UMC

T-75-07-07

UM91214/15 Series

Tone/Pulse Dialer

Features

- One touch redial operation
- Tone/Pulse switchable
- 32-digit capacity for redialing
- Automatic mixed redialing (last number redial) of pulse to DTMF with multiple automatic access pauses.
- PABX auto-pause is 2.2 seconds
- DTMF Timing:
  Manual dialing: minimum duration for bursts and pauses
  Redialing: calibrated timing
- Hands-free control function

- Wide operating voltage range: 2V to 5.5V
- Key-in beep tone output
- Digits dialed manually after redialing are cascadable and stored as additional digits for the next redialing
- Uses inexpensive ceramic resonator (3.58 MHz)
- Two versions for different telephone systems
- Built-in power up reset circuit
- Four extra function keys: flash, pause, redial and DP or DTMF mixed dialing
- Four-by-four (or 2 of 8) keyboard can be used
- Low standby current

General Description

The UM91214/15 is a single-chip, silicon gate, CMOS integrated circuit with an on-chip oscillator for a 3.58 MHz crystal or ceramic resonator. It provides dialing pulse (DP) or dual tone multi-frequency (DTMF) dialing. A standard 4 x 4 matrix keyboard can be used to support either DP or DTMF modes. Up to 32 digits can be saved in the on-chip RAM for redialing. In the DTMF mode, minimum tone duration and minimum intertone pause provide for rapid dialing. Maximum tone duration is dependent upon the key depression time in manual dialing.
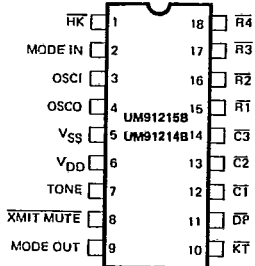
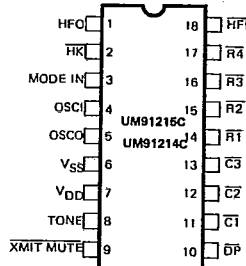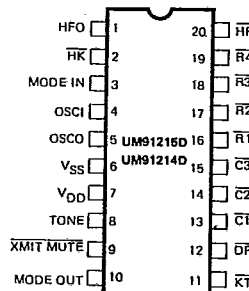### Pin Configurations

a. 16 Pin Package
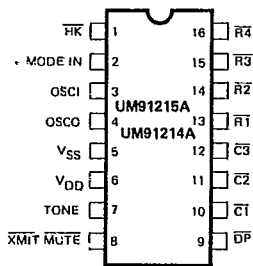
b. 18 Pin Packages
  (i) Key tone output
  (ii) Hands free control

