

*UM91314 Series

PRELIMINARY

13 Memory Tone/Pulse Dialer

Features

- Tone/Pulse switchable
- 16/18/20 Pin packages (Pin compatible to UM91214/215)
- 32-digit redial memory
- 3 emergency memory banks (16 digits each)
- 10 indirect memory banks (16 digits each)
- Friendly Memory Storage/Dialing
- Chain dialing allowed
- Flash, Pause, P -> T can be saved as a digit in memory
- Hands-Free control function (C & D version)
- Uses inexpensive ceramic resonator (3.58 MHz)
- Key release debouncing
- Power up reset circuit provided
- 32-step synthetic tone output for low DTMF output harmonic distortion

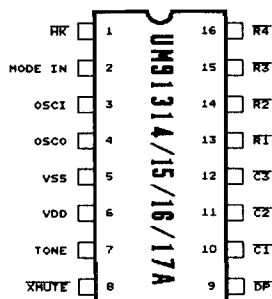
General Description

The UM91314 Series are single-chip silicon gate COMS integrated circuits with on-chip oscillators to be used with a 3.58 MHz crystal or ceramic resonator. It provides dialing pulse (DP) or dual tone multi-frequency (DTMF) dialing. A 19-key (5x4-1) matrix keyboard is used for either DP or DTMF mode. In on-chip RAM, up to 32 digits can

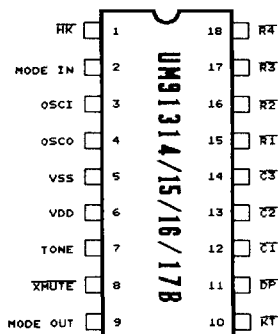
be saved for redialing, and up to 16 digits can be saved for 3 direct emergency and 10 indirect dialing memory banks. In DTMF mode, a small minimum tone duration and minimum inter tone pause allows rapid dialing. Maximum tone duration depends on the key depression time in manual dialing.

Pin Configurations

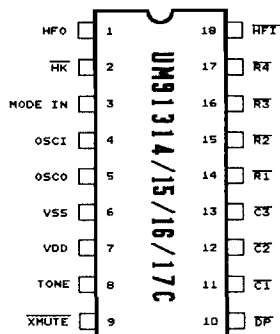
a. 16-Pin Package



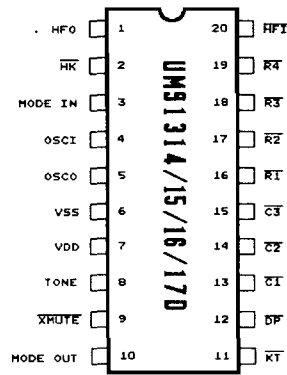
b. 18-Pin Package
(i) Key tone output



(ii) Hands-Free control



c. 20-Pin Package

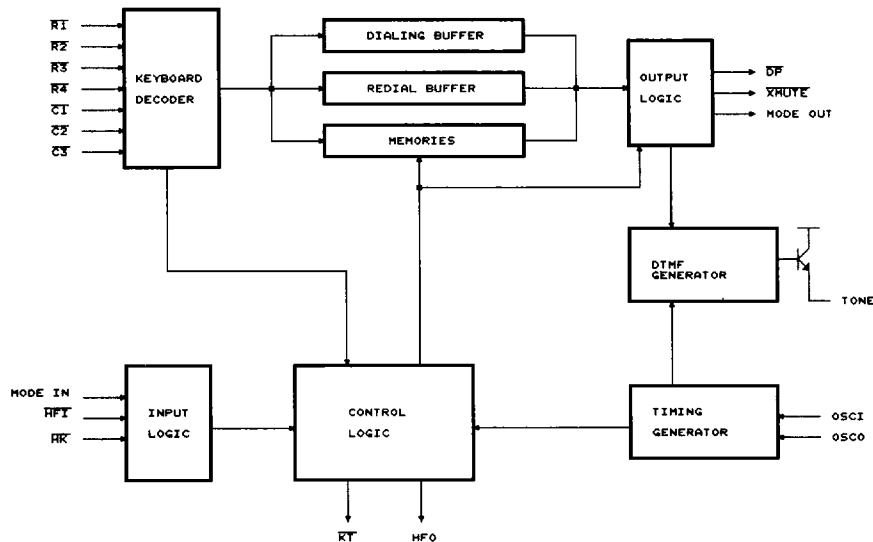


* Patents Pending

Keyboard Assignments

$\overline{R1}$	1	2	3	ST
$\overline{R2}$	4	5	6	A/L
$\overline{R3}$	7	8	9	F
$\overline{R4}$	*/T	0	#	R/P
VDD	M1	M2	M3	
	$\overline{C1}$	$\overline{C2}$	$\overline{C3}$	VSS

