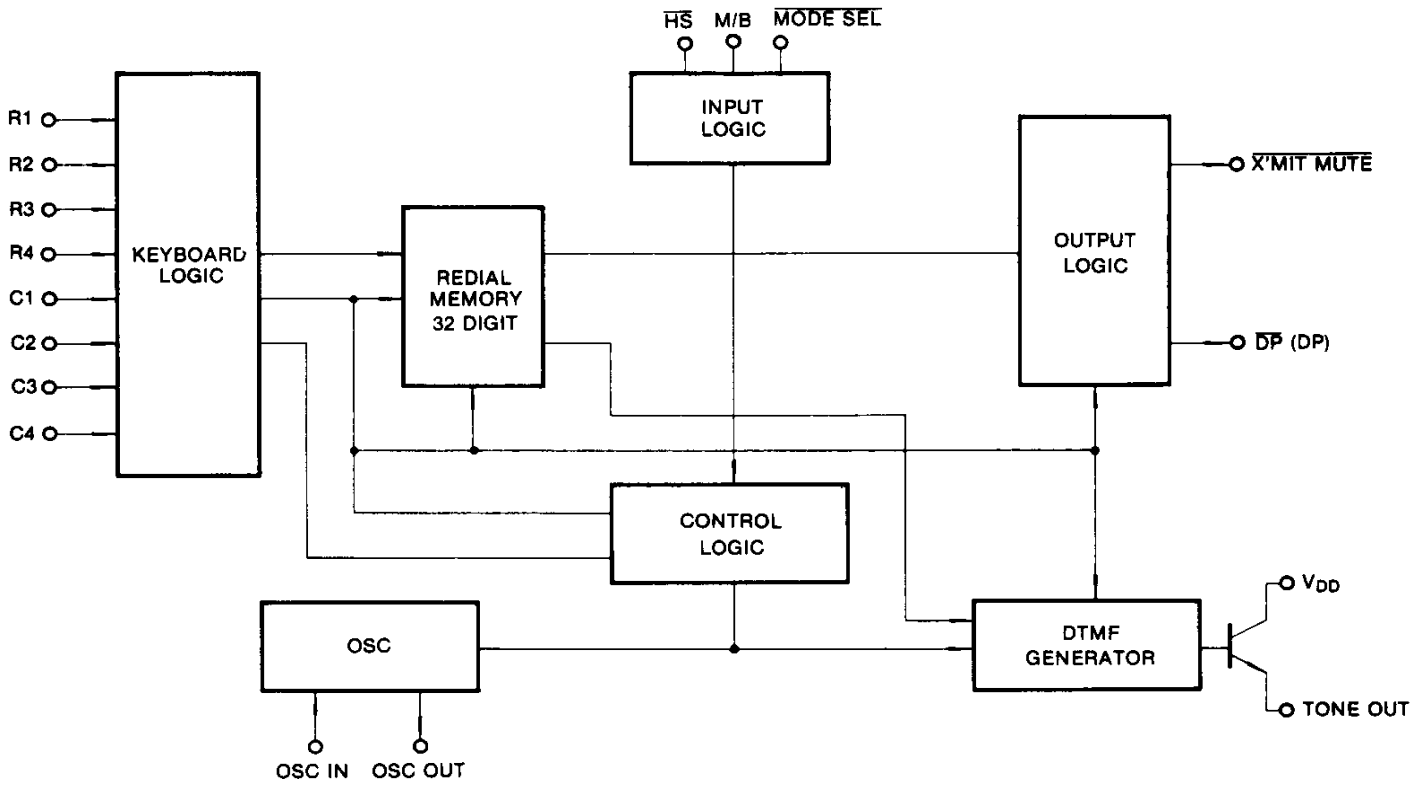
TONE DURATION & PAUSE IN REDIAL

Characteristic	Symbol	Typ	Unit
Tone Duration	T_D	110	mS
Minimum Pause	ITP	110	mS
Cycle Time	T_C	220	mS