c. 20 Pin Package

UMC

UM91214/15 Series
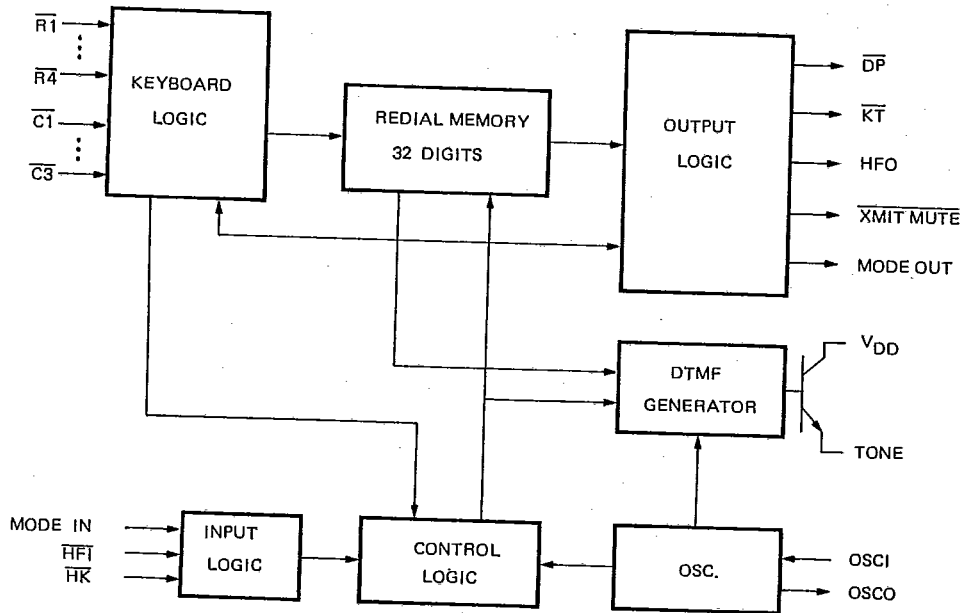
T-75-07-07

Keyboard Assignment

1	2	3	F1	$\overline{R1}$
4	5	6	F2	$\overline{R2}$
7	8	9	P	$\overline{R3}$
*/T	0	#	RD	$\overline{R4}$
$\overline{C1}$	$\overline{C2}$	$\overline{C3}$	GND	

1. */T -- At Pulse mode this key works as Pulse → DTMF key (T key), at DTMF mode the key works as *key. */T key will occupy one memory digit in either use.
2. F1 -- Flash key. The break time is 297 ms or 96 ms (UM91214/15 respectively)
3. F2 -- Flash key for break time 640 ms
4. P -- Pause key (2.2 seconds)
5. RD -- One key redial key
6. # -- At pulse mode this key input is neglected, at DTMF mode this key works as # key.

Block Diagram

2—18

UMC

UM91214/15 Series

Pin Descriptions

$T-75-07-07$

Pin No.				I/O	Symbol	Description
UM91215A UM91214A	UM91215B UM91214B	UM91215C UM91214C	UM91215D UM91214D			
3 4	3 4	4 5	4 5	I	OSCI OSCO	Oscillator Input and Output pins The time base for the UM91214/15 is a crystal controlled on — chip oscillator, which is completed by connecting a 3.58 MHz crystal or ceramic resonator between the OSCI and OSCO pins.
2	2	3	3	I, Z	MODE IN	Tri-State mode select pin. There are two versions of the UM91214/ 15. a. The UM91215 series is for European and American systems. b. The UM91214 series is for the Japanese system The mode selection pin is checked for tone/pulse dialing at each digit key entry. In pulse mode, the dialing rate is checked, along with the make/break ratio, at the first key entry.
1	1	2	2	I	$\overline{HK}$	Hook switch input. This inverter input pin detects the state of the hook switch contact. "Off Hook" is represented by a V_{SS} condition. "On Hook" is represented by a V_{DD} condition.

MODE IN table (UM91215 series):

MODE IN	Tone/ Pulse	Dial Rate	M/B Ratio
V_{DD}	Pulse	10 pps	2/3
V_{SS}	Tone	—	—
Floating	Pulse	10 pps	1/2

MODE IN table (UM91214 series):

MODE IN	Tone/ Pulse	Dial Rate	M/B Ratio
V_{DD}	Pulse	10 pps	1/2
V_{SS}	Tone	—	—
Floating	Pulse	20 pps	1/2

Tone/Pulse Dialer

UMC

Pin Descriptions (Continued)

T-75-07-07

Pin No.				I/O	Symbol	Description
UM91215A UM91214A	UM91215B UM91214B	UM91215C UM91214C	UM91215D UM91214D			
(N. A.)	10	(N. A.)	11	O	K̅T̅	Key-in tone output This N-channel open drain pin sends out a "beep" tone for each pulse mode key entry, along with entries of accepted function keys (RD, T, F1, F2, and P keys). The tone output frequency is 437 Hz and tone duration is 23 ms.
9	11	10	12	O	D̅P̅	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.
_(N. A.)	(N. A.)	1	1	O	HFO	Hands Free Control I/O pins. These pins enable and disable the Hands Free Control function. When input pin HFI goes low, the Hands Free Control state is toggled on. Status of the Hands Free Control state is listed in the following table:
		18	20	I	H̅F̅I̅	
7	7	8	8	O	Tone	Tone dialing output. When a valid keypress is detected in the DTMF mode, appropriate low group and high grop frequencies are generated which hybridize the dual tone output. TONE OUT is in the "OFF" state in pulse mode.