1. */T -- In pulse mode, this key functions as a pulse \rightarrow DTMF (P \rightarrow T) key; in DTMF Mode, it functions as a * key.
2. # -- In pulse mode, this key's input is ignored; in DTMF mode, this key functions as a # key.
3. Mn -- One-touch memory key
4. ST -- Storage key
5. A/L -- Auto/Location key
6. F -- Flash key (Flash time: 96ms, 297ms, 640ms, - see ordering information)
7. R/P -- Redial/Pause key
8. See Application Circuit for usage of VDD and VSS

Block Diagram




Absolute Maximum Ratings*

Supply Voltage (VDD) -0.3V to +6.0V
 Input Voltage (V_{in}) VSS -0.3V to VDD +0.3V
 Output Voltage (V_{out}) VSS -0.3V to VDD +0.3V
 Output Voltage (V_{out}) (\overline{DP} , \overline{XMUTE}) <1.2V
 Tone Output Current (I_{TONE}) <50 mA
 Power Dissipation (P_d) <500 mW
 Operating Temperature (Top) -20°C to +70°C
 Storage Temperature (Tstg) -40°C to +125°C

***Comments**

Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only. Functional operation of this device at these or any other conditions above those indicated in the operational sections of this specification is not implied and exposure to absolute maximum rating conditions for extended periods may affect device reliability.

DC Electrical Characteristics (VDD = 2.5V, VSS = 0V, Fosc=3.579MHz, Top=25 °C, unless otherwise specified.)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Test CKT.	
Operating Voltage	VDD	2.0		5.5	V	Pulse mode	A	
		2.0		5.5		Tone mode		
Memory Retention Voltage	VMR	0.8			V		-	
Memory Retention Current	IMR			0.5	μ A	VDD = 1.0V, \overline{HK} = VDD All outputs unloaded	-	
Operation Current	IDDP			1.0	mA	Pulse mode	All outputs unloaded	A
	IDDT			2.0		Tone mode		
Standby Current	ISC		0.3	0.5	μ A	\overline{HK} = VDD = 1.5V	All outputs unloaded, no key selected	
				20		\overline{HK} = VSS		
Input Voltage	V _{IH}	0.8		1	VDD	-		
	V _{IL}	0		0.2				
$\overline{R1}$ - $\overline{R4}$ Input Current	IR		16		μ A		C	
Tone out Voltage	Voc	580	725	870	mVp,p	Column	VDD = 2.5V RL = 5K	D
	VOR	547	545	654		Row		

DC Electrical Characteristics (continued)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Test CKT.
HFI Pull Low Current	IHFI		2.4		μA	VDD = 2.5V HFI pin connected to 0V	
HFO Drive Current	IOH1	0.25	0.85		mA	VDD = 2.5V VoH = VDD - 0.4V	B
HFO, \overline{KT} MODEOUT XMUTE Sink Current	IOL1	0.8	2.5		mA	VDD = 2.5V VoL = 0.4V	B
\overline{DP} Sink Current	IOL2	0.8	2.2		mA	VDD = 2.5V VoL = 0.4V	B
Distortion	DIS%		1	5	%	* Note 1	

Note 1:
$$DIS\% = \frac{100 * (V_1^2 + V_2^2 + \dots + V_n^2)^{\frac{1}{2}}}{(V_{IL}^2 + V_{IH}^2)^{\frac{1}{2}}}$$

- a. V1 . . . Vn are the intermodulation or the harmonic frequencies in the 500 Hz to 3400 Hz band.
- b. VIL and VIH are the individual frequency components of the DTMF signal.

AC Characteristics (VDD = 2.5V, VSS = 0V, Fosc = 3.579 MHz, Top = 25°C, unless otherwise specified.)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	
Make Time	TM		33.3		ms	10 pps	M/B = 1/2
			40.0				M/B = 2/3
			16.7			20 pps	M/B = 1/2
			20.0				M/B = 2/3
Break Time	TB		66.6		ms	10 pps	M/B = 1/2
			60.0				M/B = 2/3
			33.3			20 pps	M/B = 1/2
			30.0				M/B = 2/3
Inter Digit Pause Time	TIDP		824		ms	10 pps	
			458			20 pps	
Pause Time	TPAU		2.2		sec		