TONE FREQUENCIES

Input	Specified	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

ABSOLUTE MAXIMUM RATINGS (Ta = 25°C)

Characteristics	Symbol	Value	Unit
Supply Voltage	V_{DD}	6.0	V
Input Voltage	V_{IN}	$V_{SS} - 0.3$, $V_{DD} + 0.3$	V
Output Voltage	V_{OUT}	$V_{SS} - 0.3$, $V_{DD} + 0.3$	
Output Voltage	V_{OUT}	$\leqq V_{DD}$, ($\overline{DP}$, $\overline{X'MITMUTE}$)	V
Tone Output Current	I_{TONE}	50	mA
Power Dissipation	P_D	500	mW
Operating Temperature	T_{opr}	$-20 \sim +70$	°C
Storage Temperature	T_{stg}	$-40 \sim +125$	

ELECTRICAL CHARACTERISTICS

(V_{SS} = 0V, V_{DD} = 3.5V, fx'tal = 3.579545MHz, Ta = 25°C, unless otherwise noted)

Characteristic	Symbol	Test Conditions			Min	Typ	Max	Unit
Operating Voltage Range	V_{DDP}	Pulse Mode	All inputs connected to V_{DD} or V_{SS}		2.0		5.5	V
	V_{DDT}	Tone Mode			2.0		5.5	
Memory Retention Voltage	V_{DR}				1.0			
Operating Supply Current	I_{DDP}	$\overline{MODE} = V_{DD}$	One key selected $\overline{HS} = V_{SS}$. All outputs unloaded			0.3	0.5	mA
	I_{DDT}	$\overline{MODE} = V_{SS}$				0.5	1.0	
Standby Current	I_{SD1}	$\overline{HS} = V_{DD} = 1.5V$	No key selected. All outputs unloaded				0.05	µA
	I_{SD2}	$\overline{HS} = V_{SS}$					50	
Output Current	I_{OD1}	$\overline{DP}$	$V_{OL} = 0.4V$	$V_{DD} = 3.5V$	1.7	5.0		mA
	I_{OD2}	$\overline{X'MIT MUTE}$		$V_{DD} = 2.5V$	0.5	1.5		
Input Voltage	V_{IH}	R1-R4. C1-C3. $\overline{HS}$. M/B			$0.8V_{DD}$		V_{DD}	V
	V_{IL}	$\overline{MODE\ SELECT}$			V_{SS}		$0.2V_{DD}$	
Input Current	I_{IN1}	$V_{DD} = 3.5V$ $V_{IN} = 0V$	R1-R4				116	µA
	I_{IN2}	$V_{DD} = 2.5V$ $V_{IN} = 0V$					50	
Valid Key Entry Time	T_{kd}				23		25.3	mS
Column and Row Scanning Frequency	F_{cr}					437		Hz
Auto Access Pause Time	T_{ap}					3.5		sec
Tone Output	V_{or}	ROW TONE ONLY	$V_{DD} = 2.5V$ $R_L = 5K$		-16.0		-12.0	dBV
			$V_{DD} = 3.5V$ $R_L = 5K$		-14.0		-11.0	
Ratio of Column to Row Tone	dB_{cr}	$V_{DD} = 3.5V$			1.0	2.0	3.0	dB
Distortion	%DIS	$V_{DD} = 3.5V$					7	%
Tone Output Delay Time	T_{psd}					1.5		mS