Table within HFO/HFI description:

Current State		Next State		
Hook sw.	HFO	Input	HFO	Dialing?
—	Low	H̅F̅I̅ ⌐↓	High	Yes
On Hook	High	H̅F̅I̅ ⌐↓	Low	No
Off Hook	High	H̅F̅I̅ ⌐↓	Low	Yes
On Hook	—	Off Hook	Low	Yes
Off Hook	Low	On Hook	Low	No
Off Hook	High	On Hook	High	Yes

UMC

UM91214/15 Series

Pin Descriptions (Continued)

T-75-07-07

Pin No.				I/O	Symbol	Description
UM91215A UM91214A	UM91215B UM91214B	UM91215C UM91214C	UM91215D UM91214D			
8	8	9	9	O	$\overline{XMITMUTE}$	Dialing transmission mute output. This is an N-channel open drain output. Normally, the transmission mute output is "OFF" during pulse or DTMF dialing this output is "ON".
(N. A.)	9	(N. A.)	10	O	MODE OUT	Mode output pin. This is an N-channel, open drain output. It is "ON" during tone output and "OFF" during pulse output.
13	15	14	16		$\overline{R1}$	Keyboard pins. This input serves as the interface to an XY matrix keyboard. On a 4 x 4 matrix keyboard, the input from the fourth column, $\overline{c4}$, should be connected to V_{SS}.
14	16	15	17		$\overline{R2}$	
15	17	16	18		$\overline{R3}$	
16	18	17	19		$\overline{R4}$	
10	12	11	13		$\overline{C1}$	
11	13	12	14		$\overline{C2}$	
12	14	13	15		$\overline{C3}$	
6	6	7	7		V_{DD}	Power supply pins. This device is designed to operate from 2.0V to 5.5V
5	5	6	6		V_{SS}	

Description of Operation

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

[Off Hook] means the phone was taken off the hook.
[On Hook] means that the receiver is on the hook.
[D1] stands for the first digit dialed in a string of digits.
[Dn] stands for the last digit dialed in a string of digits.
[Dn+1] stands for the beginning of a new string of digits.
[Dn+m] stands for the last digit in a new string of digits.
[HFI↓] stand for the switch that activates the Hands Free dialing mode going low.
[*/T] is the Pulse-to-DTMF key.
[RD] is the Redial key.

[0] is the Zero key.
[P] is the Pause key.
[F] is the Flash key.

1. Pulse mode operation
    a. [Off Hook][D1] . . . . . [Dn]

    Pulse mode is defined as the initial mode, provided

the first keyboard input is not the [*/T] key following the [Off Hook] condition and the mode selection pin is floating (MODE IN = V_{DD} or floating)

b. [On Hook][HFI↓][D1] . . . . [Dn]

Pulse mode is defined as the initial mode, provided the key input [D1] is not [*/T] while the mode selection pin is V_{DD} or floating. The chip will pause for 824 ms automatically after it detects an [Off Hook] condition or the [HFI↓] key is depressed. It then proceeds with pulse or DTMF dialing if any keys have been depressed.

The dialing rate or make/break ratio is decided at the first key entry by checking the MODE IN status and will not be altered. The MODE IN status can only switch the dialing mode from Pulse to DTMF after the first key entry.

2. DTMF mode operation

a. |Off Hook| |D1| ..... |Dn| or
   |On Hook| |HFT↓| |D1| ..... |Dn|

DTMF mode is defined as the initial mode of the mode selection pin MODE IN is V_{SS}.

b. |Off Hook| |*/T| |D1| ..... |Dn| or
   |On Hook| |HFT↓| |*/T| |D1| ..... |Dn|

The initial mode is pulse mode if the mode selection pin, MODE IN, is V_{DD} or floating. The |*/T| key can switch the dialing mode to tone mode. Unlike normal mode switching, the |*/T| key entry, as the first key pressed, will not produce any pause time. There are only 31 digits of redial memory available in the buffer to be used for operations a and b, since the mode switching key, |*/T|, will occupy one digit of space.

3. Manual dialing with automatic access pause

|Off Hook| |O| |P| |D1| ..... |Dn|

Pause key entries can be accepted and stored in the redial memory. Each is stored as a digit. Each key-in will provide a pause of 3.57 seconds, depending on which model you are using.