AC Characteristics (continued)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Key Valid to Signal Out Delay	Td		2		ms	
Pick-Up Pause	THK		824		ms	
Key-in Debounce	Tkd		22		ms	
Key-release Debounce	Trd		24		ms	
Key-in Tone Duration	TKTD		27		ms	
Key-in Tone Frequency	FKT		437		Hz	
Minimum Tone Duration	TMFD		94		ms	
Min. Tone Inter-digit Pause	TIDP		96		ms	
Redial Tone Duration	TRFDR		94		ms	
Redial Tone Inter-digit Duration	TTIDPR		96		ms	
Memory Tone Duration	TRFDM		94		ms	
Memory Tone Inter-digit Duration	TTODPM		96		ms	

Comparisons of Specified vs. Actual Tone Frequencies

R/C	Spec.	Actual	Error (%)	Unit	Conditions
R1	697	699.2	+0.32	Hz	Fosc = 3.579 MHz
R2	770	766.3	-0.48	Hz	
R3	852	847.5	-0.53	Hz	
R4	941	948.1	+0.74	Hz	
C1	1,209	1,216.0	+0.58	Hz	
C2	1,336	1,331.8	-0.31	Hz	
C3	1,477	1,472.0	-0.34	Hz	

Pin Descriptions

Pin No.				Designation	I/O	Description																																
UM9131XA	UM9131XB	UM9131XC	UM9131XD																																			
1	1	2	2	HK	I	Hook switch input This inverter input pin detects the state of the hook switch contact. "Off Hook" is represented by a VSS condition. "On Hook" is represented by a VDD condition																																
2	2	3	3	MODE IN	I, Z	Tri-State mode select pin The following four versions of the UM91314/15/16/17 Series are given below: a. UM91315/16/17 Series <table border="1"> <thead> <tr> <th>MODE IN</th> <th>Tone/Pulse</th> <th>Dial Rate</th> <th>M/B Ratio</th> </tr> </thead> <tbody> <tr> <td>VDD</td> <td>Pulse</td> <td>10pps</td> <td>2/3</td> </tr> <tr> <td>VSS</td> <td>Tone</td> <td>—</td> <td>—</td> </tr> <tr> <td>Floating</td> <td>Pulse</td> <td>10pps</td> <td>1/2</td> </tr> </tbody> </table> b. UM91314 Series <table border="1"> <thead> <tr> <th>MODE IN</th> <th>Tone/Pulse</th> <th>Dial Rate</th> <th>M/B Ratio</th> </tr> </thead> <tbody> <tr> <td>VDD</td> <td>Pulse</td> <td>10pps</td> <td>1/2</td> </tr> <tr> <td>VSS</td> <td>Tone</td> <td>—</td> <td>—</td> </tr> <tr> <td>Floating</td> <td>Pulse</td> <td>20pps</td> <td>1/2</td> </tr> </tbody> </table> The mode selection pin is checked for tone/pulse dialing as each digit is entered. In pulse mode, the dialing rate is checked, along with the make/break ratio, at the entry of the first key	MODE IN	Tone/Pulse	Dial Rate	M/B Ratio	VDD	Pulse	10pps	2/3	VSS	Tone	—	—	Floating	Pulse	10pps	1/2	MODE IN	Tone/Pulse	Dial Rate	M/B Ratio	VDD	Pulse	10pps	1/2	VSS	Tone	—	—	Floating	Pulse	20pps	1/2
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Remark: X stands for 4, 5, 6, 7

Pin Descriptions (continued)

Pin No.				Designation	I/O	Description
UM9131XA	UM9131XB	UM9131XC	UM9131XD			
3 4	3 4	4 5	4 5	OSCI OSCO	I	Oscillator Input and Output pins The time base for the UM91314 Series is a crystal controlled on-chip oscillator. It is completed by connecting a 3.58 MHz crystal or ceramic resonator between the OSCI and OSKO pins
6	6	7	7	VDD		Power supply pins These devices are designed to operate from 2.0V to 5.5V
5	5	6	6	VSS		
7	7	8	8	TONE	O	Tone dialing output When a valid keystroke is detected in DTMF mode, appropriate low group and high group frequencies are generated, which hybridize the dual tone output. Tone output is in the OFF state when in pulse mode
8	8	9	9	$\overline{\text{XMUTE}}$	O	Dialing transmission mute output This is an N-channel open drain output. The $\overline{\text{XMUTE}}$ is normally OFF. During Pulse or DTMF dialing, this output is ON
9	11	10	12	$\overline{\text{DP}}$	O	Dialing pulse output This is an N-channel open drain output. The normal output will be ON during break and OFF during make in the pulse dialing mode
10	12	11	13	$\overline{\text{C1}}$		Keyboard pins This input serves as the interface to an XY matrix keyboard. On a 5x4-1 matrix keyboard, the input from the fifth row, R5, should be connected to VDD, and the input from the fourth column, C4, should be connected to VSS
11	13	12	14	$\overline{\text{C2}}$		
12	14	13	15	$\overline{\text{C3}}$		
13	15	14	16	$\overline{\text{R1}}$		
14	16	15	17	$\overline{\text{R2}}$		
15	17	16	18	$\overline{\text{R3}}$		
16	18	17	19	$\overline{\text{R4}}$		