SAMSUNG Electronics

PIN DESCRIPTION

Pin	Name	Description
1-4 15-18	R1-R4 C1-C4	Keyboard (R1, R2, R3, R4, C1, C2, C3, C4) These inputs can be interfaced to an XY matrix keyboard. C1-C4 & R1-R4 are set to low at On Hook ($\overline{HS}$ = high). C1-C4 key inputs are set to low and R1-R4 are set to high at OFF HOOK ($\overline{HS}$ = low) which enables the key-input operation. The oscillator starts running when a keypress is detected. Scanning signals are presented at both column and row inputs (TYP: 437Hz) until the input key is released. Key inputs are compatible with standard 2-of-8 form or single-contact keyboard. Debouncing is provided to avoid false entry (TYP: 25mS).
5	$\overline{HS}$	Hook Switch This input detects the state of the hook switch contact. "Off Hook" corresponds to V_{SS} condition. "On Hook" corresponds to V_{DD} condition.
6	M/B	Make/Break Ratio This input provides the selection of the Make/Break ratio (33.3: 66.6/40:60) when M/B is connected to V_{DD}/V_{SS}.
7	$\overline{MODE\ SELECT}$	Mode Select Input Pulse/DTMF mode is selected as shown in the following table. Initial Mode means the state after going Off Hook ($\overline{HS}$→"V_{SS}") | $\overline{MODE}$ $\overline{SELECT}$	INITIAL MODE	SWITCHING ENTRY MODE
V_{DD}	Pulse	$\overline{MODE\ SELECT}$ Input = V_{SS}
V_{SS}	Tone	N/A	
8-9	OSC IN OSC OUT	Oscillator Input/Output These pins are provided to connect an external 3.58MHz crystal. Oscillator starts (at Off Hook) and is sustained until pulse or DTMF signals are finished.
10-11	V_{DD}, V_{SS}	Power These are the power supply inputs. The device is designed to be operated on 2.0V to 5.5V.
12	TONE OUT	DTMF Signal Output When a valid keypress is detected in DTMF mode appropriate low and high group frequencies are generated which hybrid the Dual Tone Output. Tone out is Off State in pulse mode.
13	$\overline{X'MIT\ MUTE}$	X'mit Mute Output 	$\overline{HS}$	$\overline{X'mit\ Mute\ Output}$
---	---
V_{DD}	"ON"
V_{SS}	Normally "OFF" "ON" during pulse and DTMF dialing	 (N channel open drain)
14	$\overline{DP}$, DP	Dial Pulse Out DP: The normal output will be "OFF" during break and "ON" during make at "OFF HOOK." The output will be "ON" at "ON HOOK," $\overline{DP}$: The normal output will be "ON" during break and "OFF" during make at "OFF HOOK." The output will be "OFF" at "ON HOOK."

KEYBOARD OPERATION

1. SINGLE MODE OPERATION

• Pulse Mode Operation

| Off Hook | | D1 | • • • | Dn |

Pulse mode is defined by the initial mode after going Off Hook and latched at $\boxed{D1}$ key entry. This is the condition under $\overline{\text{Mode Select}} = V_{DD}$.

• Tone Mode Operation

| Off Hook | | D1 | • • • | Dn |

Tone mode is defined by the initial mode after going Off Hook and latched at $\boxed{D1}$ key entry. This condition is under $\overline{\text{Mode Select}} = V_{SS}$.

• Manual Dialing with Automatic Access Pause

| Off Hook | | D | P | D1 | • • • | Dn |

Multiple Pause key entries can be accepted and stored in the redial memory, each as a digit. Each $\boxed{P}$ key provides 3.5 seconds pause time, but the $\boxed{P}$ key entry as the first digit after going Off Hook is ignored. The $\boxed{*}$ key can also be used as a pause key in the pulse mode. Pause (s) can be the cancelled with the $\boxed{P}$ or $\boxed{RD}$ key during pause time in redialing.
$\boxed{D}$ = Any numeric key.

