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**20-MEMORY TONE/PULSE SWITCHABLE DIALER**
**GENERAL DESCRIPTION**

The WE9148 /A/B series are TONE/PULSE switchable telephone dialers with 19 repertory 16-digit memories for direct dialing and one 32-digit last-number-redial memory.

For PABX operation, PAUSE, P-T and FLASH keys are Implemented. Pause time is 3.5 sec, stackable and can be released by any key in auto-dialing. The P-T which will change the pulse mode into tone mode also provides 3.5 sec pause time, which is stackable and can be released by any key during the auto-dialing.

The chips work in wide operating voltage range (2.0-5.5V) and consume very low retention current ( $\leq 0.2\mu\text{A}$ ) at  $V_{DD} = 1.0\text{V}$  and  $\overline{\text{HKS}} = 1$ .

**FEATURES**

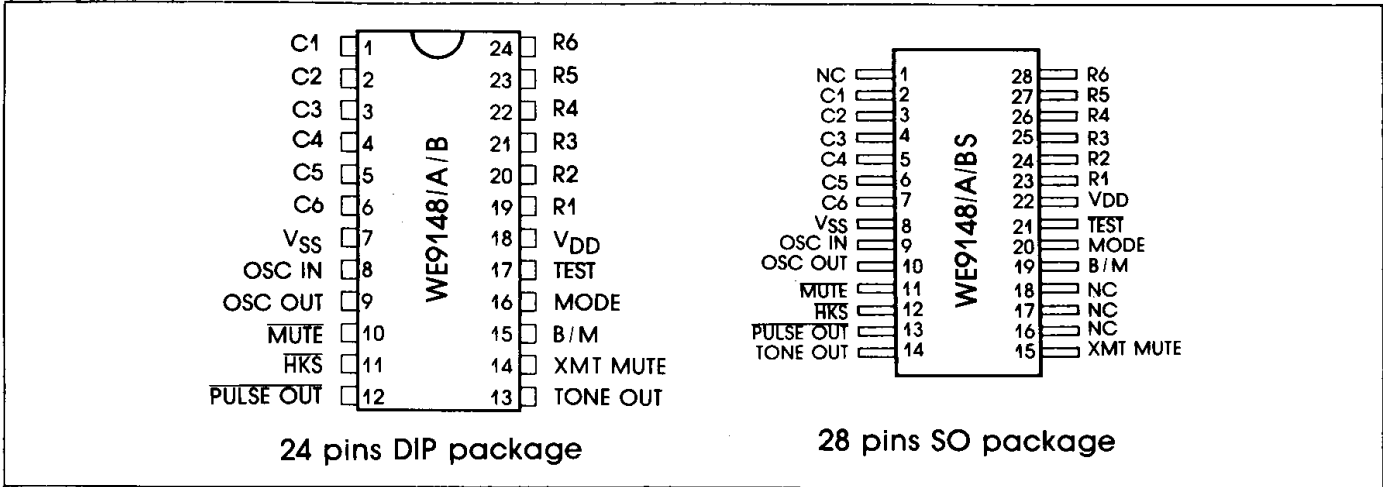
- Tone/pulse switchable.
- 19 repertory 16-digit memories for direct dialing.
- One 32-digit memory for the last number redial.
- Both key-in debounce and key-released debounce are 20ms.
- Minimum tone duration = 100ms for rapid key-in in normal dialing.
- PAUSE key for PABX operation; 3.5 sec per pause, stackable and can be released by any key during auto-dialing.
- P-T key for LDC operation, auto access 3.5 sec pause time per P-T in auto dialing.
- Mix-dialing is allowable, and the dialing length is unlimited.
- B/M is pin option to 3:2 or 2:1.
- Uses form A or 2 of 12 address keyboard.
- Electronic keypad input is available; active low.
- Low operating voltage, 2.0V for both tone and pulse mode.
- Memory retained on line; retention current  $\leq 0.2\mu\text{A}$ , at  $V_{DD} = 1.0\text{V}$  and  $\overline{\text{HKS}} = 1$ .
- Uses inexpensive 3.579545MHz T.V. color-burst crystal.
- 24 pins DIP, 28 pins SO package

Table 1

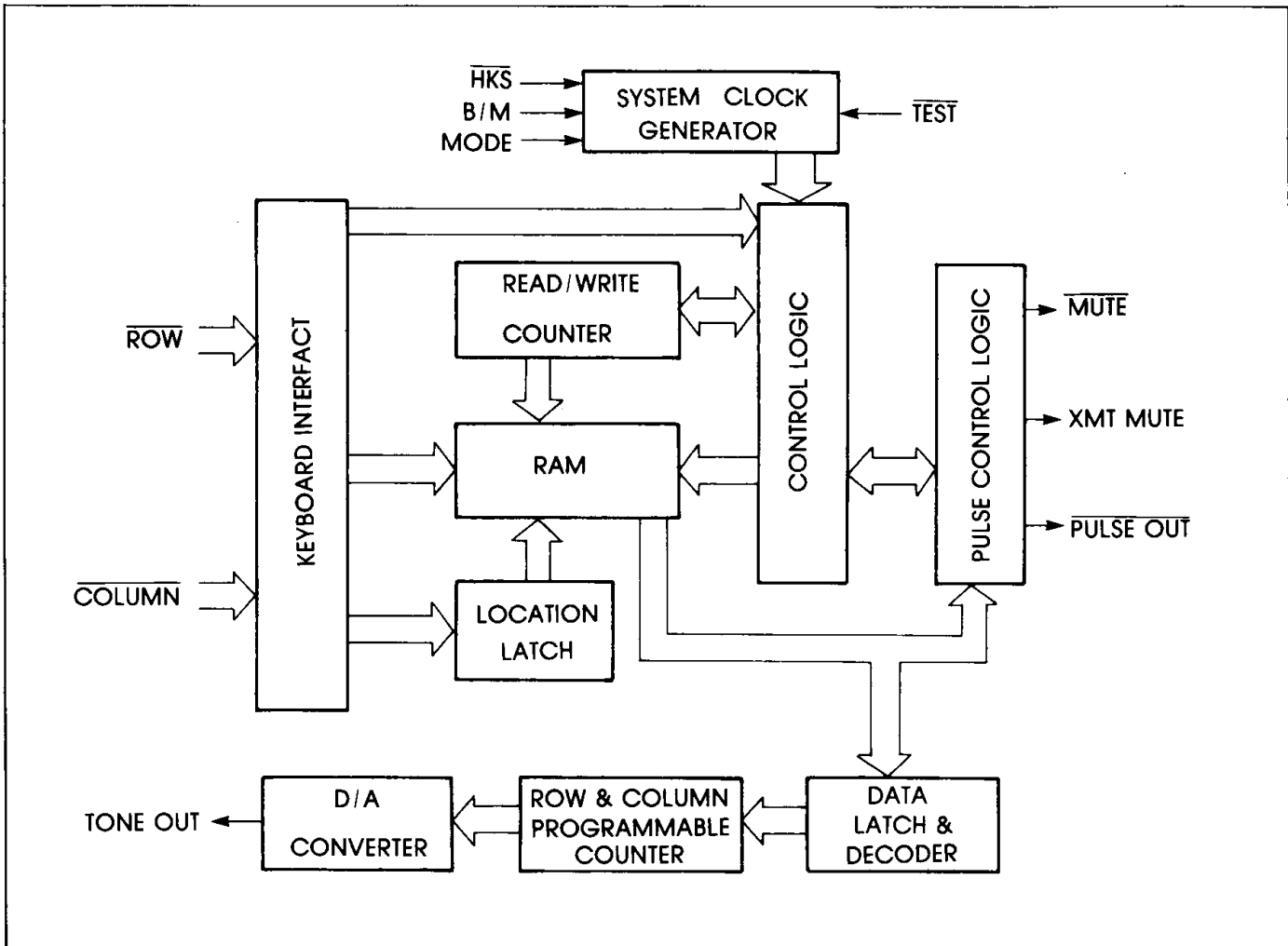
TYPE NO	DIFFERENCE OF CHARACTERISTICS
WE9148	DR = 10 PPS, FLASH = 600mS
**WE9148A	DR = 20 PPS, FLASH = 600mS
WE9148B	DR = 10 PPS, FLASH = 100mS