4. Redial

a. |Off Hook| |RD| or |On Hook| |HFT↓| |RD|

Up to 32 digits (in pulse mode) or 31 digits (in tone mode) can be dialed using the |RD| key. The |RD| key is disabled while pulse or tone signals are being transmitted. Redial will also be inhibited if the last number dialed exceeds 32 digits because the redial memory can only hold 32 digits.

b. |Off Hook| |RD| |D1| ..... |Dn| or
   |On Hook| |HFT↓| |RD| |D1| ..... |Dn|

After pressing the |RD| key, we can add digits to the number in redial memory. When finished dialing, the redial memory will contain the original digits plus the digits dialed after pressing |RD|. Each time the redial key is pressed, the stored number will be dialed exactly the same as it was previously, regardless of the status of the MODE IN pin.

5. TONE/PULSE switching operation

a. |Off Hook| |D1| ..... |Dn| |MODE IN pin
   |←——— Pulse Mode ———
   switched to VSS| |Dn+1| .... |Dn+m|
   ————————————→| |←—DTMF Mode—→|

The mode selection pin is always checked for tone or pulse mode key entry. Dialing can be switched from pulse to tone mode, but not from tone to pulse mode. Switching the MODE IN pin to V_{SS} will cause the chip to store a |*/T| digit prior to the first tone digit in the redial me-

mory and will automatically insert a 2.2 second pause before the tone digits are dialed out. After the mode has been switched, the status of the mode selection pin will no longer be checked. Therefore, it will not be possible to switch from tone to pulse mode.

b. |Off Hook| |D1| ..... |Dn| |*/T| |Dn+1|
   |←——Pulse Mode —→|←——
   ..... |Dn+m|
   DTMF Mode—→|

Pulse mode is initially defined with the mode selection pin, MODE IN, equal to V_{DD} or floating. At this time, the mode can be switched to DTMF by pressing the |*/T| key. DTMF mode will begin as soon as the last pulse has been transmitted. In this mode, |Dn+1| through |Dn+m| are sent through the TONE OUT pin as DTMF signals. If a |P| key entry is contained in the series of digits before or after the |*/T| entry, or the MODE IN switch is depressed, 2.2 second pause will be added to the automatically inserted pause time, which is also 3.57 seconds. Both of the above switching modes can store as many as 31 digits in the redial memory.

6. One-Key redialing

|Off Hook| |D1| ..... |Dn| |RD| or
|On Hook| |HFT↓| |D1| ..... |Dn| |RD|

If the dialing of |D1| to |Dn| is finished, pressing |RD| will cause the pulse dialing pin to go low for 2.2 seconds of break time and an 824 ms pause will automatically be added. If the pulses of the number dialed with |D1| to |Dn| have not finished, the pressing of the redial key will be ignored.

7. Flash dialing

|Off Hook| |F| |D1| ..... |Dn| or
|On Hook| |HFT↓| |F| |D1| ..... |Dn|

The flash keys emulate quick On-Off Hook operations. Pressing the flash keys, |F1| or |F2|, will cause a break of 96 ms or 640 ms (or, 297 ms or 640 ms, depending on the model) on the $\overline{DP}$ output pin. Then, it pauses for 824 ms and continues dialing the digits, |D1| to |Dn|. These digits are then stored in the redial memory.

Each time the flash key is pressed, the redial memory will be cleared to store a new entry. In addition, the MODE IN status will be checked again for the setting of the Tone/Pulse dialing mode.

Similarly, to make sure that the IC is working properly, new flash key inputs will be ignored as long as the digits that were dialed have not finished.