• Redialing

| Off Hook | | RD |

Up to 32 digits can be dialed with the $\boxed{RD}$ key. The $\boxed{RD}$ key is disabled while pulse or DTMF signals are transmitted. When more then 32 digits are stored, redial is also inhibited.
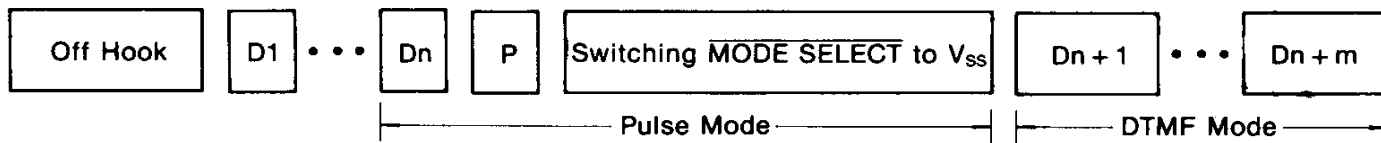The $\boxed{\#}$ key can be used as the $\boxed{RD}$ key in the pulse mode.

• Inhibiting Redial

| Off Hook | | D1 | • • • | Dn | RD | RD |
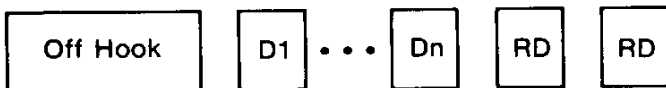
Redial can be inhibited by depressing the $\boxed{RD}$ key twice after DTMF or pulse signals are transmitted.

SAMSUNG Electronics

158

2. PULSE/TONE SWITCHABLE OPERATION

• **Mode Switching by $\overline{\text{MODE SELECT}}$ Input**

Off Hook	D1	• • •	Dn	P	Switching $\overline{\text{MODE SELECT}}$ to V$_{SS}$	Dn + 1	• • •	Dn + m

|← Pulse Mode →|← DTMF Mode →|

The pulse mode is initially defined $\overline{\text{MODE SELECT}}$ = V$_{DD}$. Mode switching to the DTMF mode can be accepted by $\overline{\text{MODE SELECT}}$ = V$_{SS}$, the DTMF mode will be set up after the pulse mode is finished. In this mode, digits $\boxed{\text{Dn + 1}}$ ... $\boxed{\text{Dn + m}}$ are transmitted from Tone Out as DTMF signals by depressing the corresponding keys.
If no $\boxed{\text{P}}$ key is contained serially before or after mode switching, the following condition is obtained.

Off Hook	D1	• • •	Dn	Switching $\overline{\text{MODE SELECT}}$ to V$_{SS}$	Dn + 1	• • •	Dn + m

|← Pulse Mode →|← DTMF Mode →|

(Dn + 1 ≠ Pause)
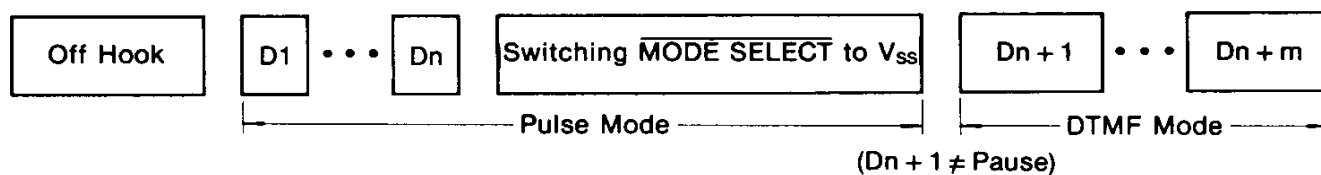
If digit $\boxed{\text{Dn + 1}}$ is depressed after the pulse mode is finished, the DTMF mode will be set up after the last pulse signal ($\boxed{\text{Dn}}$) is generated. In this mode, digits $\boxed{\text{Dn + 1}}$ ... $\boxed{\text{Dn + m}}$ are transmitted from Tone Out as DTMF signals by depressing the corresponding keys. If digit $\boxed{\text{Dn + 1}}$ is depressed during dialing pulse signals, DTMF mode, in the Hold State, will be set after the last pulse signal $\boxed{\text{Dn}}$ is finished. MODE OUT will flash to indicate this Hold State $\boxed{\text{Dn + 1}}$ ... $\boxed{\text{Dn + m}}$ is stored in the redial memory as DTMF data and not transmitted from Tone Out. When it is ready to transmit the DTMF data in redial memory, the $\boxed{\text{T}}$, $\boxed{\text{RD}}$ or $\boxed{\text{P}}$ key is depressed to reset this Hold State and $\boxed{\text{Dn + 1}}$ ... $\boxed{\text{Dn + m}}$ data are serially transmitted.