\*\* STOP PRODUCTION

## PIN CONFIGURATION



## BLOCK DIAGRAM



## KEYBOARD SCHEME

COL GROUP		C1	C2	C3	C4	C5	C6	
		1216HZ	1332HZ	1472HZ				
ROW GROUP	R1	699	1	2	3	P→T	M1	M2
	R2	766	4	5	6	P	M3	M4
	R3	848	7	8	9	F	M5	M6
	R4	948	*	0	#	R	M7	M8
	R5		S	M9	M10	M11	M12	M13
	R6		M14	M15	M16	M17	M18	M19

(Frequency = Hz)                      S : Store  
P→T: Pulse to Tone Switch        P : Pause  
F : Flash                                R : Redial

## PIN/FUNCTIONAL DESCRIPTION

## A. ROW-COLUMN:

The keypads inputs compatible with the standard 2 of 12 keyboard. The keypad debounce method will be acceptable only if it lasts longer than 20ms, and the next key-in will be unacceptable unless the key has been released longer than 20ms. In normal

operation, any single button is pushed to produce dual tone, pulses, or function. Activation of two or more buttons will result no response, except in test mode ( $\overline{\text{TEST}} = 0$ ). TABLE 2 illustrates the address keypads function in detail.

Table 2 ADDRESS KEYFADS TRUTH TABLE

		ACTIVE LOW INPUTS		OUTPUT TONE (PIN 13) PULSE (PIN 12)
		ROW PIN 19-24	COLUMN PIN 1-6	
TONE MODE (MODE=0)	NORMAL ( $\overline{\text{TEST}}=1$ )	One	One	Dual Tone
		Two or More	One	Pin 13=0
		One	Two or More	
		Two or More	Two or More	
	TEST ( $\overline{\text{TEST}}=0$ )	One	One	Dual Tone
		Two or More	One	Column Tone
		One	Two or More	Row Tone
		Two or More	Two or More	Pin 13=0

TONE/PULSE  
DIALER

		ACTIVE LOW INPUTS		OUTPUT TONE (PIN 13) PULSE (PIN 12)
		ROW PIN 19-24	COLUMN PIN 1-6	
PULSE MODE (MODE=1)	NORMAL (TEST=1)	One	One	10 PPS
		Two or More	One	PIN 12=1
		One	Two or More	
		Two or More	Two or More	
	TEST (TEST=0)	One	One	600 PPS
		Two or More	One	Pin 12=1
		One	Two or More	
		Two or More	Two or More	

Notes:

1. In Pulse mode, pin 12=1 for \*, # button.
2. In Pulse mode, always pin 13=0, in Tone mode always pin 12=1.

#### B. OSC IN, OSC OUT:

A built-in inverter provides oscillation with an 3.579545MHz T.V. color-burst crystal. It will be disable when there is no keypad entry.

#### C. MUTE

The mute output is a CMOS inverter that is pulled high normally, but pulled low in the transmitting period of dialing.

#### D. HKS

The HOOK SWITCH input is used to detect the state of handset. In ON-HOOK state the input must be pulled high in order to disable the dialing operation and decrease the consumption of power. When OFF-HOOK, the input must be pulled low.

#### E. PULSE OUT

This pin is an open-drain NMOS transistor output. In OFF-HOOK state, this transistor keeps in OFF-state normally, but goes into ON-state when breaking or flashing in

order to send pulse address codes or flash signal(See Figure 1).

#### F. TONE OUT

This pin is used to output DTMF address code. During pulse mode, it keeps in low state. In tone mode, it will output dual or single tone(See TABLE 2). In normal dialing, the tone duration depends on key-in duation. When keypad is pressed less than 100ms, the tone duration will be fixed to 100ms. In opposite, the tone duration will last as long as key is pressed. In auto-dialing, the tone duration and inter-tone-pause are internally set to 100ms and 106ms respectively. (See Figure 2-(a),(b).

#### G. XMT MUTE

This pin is a CMOS inveter output which will be pulled high only in tone duration, and keeps low in the other state. It can be used to mute the speech circuit in tone mode or control a LED to indicate the tone duration.

**H. B/M**

In pulse mode, when B/M = HIGH the BREAK/MAKE ratio is 3:2, and B/M=LOW the BREAK/MAKE ratio is 2:1.

**I. MODE**

The input state of this pin will set the initial operation mode, high for pulse mode, low for tone mode. Note: The P- T key can change the operating mode into tone mode, after that if we want to reset the operating mode to pulse mode, the only way is ON-HOOK and let MODE=HIGH.

**J. TEST**

In normal operation, this pin always pulled high. When it is pulled LOW, this chip is set in testing mode(See TABLE 2).

**KEYBOARD OPERATIONS**

Note: 1. All the keyboard operations should be under OFF-HOOK condition.

2. D1-Dn: 0-9, \*, #

**A. NORMAL DIALING**

$\boxed{D1}$ ,  $\boxed{D2}$  ,...,  $\boxed{Dn}$

**B. REDIALING**

After normal dialing,  $Dn < 33$ ; if busy, after ON-HOOK, Come OFF-HOOK, push  $\boxed{R}$  the last number will be dialed out automatically.

**C. STORE**

a.  $\boxed{D1}$ ,  $\boxed{D2}$  ,...,  $\boxed{Dn}$ ,  $\boxed{S}$ ,  $\boxed{Ln}$ ;  $\boxed{Ln}$ : memory location.

Note: 1. First,  $\boxed{D1}$ ,  $\boxed{D2}$  ,...,  $\boxed{Dn}$  will be dialed out and also stored in location Ln.

2. If you dial wrong number, then you can clear it and store it again as following sequence:

$\boxed{D1}$ ,  $\boxed{D2}$  ,...,  $\boxed{Dn}$ ,  $\boxed{S}$ ,  $\boxed{D1'}$ ,  $\boxed{D2'}$  ,...,  $\boxed{Dn'}$ ,  $\boxed{S}$ ,  $\boxed{Ln}$  Then  $\boxed{D1}$ ,  $D2$ , ...  $Dn'$  will be stored in location Ln instead of  $D1$ ,  $D2$ , ...,  $Dn$ .

b.  $\boxed{S}$ ,  $\boxed{D1}$ ,  $\boxed{D2}$  ,...,  $\boxed{Dn}$ ,  $\boxed{Ln}$

Then,  $D1$ ,  $D2$ , ...  $Dn$  will be stored in location Ln but not dialed out.