Pin Descriptions (continued)

Pin No.				Designation	I/O	Description																																								
UM9131XA	UM9131XB	UM9131XC	UM9131XD																																											
(N.A.)	10	(N.A.)	11	\overline{KT}	O	<p>Key-in tone output</p> <p>This N-channel open drain pin sends out a "beep" tone for each pulse mode and each store state key entry, as well as for entries of accepted function keys (ST, A/L, F, R/P and memory keys). Tone output frequency is 437 Hz, and tone duration is 27 ms</p>																																								
(N.A.)	(N.A.)	1	1	HFO	O	<p>Hands-Free Control I/O pins</p> <p>These pins enable and disable the Hands-Free Control function. When input pin HFI goes low, the Hands-Free Control state is toggled on. The status of the Hands-Free Control state is listed in the following table:</p> <table border="1"> <thead> <tr> <th colspan="2">Current State</th> <th colspan="3">Next States</th> </tr> <tr> <th>Hook sw.</th> <th>HFO</th> <th>Input</th> <th>HFO</th> <th>Dialing?</th> </tr> </thead> <tbody> <tr> <td>-</td> <td>Low</td> <td>\overline{HFI} <input type="checkbox"/></td> <td>High</td> <td>Yes</td> </tr> <tr> <td>On Hook</td> <td>High</td> <td>\overline{HFI} <input type="checkbox"/></td> <td>Low</td> <td>No</td> </tr> <tr> <td>Off Hook</td> <td>High</td> <td>\overline{HFI} <input type="checkbox"/></td> <td>Low</td> <td>Yes</td> </tr> <tr> <td>On Hook</td> <td>-</td> <td>Off Hook</td> <td>Low</td> <td>Yes</td> </tr> <tr> <td>Off Hook</td> <td>Low</td> <td>On Hook</td> <td>Low</td> <td>No</td> </tr> <tr> <td>Off Hook</td> <td>High</td> <td>On Hook</td> <td>High</td> <td>Yes</td> </tr> </tbody> </table>	Current State		Next States			Hook sw.	HFO	Input	HFO	Dialing?	-	Low	\overline{HFI} <input type="checkbox"/>	High	Yes	On Hook	High	\overline{HFI} <input type="checkbox"/>	Low	No	Off Hook	High	\overline{HFI} <input type="checkbox"/>	Low	Yes	On Hook	-	Off Hook	Low	Yes	Off Hook	Low	On Hook	Low	No	Off Hook	High	On Hook	High	Yes
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Off Hook	High	\overline{HFI} <input type="checkbox"/>	Low	Yes																																										
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Off Hook	High	On Hook	High	Yes																																										
		18	20	\overline{HFI}	I																																									
(N.A.)	9	(N.A.)	10	MODE OUT	O	<p>Mode output pin</p> <p>This is an N-channel open drain output. It is ON during tone output and OFF during pulse output</p>																																								

Operational Procedures

Symbol Definitions:

In the description below, signals are defined in terms of the key or switch which is activated.

Off Hook means the phone is off the hook.

On Hook means the phone is on the hook.

D1 represents the first digit dialed in a string of digits.

Dn (**Dk**) represents the last digit dialed in a string of digits.

Dn+1 (**Dk+1**) represents the beginning of a new string of digits.

ST is the store key.

A/L is the Auto/Location key.

F is the flash key.

R/P is the redial/pause key.

Mi is the Emergency key.

Functional Descriptions

1. Normal dialing

OffHook **D1** . . . **Dn**

Dial out **D1** . . . **Dn** in either pulse or tone mode according to the state of input pin "MODE IN". The redial memory will be **D1** . . . **Dn**. (The number of dialing digits is unlimited, but redial memory is limited to 32 digits.)

2. Flash dialing

OffHook **F** **D1** . . . **Dn**

DP will break for 96/297/640ms (version-dependent) and pause for an additional 824ms. It will then dial out **D1** . . . **Dn**, which will be stored in redial memory.

OffHook **D1** . . . **Dk** **F** **Dk+1** . . . **Dn**

The **F** key is unavailable until **D1** **Dk** is dialed out. Dialing **F** **Dk+1** **Dn** uses the same process as the previous case. The redial memory will be **Dk+1** . . . **Dn**.

OffHook **F**

DP will break for 96/297/640ms (version-dependent). Redial memory remains unchanged.