Single Tone Operation in DTMF Mode (Test mode)

1. The M/B pin is used to trigger the chip into the test mode by applying a positive or negative pulse after "Off Hook." The test mode is sustained until On Hook. The single tone is shown in the following table which contrast with the normal mode.
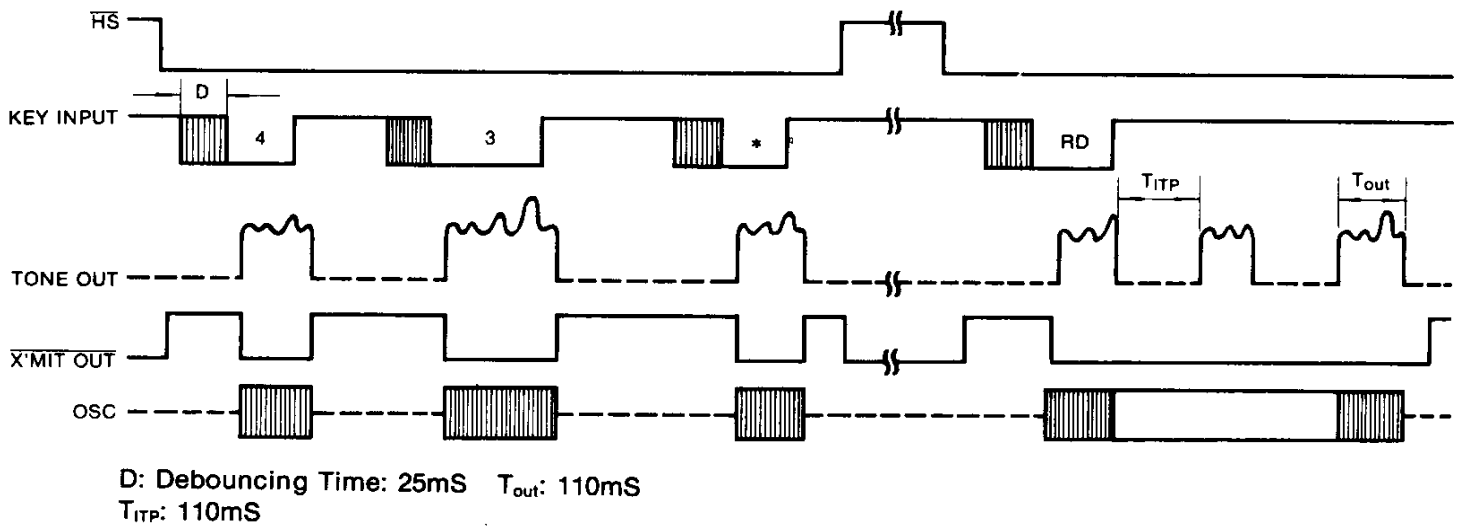
Normal mode