**D. DIRECT DIALING**

After the number had been stored in location Ln, then push  $\boxed{Ln}$ , the number will be dialed out automatically as selected mode.

**E. MIX-DIALING**

The following methods are allowable.

a.  $\boxed{D1}$ ,  $\boxed{D2}$  ,...,  $\boxed{Dn}$  +  $\boxed{Ln}$

b.  $\boxed{Ln}$  +  $\boxed{D1}$ ,  $\boxed{D2}$  ,...,  $\boxed{Dn}$

c.  $\boxed{R}$  +  $\boxed{D1}$ ,  $\boxed{D2}$  ,...,  $\boxed{Dn}$

d.  $\boxed{Lm}$  +  $\boxed{Ln}$

e.  $\boxed{R}$  +  $\boxed{Ln}$

Note: 1. The total dialing length is unlimited.

2. "+" means P, P-T, or none key entry.

3. The second sequence should not be operated until the first is dialed out completely.

4.  $\boxed{Lm}$ ,  $\boxed{Ln}$  will not be stored in redial memory.

**F. PAUSE AND PULSE TO TONE KEYS OPERATION**

In PABX or LDC service, both Pulse and Tone operation should inserted in dialing sequence and different dialing mode. Only in Redial, Pause and Pulse to Tone opera-