3. Memory dialing

OffHook (**A/L**) **Mn** (n = 1,2,3) or **OffHook**

A/L **Dn** (**Dn** = 0-9).

Dial out digits in direct memory **Mn** or indirect memory **Dn** (up to 16 digits). Redial memory remains unchanged.

Notes:

- In both tone and pulse modes, there can be up to 16 digits in a memory location. The tone/pulse attribute is also recorded. In memory dialing, the MODE IN pin state does not affect the tone/pulse attribute in memory.
- The **F** key can be stored only as the first key in memory, not in any other position.

4. Chain dialing

- a. **OffHook** **D1** . . . **Dk** **Mi** (i = 1, 2, 3)
A/L **Dm** (**Dm** = 0-9) **Dk+1** . . . **Dn**.

It first dials out **D1** . . . **Dk**, then the digits of **Mi**, then the digits of indirect memory **Dm**, and finally **Dk+1** . . . **Dn**.

- b. **OffHook** **R/P** **R/P** **D1** . . . **Dn** **Mi**

(i = 1, 2, 3)
Dials out the digits in redial memory, pauses for 2.2 sec, then dials **D1** . . . **Dn**, and finally the digits in **Mi**. The redial memory is unchanged.

Note:
Memory keys can be accepted at any time during chain dialing, whether or not the dialing process is completed.

5. Mix dialing

Only pulse mode to tone mode is switchable. This is achieved by either changing the MODE IN state, or by depressing the ***/T** key in pulse mode. Tone mode to pulse mode switching is not allowed.

6. Memory storage

- a. Direct memory storage

ST **D1** . . . **Dn** **Mi** or **ST** **D1** . . .
Dn **ST** **Mi** or **ST** **D1** . . . **Dn**
A/L **Mi** or **ST** **D1** . . . **Dn** **ST** **A/L**
Mi (i = 1, 2, 3).

- b. Indirect memory storage

ST **D1** . . . **Dn** **ST** **Dj** or **ST** **D1** . . .
Dn **A/L** **Dj** or **ST** **D1** . . . **Dn** **ST**
A/L **Dj** (**Dj** = 0-9).

- c. Quick storage

ST **D1** . . . **Dk** (**ST** **A/L**) **Mi** **ST**
Dk+1 . . . **Dm** **ST** **Dj** **ST** **Dm+1** . . .
Dn **A/L** **Dl**.

- d. Redial memory storage

ST (**ST**) **Mi** (i = 1, 2, 3) or **ST** (**ST**)
A/L **Dj** or **ST** **ST** **Dj** (**Dj** = 0-9).

Note: **ST** **R/P** **ST** **Mi** will interpret **R/P** as a pause key.

- e. Storage after dialing

D1 . . . **Dn** **ST** (**ST**) **Mi** (i = 1, 2, 3)
D1 . . . **Dn** will be dialed out and stored in **Mi**.

D1 . . . **Dk** **ST** **Dk+1** . . . **Dn** **ST** **A/L**
Dj (**Dj** = 0-9)

D1 . . . **Dk** will be dialed out, and **Dk+1**
. . . **Dn** will be stored in **A/L** **Dj**.

Notes:

- a. Storage is processed in Off-Hook state only.

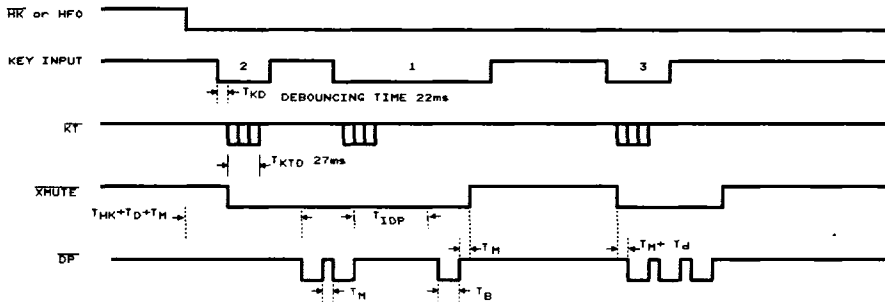
- b. In pulse mode, the key tone is active as valid key input. In tone mode, **D1** . . . **Dn** **ST** **ST** **Mi**, only the last three keys can produce key tones, but **ST** **D1** . . . **Dn** **ST** **A/L** **Dj** has key tones with every key entry whether in pulse or tone mode.

- c. ("MODE IN" = VDD or floated) **ST** **D1** . . . **Dk**
("MODE IN" = 0) **Dk+1** . . . **Dn** **ST** **Dj**
Stores pulse digits **D1** . . . **Dk**, **P->T**, and tone digits **Dk+1** . . . **Dn** in indirect memory **Dj**.