	C1	C2	C3
R1	1	2	3
R2	4	5	6
R3	7	8	9
R4	*	0	#

Single tone mode

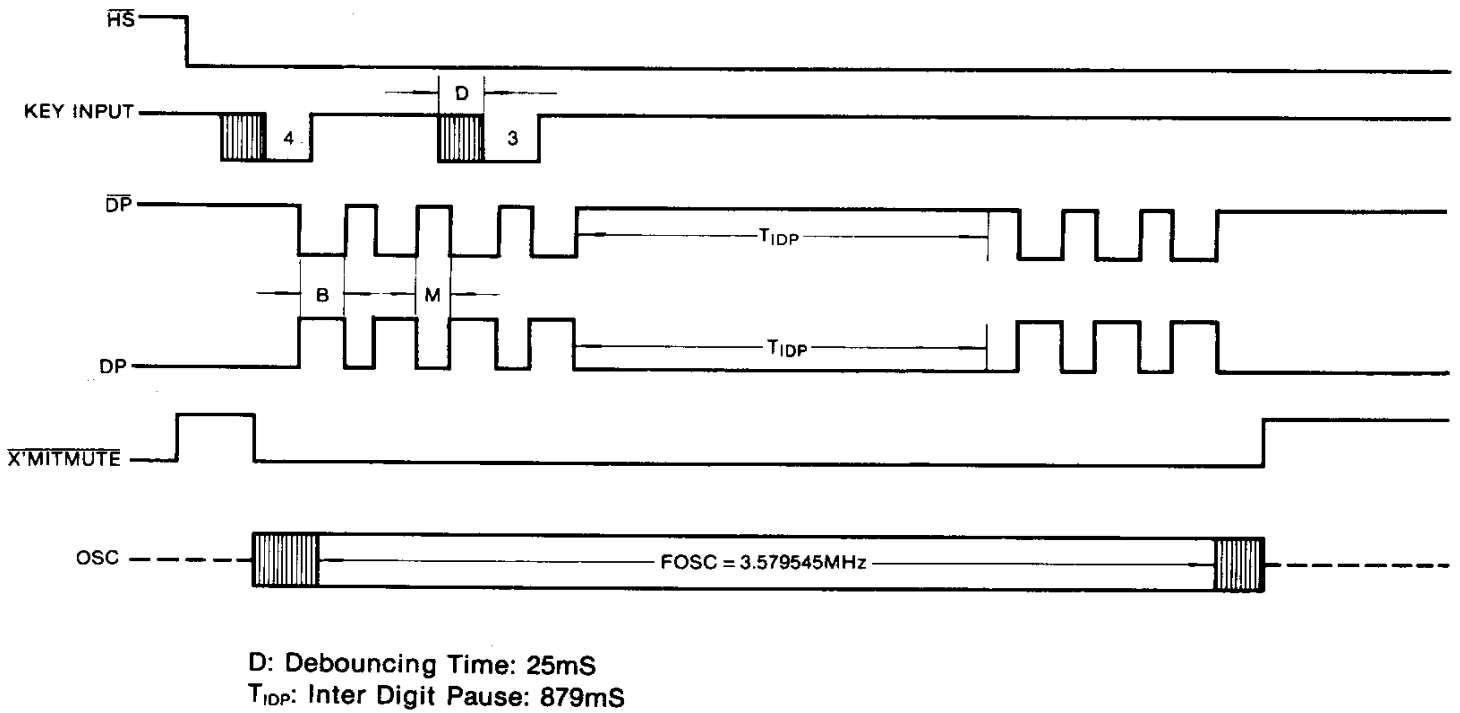|	C1	C2	C3
R1	R1	C2	C3
R2	C1	C2	R2
R3	R3	C2	C3
R4	C1	R4	C3