### TIMING WAVEFORM

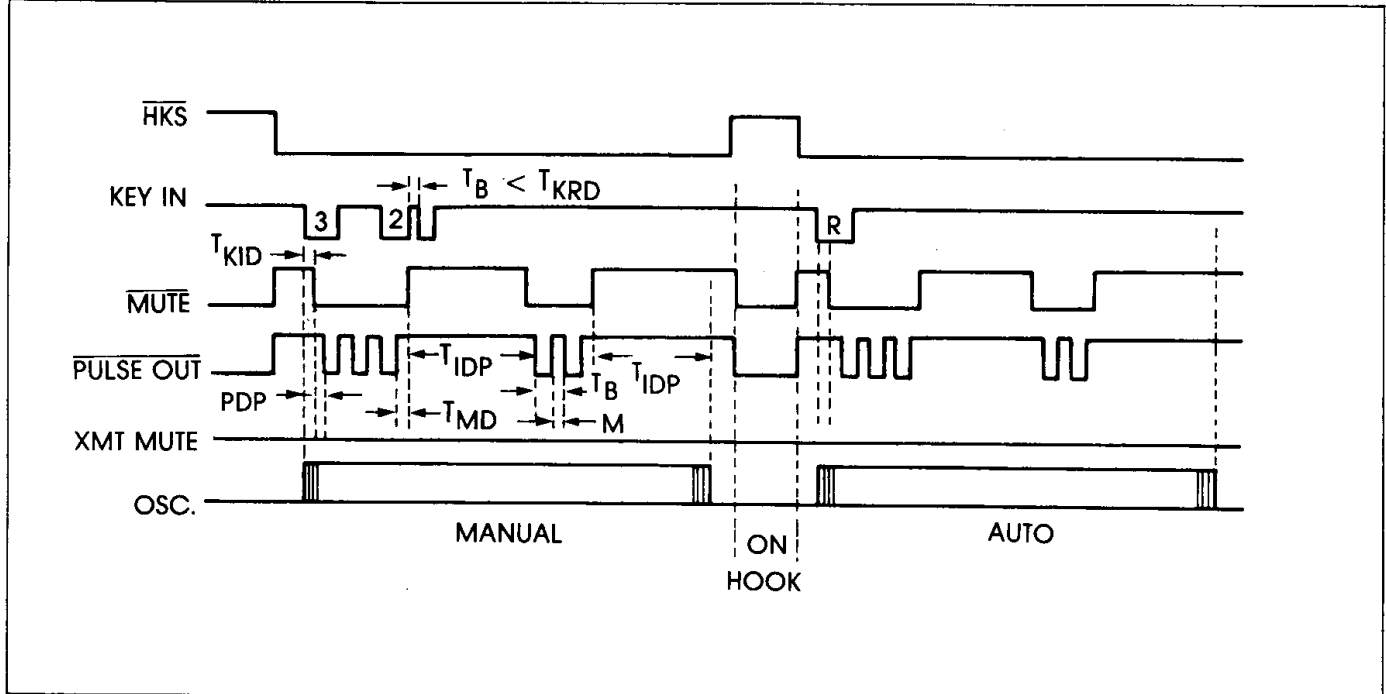


Figure 1. Pulse Mode Timing Diagram

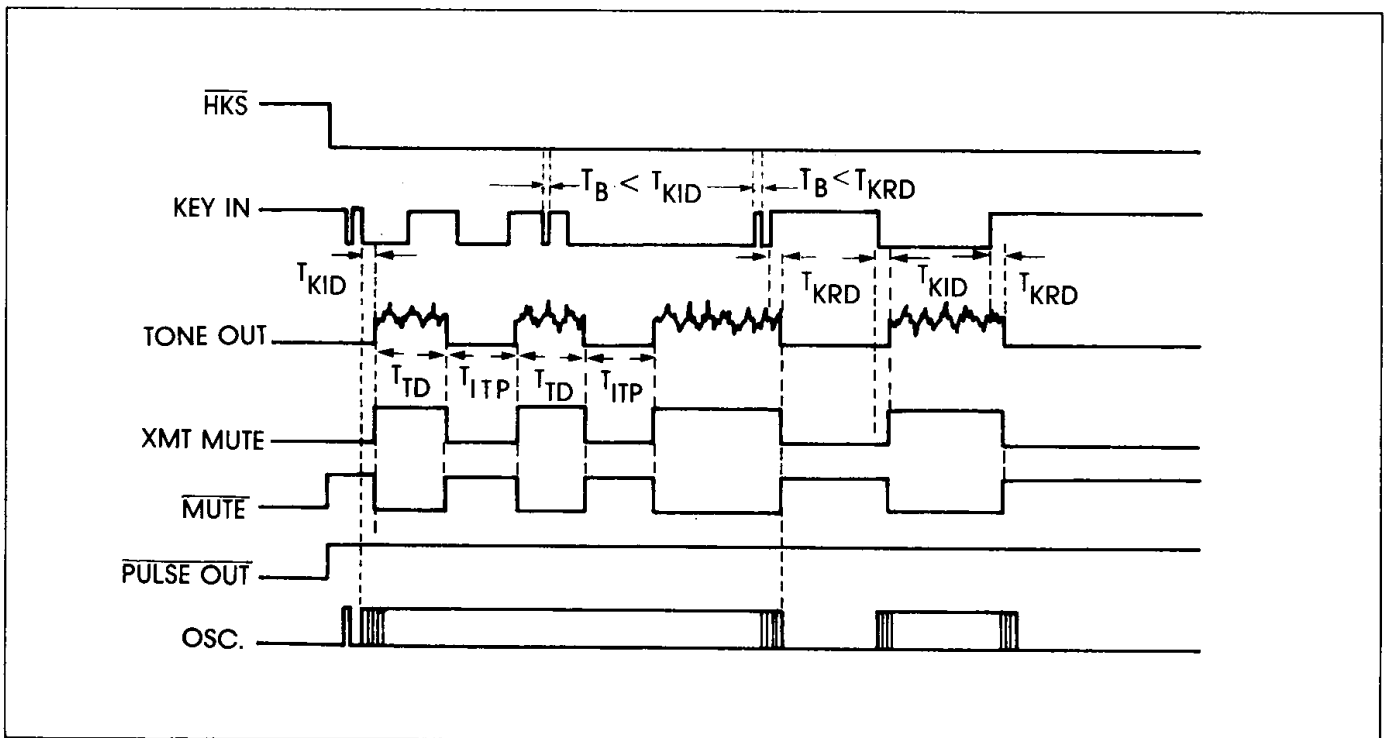


Figure 2 (a). Tone Mode Normal Dialing Timing Diagram

(Continued)

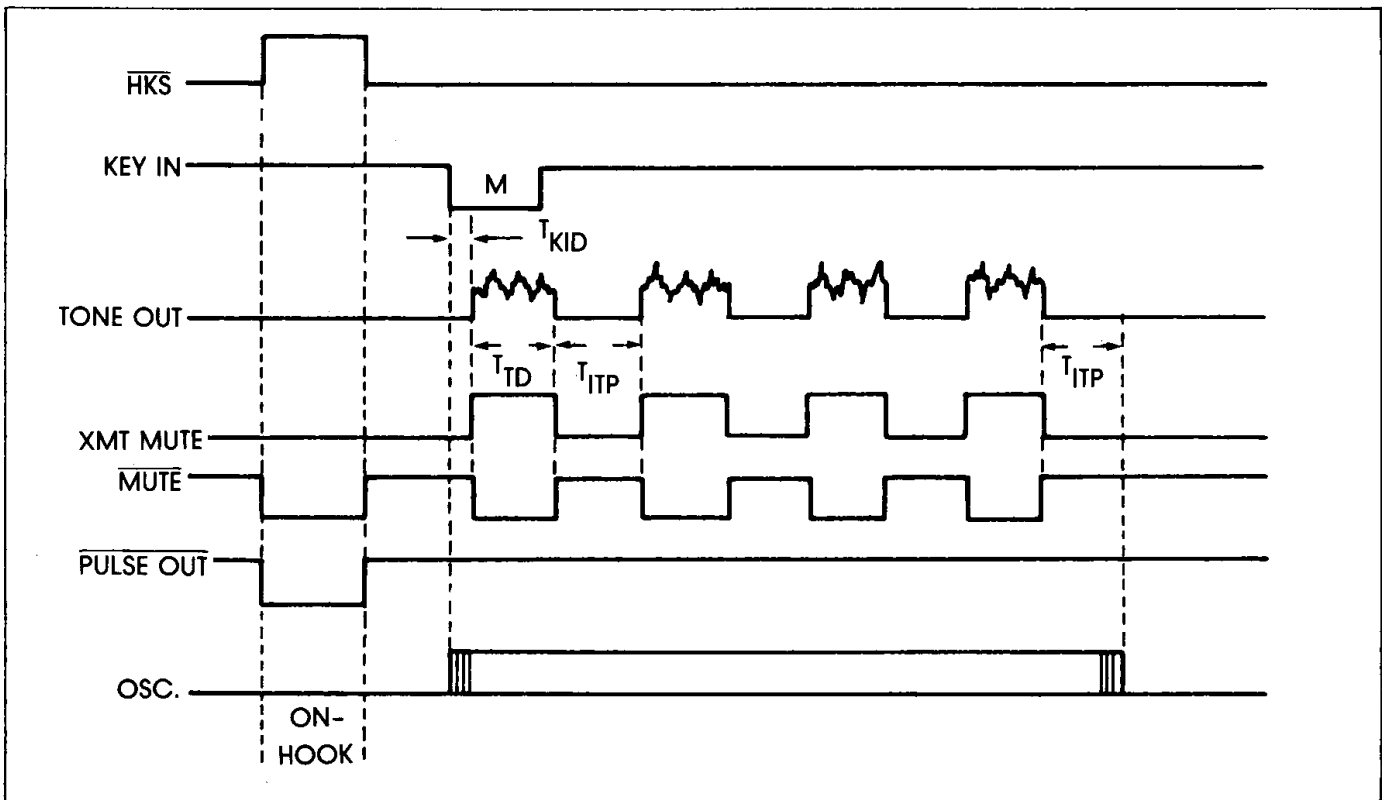


Figure 2 (b). Tone Mode Redialing Timing Diagram

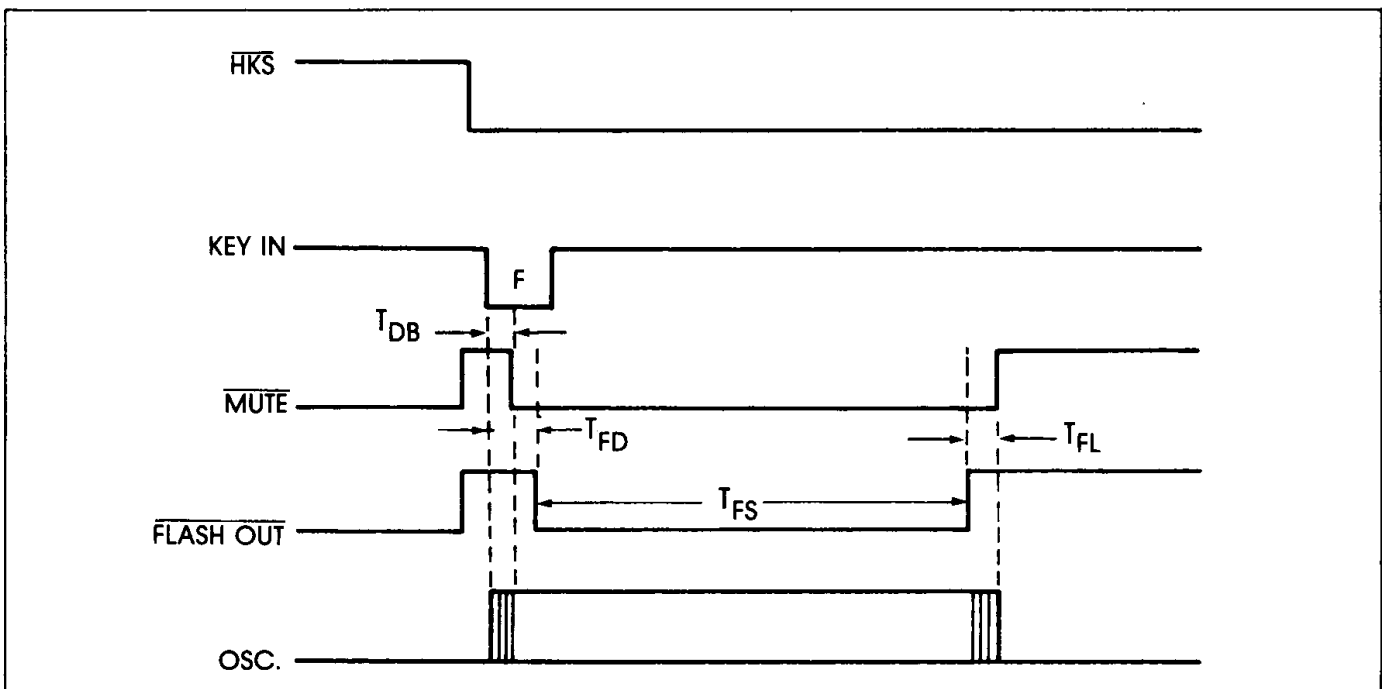


Figure 3. Flash Timing Diagram

TONE/PULSE  
DIALER

tion will auto insert 3.5 sec pause time.