- d. In memory storage, the chip will retain the tone/pulse attribute automatically. In memory dialing, the "MODE IN" state is ignored.
- e. Memory storage can proceed either before dialing out a number, or after a dialing sequence is completed.
- f. During memory storage, \overline{XMUTE} , \overline{DP} remains in the OFF state, and all outputs remain unchanged except the key tone.
- g. Memory storage will not alter the digits in redial memory.

Timing Waveforms

1. Timing Waveform in Pulse Mode:



T_{HK} : Pick-Up Pause, 824ms

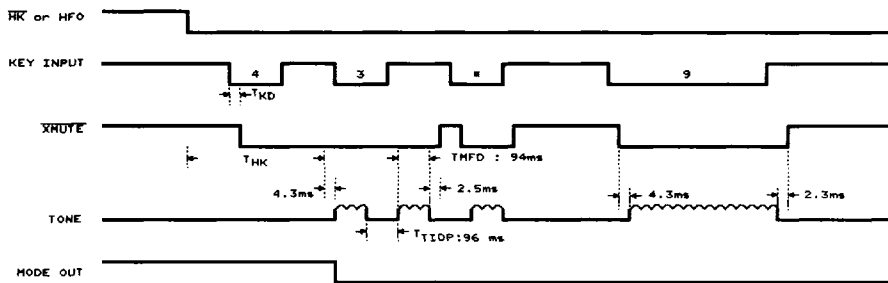
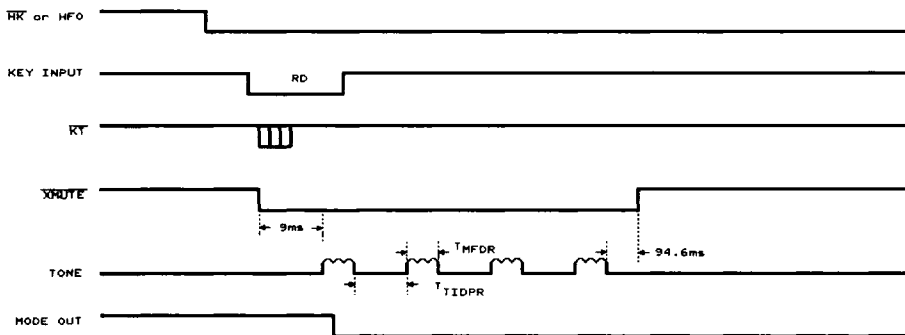
T_d : Delay time or Key valid to dialing signal out, typically 2ms

T_{IDP} : Inter digit pause time

T_{KTD} : Key in tone duration

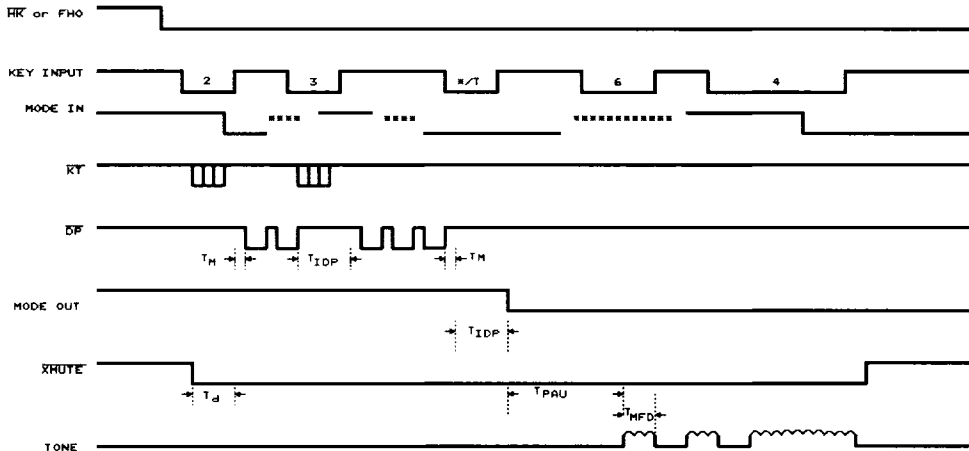
T_{KD} : Debouncing time

Note: " \overline{HK} " or "HFO" indicates that the chip is active when hook switch \overline{HK} goes low or Hands-Free control output HFO goes high.