2. The single tone can be generated by simultaneously depressing two digit keys in the appropriate Row and Column. If tthe wo digit keys are not in the same Row or Column, the dual tone is disabled and no output is provided.
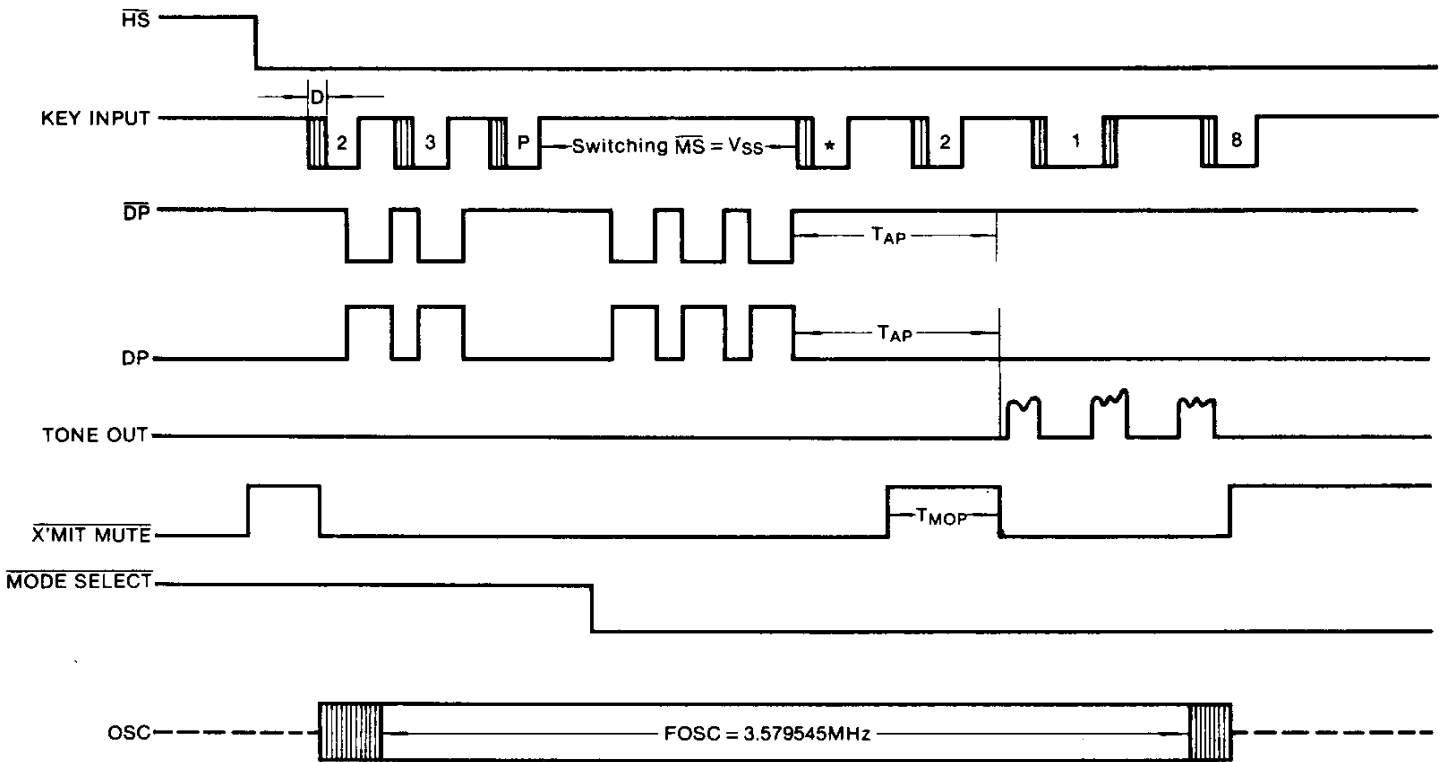
TONE MODE TIMING ($\overline{\text{MODE SELECT}} = V_{SS}$)

D: Debouncing Time: 25mS T_{out}: 110mS
T_{ITP}: 110mS

PULSE MODE TIMING ($\overline{\text{MODE SELECT}} = V_{DD}$)

FOSC = 3.579545MHz

D: Debouncing Time: 25mS
T_{IDP}: Inter Digit Pause: 879mS

TIMING DIAGRAM (for Switching Mode Operation by $\overline{\text{MODE SELECT}}$ Input)

T_{AP}: Auto Pause Time 3.5sec