a. Dialing with Pause

Select Pulse or Tone mode. Push **[D1]**, **[P]**, **[D2]**, ..., **[Dn]**; D1-Dn: 0-9, \*, #. Then the number will be dialed out as following sequence: D1, D2, ..., Dn; without pause.

b. Redialing with Pause

In Redial operation, the signal will be dialed out automatically as following sequence: D1, pause 3.5 sec., D2, ..., Dn.

c. Dialing with P-T key

Push **[D1]**, **[D2]**, ..., **[Dn]**, **[P-T]**, **[D1']**, **[D2']**, ..., **[Dn']**

1. If the switch is in pulse mode, then output D1, D2, ..., Dn, (Pulse mode) D1', D2', ..., Dn'; without pause (Tone mode)

2. If the mode switch is set in Tone mode, then the output signal will be: D1, D2, ..., Dn, D1', D2', ..., Dn'; without pause (Pulse mode)

d. Redialing with P-T key

After above operation, but busy, the execute redial operation the signal will be dialed out automatically as same sequence of dialing with Pulse to Tone key, but has a 3.5 sec pause during changing mode.

e. Direct Dialing with Pause and P-T key  
If pause or P-T key is stored in memory, then the signal will be dialed out automatically as the same sequence as (b), (d).

**G. FLASH OPERAITON**

This chip provides a convenient and precise flash function for PABX service. The operation is: Push **[F]**, then auto flash is supplied, and central unit will do service to caller, such as : transfer, wait .... The timing diagram of FLASH is shown in Figure 3.

**ABSOLUTE MAXIMUM RATINGS**

PARAMETER	SYM	RATING	UNIT
DC Supply Voltage	V <sub>DD</sub>	6.0	V
Input Voltage Range	V <sub>IN</sub>	-0.5 ~ V <sub>DD</sub> +0.5	V
Power Dissipation Per Package	P <sub>D</sub>	500 (for T <sub>A</sub> = -25 ~ +60°C)	mW
Operating Temperature	T <sub>A</sub>	-25 ~ +85	°C
Storage Temperature	T <sub>STG</sub>	-65 ~ +150	°C



**D.C. CHARACTERISTICS**(V<sub>DD</sub>=2.5V, T<sub>A</sub>=25°C, unless otherwise noted)

PARAMETER	SYM.	TEST CKT.	TEST CONDITIONS	LIMIT			UNIT
				MIN	TYP	MAX	
Operating Voltage	V <sub>DD</sub>		Tone/Pulse	2.0	—	5.5	V
			Memory	1.0	—	5.5	
Operating Current	I <sub>OP</sub>	A	Keypad Entry and All output Unload	Tone	—	1.0	mA
				Pulse	—	0.5	
Standby Current	I <sub>S</sub>	A	No keypad Entry, and All Output Unload	—	0.1	5	μA
Memory Retention Current	I <sub>MR</sub>	A	HKS=1, V <sub>DD</sub> =1.0V	—	0.01	0.2	μA
Tone Output	V <sub>TO</sub>	C	Row Group, R <sub>L</sub> =10Kohm	120	150	180	mV
Pre-Empasis		D	Column Group Row Group	1	2	3	dB
DTMF Distortion	T <sub>HD</sub>	D	R <sub>L</sub> =10KΩ, Note 2	—	-35	-23	dB
Tone Output Load Impedance	R <sub>L</sub>		THD ≤ -23dB	10	—	—	KΩ
Tone Output DC Level	V <sub>TDC</sub>	D	Keypad Entry, V <sub>DD</sub> = 2.0-5.5V	0.5	—	0.6	V <sub>DD</sub>
Tone Output Sink Current	I <sub>TL</sub>	E	No Keypad Entry V <sub>TO</sub> =0.5V	0.2	—	—	mA
Pulse Output Current	Leakage	I <sub>PH</sub>	E	V <sub>PI</sub> =5.0V	—	0.1	μA
				V <sub>PI</sub> =12.0V	—	1.0	
	Sink	I <sub>PL</sub>	F	V <sub>PO</sub> =0.5V	1.0	—	mA
Mute Output Current	Drive	I <sub>MH</sub>	E	V <sub>MO</sub> =2.0V	0.5	—	mA
	Sink	I <sub>HL</sub>		V <sub>MO</sub> =0.5V	2.0	—	
XMT Mute Output Current	Dirve	I <sub>XMH</sub>	E	V <sub>XMO</sub> =2.0V	0.5	—	mA
	Sink	I <sub>XML</sub>		V <sub>XMO</sub> =0.5V	0.5	—	
Keypad Input	Drive	I <sub>KH</sub>	G	V <sub>KI</sub> =0V	4	10	μA
	Sink	I <sub>KL</sub>	E.H	V <sub>KI</sub> =2.5V	200	400	
Input Voltage	Low	V <sub>IL</sub>		Pin: 1-6, 11, 15, 16, 17, 19-24	V <sub>SS</sub>	—	V <sub>DD</sub>
	High	V <sub>IH</sub>			0.7	—	
Control Pin Input Leakage Current	I <sub>H</sub>		Pin: 11, 15, 16, 17	—	±10 <sup>-5</sup>	+0.1	μA