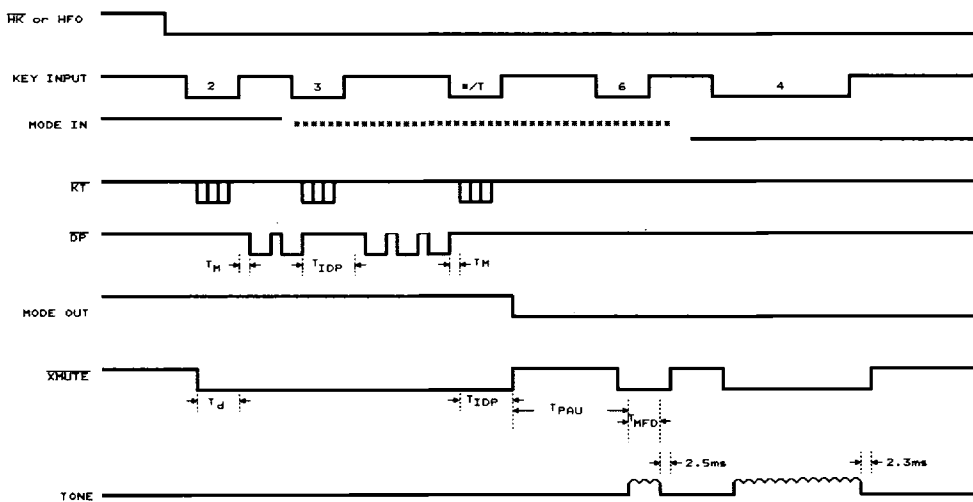
Timing Waveforms (continued)
2. Timing Waveform in Tone Mode:
(i) Normal Dialing

(ii) After (i), Redialing


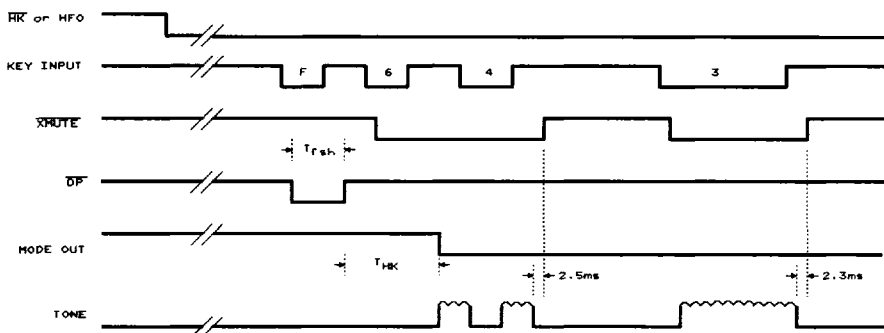
Timing Waveforms (continued)
3. Timing Waveform for Switching Mode Operation:

(i) By mode selection pin switches

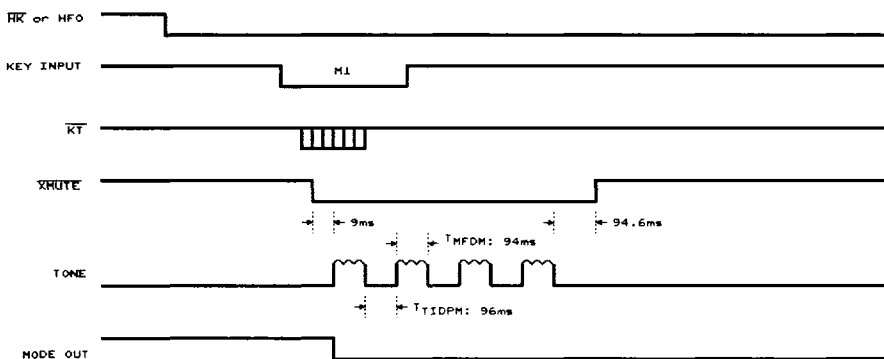


(ii) By */T key entry



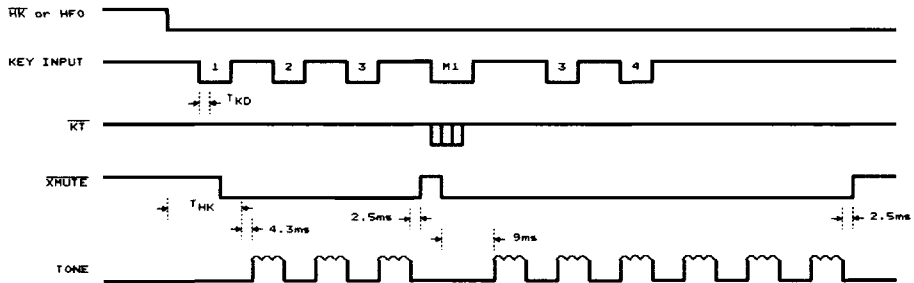
Timing Waveforms (continued)
4. Timing Dialing (DTMF mode used as example):