### A.C. CHARACTERISTICS

PARAMETER	SYM	TEST CKT	TEST CONDITIONS	LIMIT			UNIT	
				MIN	TYP	MAX		
Key-in Debounce	T <sub>KID</sub>		$\overline{\text{TEST}} = 1$	—	20	—	mS	
Key-released Debounce	T <sub>KRD</sub>		$\overline{\text{TEST}} = 1$	—	20	—	mS	
Pulse Mute Delay	T <sub>MD</sub>		$\overline{\text{TEST}} = 1$	B/M=1	—	40	—	mS
				B/M=0	—	33.3	—	
Pre-Digit Pause	T <sub>PDP</sub>		$\overline{\text{TEST}} = 1$	B/M=1	—	40	—	mS
				B/M=0	—	33.3	—	
Break/Make Ratio	B:M			B/M=1	—	60:40	—	%
				B/M=0	—	66.6/ 33.3	—	
Inter-Digit Pause	T <sub>IDP</sub>		$\overline{\text{TEST}} = 1$	—	800	—	mS	
			$\overline{\text{TEST}} = 0$	—	13.6	—		
Pulse Rate			WE9148/B	$\overline{\text{TEST}} = 1$	—	10	—	PPS
				$\overline{\text{TEST}} = 0$	—	600	—	
			WE9148A	$\overline{\text{TEST}} = 1$	—	20	—	
				$\overline{\text{TEST}} = 0$	—	1200	—	
Flash Time	T <sub>FS</sub>		WE9148/A WE9148 B	—	600 100	—	mS	
Flash Delay	T <sub>FD</sub>			—	20	—	mS	
Flash Lead	T <sub>FL</sub>			—	20	—	mS	
Tone Duration	T <sub>TD</sub>			100	—	—	mS	
Inter Tone Pause	T <sub>IDP</sub>			—	106	—	mS	
OSC Start-up	T <sub>ST</sub>			—	5	10	mS	
Row Group Frequency	F1	C	Note 1	697	699	701	Hz	
	F2			764	766	768		
	F3			846	848	850		
	F4			946	948	950		
Column Group Frequency	F5	C	Note 1	1213	1216	1219	Hz	
	F6			1329	1332	1335		
	F7			1469	1472	1475		

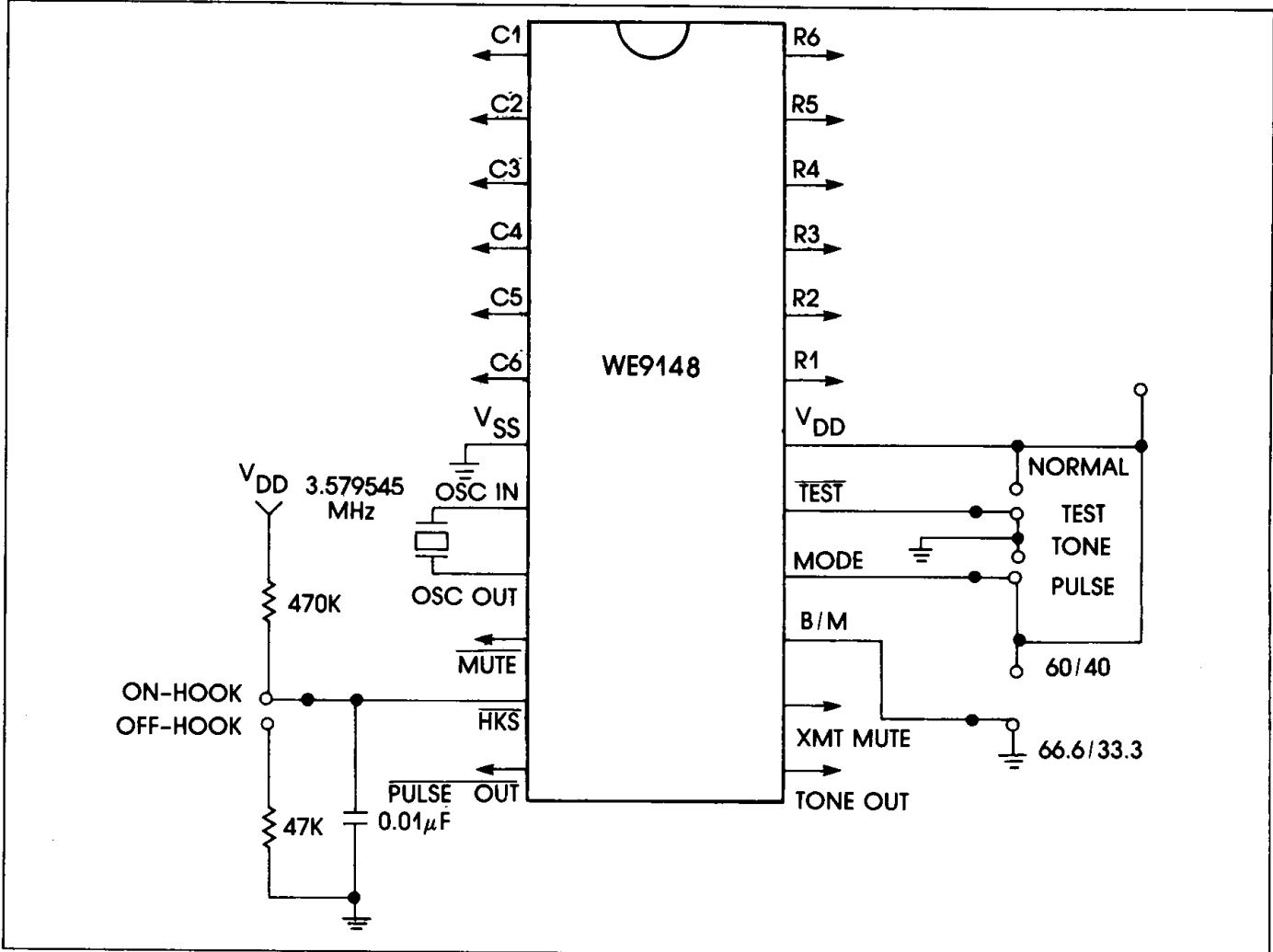
Notes:

- Crystal parameters defined as  $R_S \leq 100\Omega$ ,  $L_m = 96\text{mH}$ ,  $C_m = 0.25\text{pF}$ ,  $C_h = 5\text{PF}$ ,  $f = 3.579545\text{MHz}$  &  $C_L = 18\text{PF}$ ,  $\Delta f \leq \pm 200\text{PPM}$ .
- Dual Tone multi-frequency distortion is measured in terms of total out-of-band power related to sum of row and column fundamental power.

**COMPARISON OF SPECIFIED VS. ACTUAL TONE FREQUENCIES**

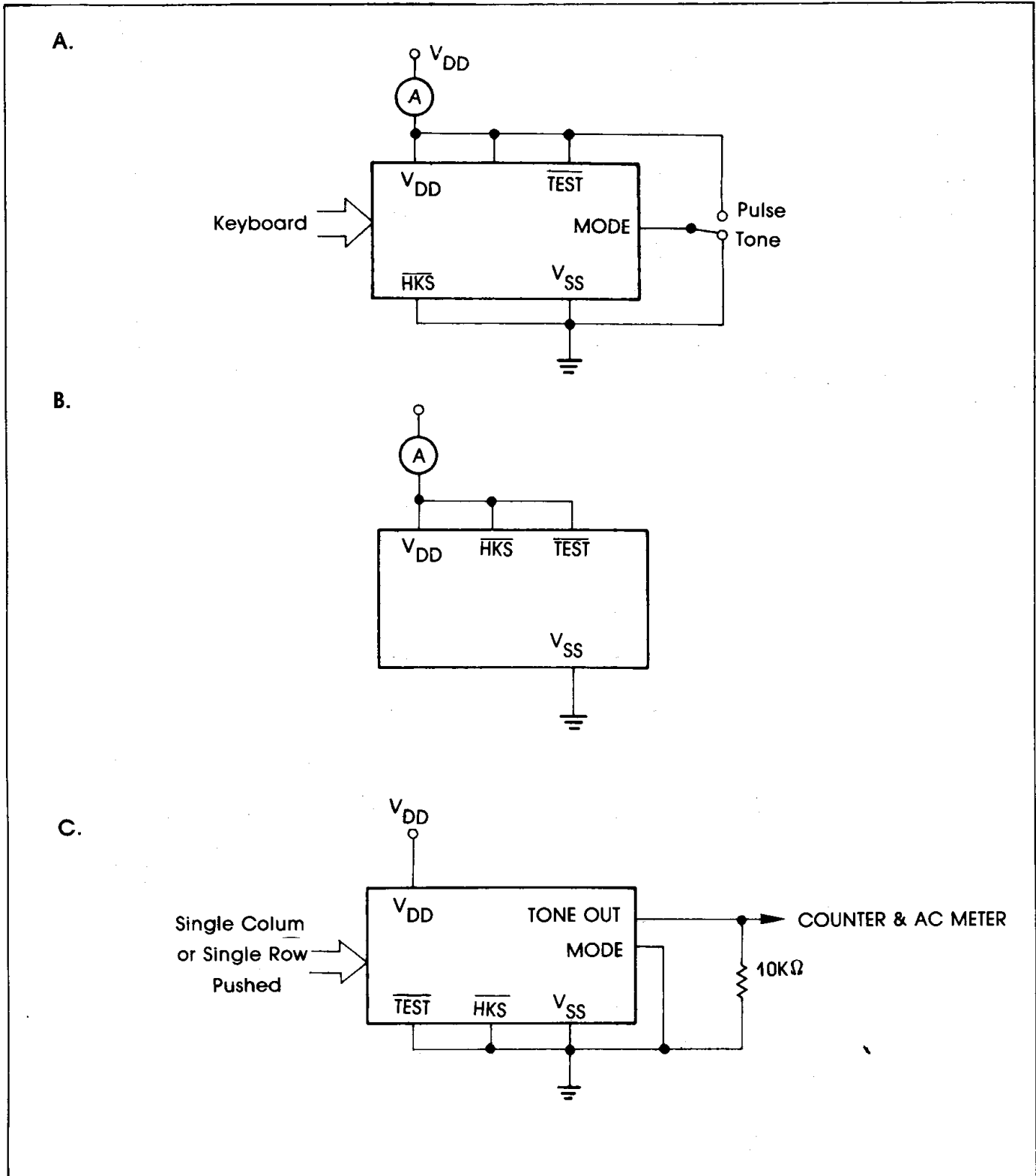
ACTIVE INPUT	OUTPUT FREQUENCY Hz		ERROR %
	SPECIFIED	ACTUAL	
ROW 1	697	699	+0.29
ROW 2	770	766	-0.52
ROW 3	852	848	-0.47
ROW 4	941	948	+0.74
COLUMN 1	1209	1216	+0.58
COLUMN 2	1339	1332	-0.52
COLUMN 3	1477	1472	-0.34

**GENERAL TEST CIRCUIT**



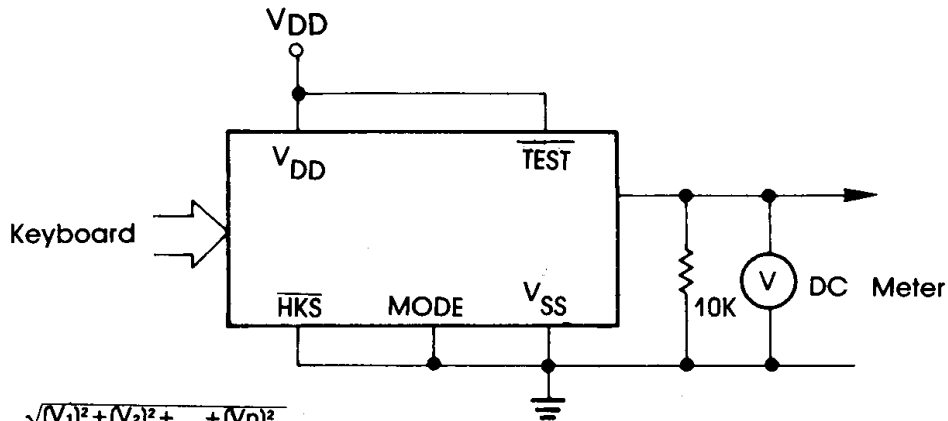
TONE/PULSE  
DIALER

## TEST CIRCUIT



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D.



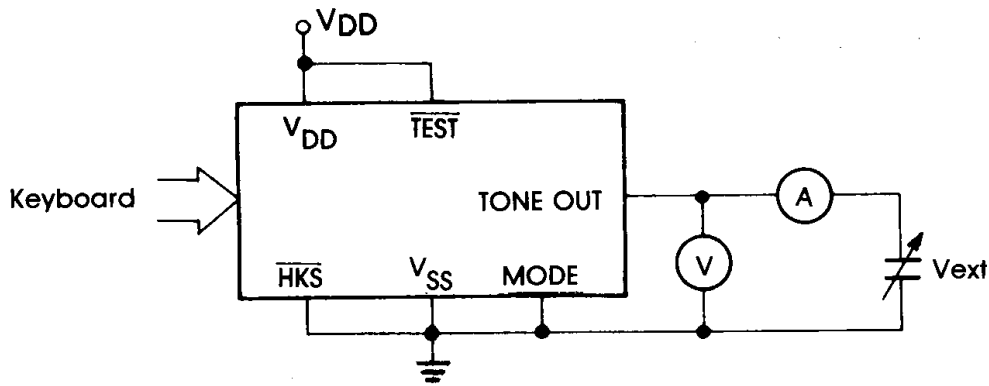
$$\text{DISTdb} = 20 \log \frac{\sqrt{(V_1)^2 + (V_2)^2 + \dots + (V_n)^2}}{\sqrt{(V_L)^2 + (V_H)^2}}$$

V<sub>1</sub>, ..., V<sub>n</sub> are extraneous frequency (ie intermodulation and harmonic) components in the 500 Hz to 3400 Hz band.

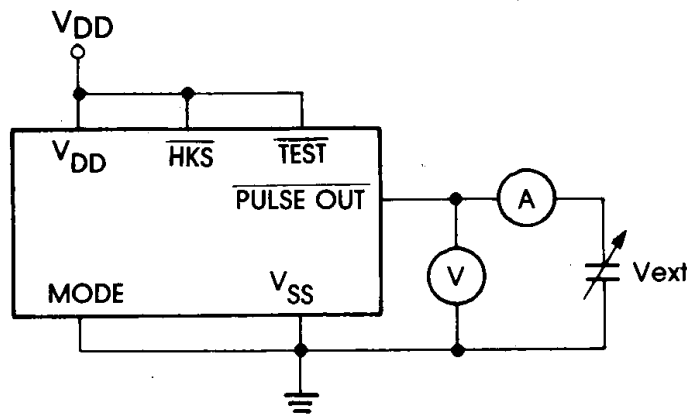
\*V<sub>L</sub>, V<sub>H</sub> are the individual frequency components of the DTMF signal.

Note: Whether keyboard is pushed refer to the DTMF mode timing diagram.

E.