5. Memory Dial (DTMF mode used as example):

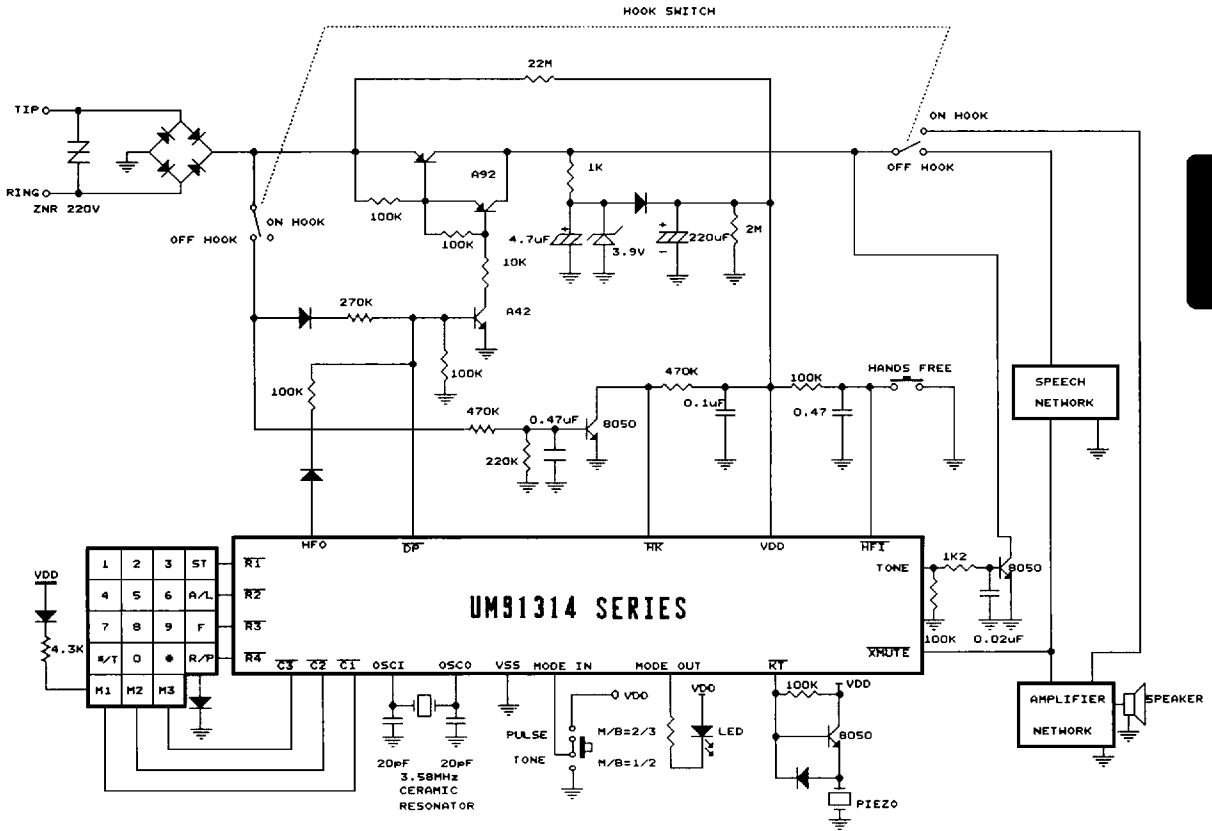
(1, 2, 3, 4 stored in M1)



Timing Waveforms (continued)
6. Chain Dialing (DTMF mode used as example):

(1, 2, 3, 4 stored in M1)



Application Circuit (for reference only)




Ordering Information

Part No.	Key Tone	Hand Free Control	Dial Rate	M/B Ratio	Flash	Package
UM91314A	N.A.	N.A.	10/20 pps	1/2	640 ms	16L-DIP
UM91314B	A	N.A.				18L-DIP
UM91314C	N.A.	A				18L-DIP
UM91314D	A	A				20L-DIP
UM91315A	N.A.	N.A.	10 pps	1/2, 2/3 selection	640 ms	16L-DIP
UM91315B	A	N.A.				18L-DIP
UM91315C	N.A.	A				18L-DIP
UM91315D	A	A				20L-DIP
UM91316A	N.A.	N.A.	10 pps	1/2, 2/3 selection	96 ms	16L-DIP
UM91316B	A	N.A.				18L-DIP
UM91316C	N.A.	A				18L-DIP
UM91316D	A	A				20L-DIP
UM91317A	N.A.	N.A.	10 pps	1/2, 2/3 selection	297 ms	16L-DIP
UM91317B	A	N.A.				18L-DIP
UM91317C	N.A.	A				18L-DIP
UM91317D	A	A				20L-DIP

N.A.: Not Available A: Available