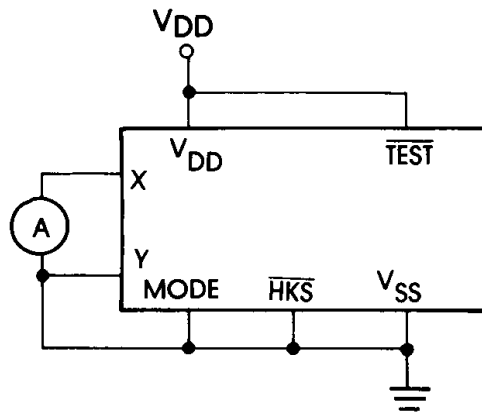
F.



TONE/PULSE  
DIALER

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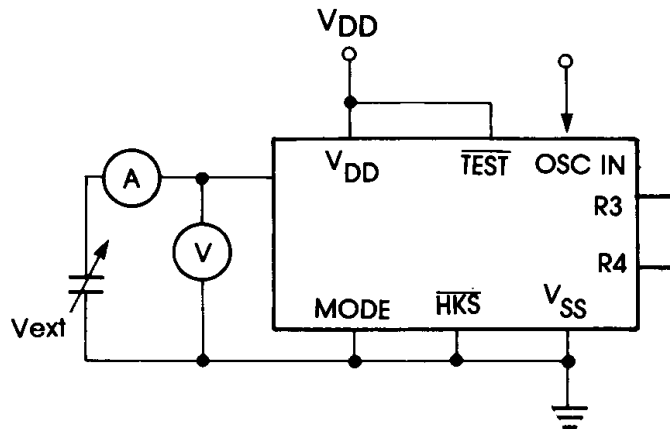
G.



Notes:

1. When column drive current is tested, the X is column and Y is row. When row drive current is tested, they are changed.
2.  $I_{Drive} = I / \text{Duty Cycle}$ ; I is the net DC current measured Drive from ampere meter.

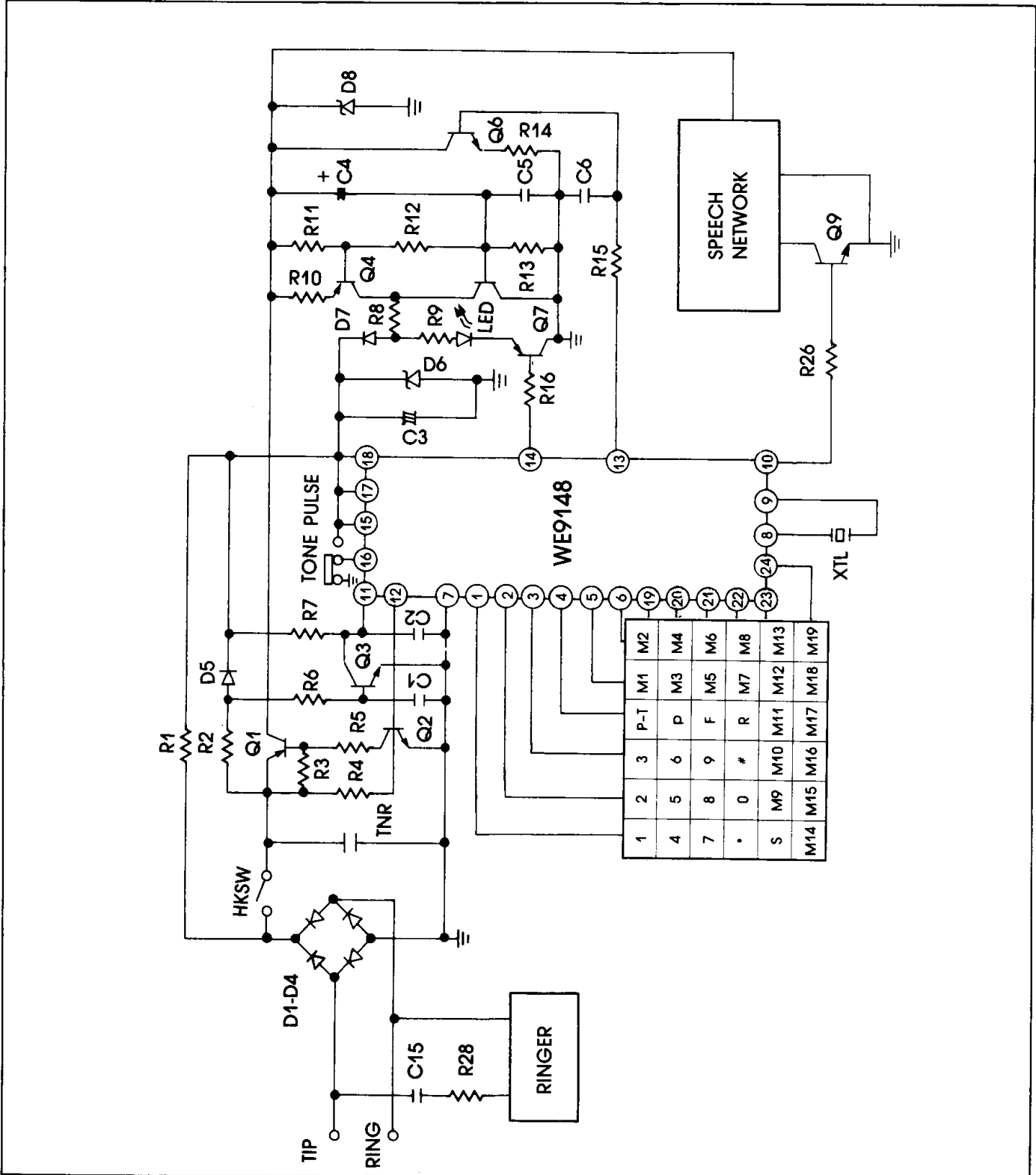
H.



Notes:

1. First, provide clocks until output changes to low.
2. Measure its current.

APPLICATION CIRCUIT DIAGRAM



TONE/PULSE  
DIALER

R1	20M $\Omega$	R15	2.2K $\Omega$	C3	100 $\mu$ F/10V
R2	220K $\Omega$	R16	4.7K $\Omega$	C4	2.2 $\mu$ F/16V
R3	33K $\Omega$	R26	33K $\Omega$	C5	0.01 $\mu$ F
R4	200K $\Omega$	R28	2.2K $\Omega$	C6	0.33 $\mu$ F
R5	4.7K $\Omega$	Q1	2SB647	C15	1 $\mu$ F/250V
R6	330K $\Omega$	Q2	2N5551	D1	1N4002
R7	470K $\Omega$	Q3	2N9014	D2	1N4002
R8	100 $\Omega$	Q4	2N9015	D3	1N4002
R9	240K $\Omega$	Q5	2N9015	D4	1N4002
R10	10 $\Omega$	Q6	2SD667	D5	1N4148
R11	1.5K $\Omega$	Q7	2N9015	D6	1N4731
R12	1.2K $\Omega$	Q9	2N9014	D7	1N4148
R13	4.7K $\Omega$	C1	0.1 $\mu$ F	D8	1N4744
R14	68 $\Omega$	C2	0.1 $\mu$ F	TNR	TNR820K9
				XTL	3.579545MHz