UMC

UM91214/15 Series

T-75-07-07

Absolute Maximum Ratings *

Supply Voltage (V_{DD}) . . . . $\leqslant 6.0V$
Input Voltage (V_{IN}) . . . . $V_{SS} - 0.3V$ to $V_{DD} + 0.3V$
Output Voltage (V_{OUT}) . . . . . $V_{SS} - 0.3V$ to $V_{DD} + 0.3V$
Output Voltage (V_{OUT}) (DP, XMIT MUTE) . . . . $\leqslant 1.2V$
Tone Output Current (I_{TONE}) . . . . $\leqslant 50$ mA
Power Dissipation (P_D) . . . . $\leqslant 500$ mW
Operating Temperature (T_{OP}) . . . . $-20°C$ to $+70°C$
Storage Temperature (T_{STG}) . . . . $-40°C$ 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

($V_{DD} = 3.5V$, $V_{SS} = 0V$, $F_{OSC} = 3.579545$ MHz, $T_{OP} = 25°C$, unless otherwise specified)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions		Test CKT.
Operating Voltage	V_{DD}	2.0		5.5	V	Pulse mode		A
		2.0		5.5		Tone mode		
Memory Retention Voltage	V_{MR}	1			V			–
Memory Retention Current	I_{MR}		0.05	0.4	μA	$V_{DD} = 1.0V$, $\overline{HK} = V_{DD}$ All outputs unloaded		–
Operation Current	I_{DDP}		0.32	1.0	mA	Pulse mode	All outputs unloaded	A
	I_{DDT}		0.6	2.0		Tone mode		
Standby Current	I_{SO}		0.03	0.05	μA	$\overline{HK} = V_{DD} = 1.5V$	All outputs unloaded No key selected	A
			0.5	10		$\overline{HK} = V_{SS}$		
Input Voltage	V_{IH}	0.8		1	V_{DD}			
	V_{IL}	0		0.2				
$\overline{R1} \sim \overline{R4}$ Input Current	I_R		115		μA			C
Tone out Voltage	V_{OC}	584	730	876	mV_{P-P}	Column	$V_{DD} = 3.5V$	D
	V_{OR}	456	570	684		Row	$R_L = 5K$	
$\overline{HFI}$ Pull Low Current	$|I_{HFI}|$		5		μA	$V_{DD} = 3.5V$. (Note 1) $\overline{HFI}$ pin connected to 0V		
HFO Source Current	$|I_{OH1}|$	0.4	2		mA	$V_{DD} = 3.5V$ $V_{OH} = V_{DD} - 0.4V$		B
HFO, $\overline{KT}$, MODEOUT $\overline{XMUTE}$ Sink Current	I_{OL1}	0.9	5.3		mA	$V_{DD} = 3.5V$ $V_{OL} = 0.4V$		B
$\overline{DP}$ Sink Current	I_{OL2}	1.1	5.3		mA	$V_{DD} = 3.5V$ $V_{OL} = 0.4V$		B
Distrotion	DIS %			10	%	*Note 1		

Note 1:

$$DIS\% = \frac{100 \cdot (V_1^2 + V_2^2 + \ldots + V_n^2)^{½}}{(V_{IL}^2 + V_{IH}^2)^{½}}$$

a. $V_1 \ldots V_n$ are the intermodulation or the harmonic frequencies in the 500 Hz to 3400 Hz band.

b. V_{IL} and V_{IH} are the individual frequency components of the DTMF signal.

Tone/Pulse Dialer

UMC

AC Electrical Characteristics

(V_{DD} = 3.5V, V_{SS} = 0V, F_{OSC} = 3.579545 MHz T_{OP} = 25°C, unless otherwise specified)

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
Make Time	T_M	10 pps	M/B = 1/2		33.3		mS
			M/B = 2/3		40.0		
		20 pps	M/B = 1/2		16.7		
			M/B = 2/3		20.0		
Break Time	T_B	10 pps	M/B = 1/2		66.6		mS
			M/B = 2/3		60		
		20 pps	M/B = 1/2		33.3		
			M/B = 2/3		30		
Inter Digit Pause Time	T_{IDP}	10 pps			824		mS
		20 pps			458		
Pause Time	T_{PAU}				2.2		S
Auto-redial Break Time	T_{ROBK}	*Optional			2.2		S
Delay time Key valid to Signal out	T_d				0		mS
Key-in Debaunce	T_{KD}				21		mS
Key-in Tone Duration	T_{KTD}				23		mS
Key-in Tone Frequency	F_{KT}				437		Hz
Minimun Tone Duration Time	T_{MFD}				94		mS
Min. Tone Inter-digit Pause	T_{TIDP}				96		mS
Redial Tone Duration	T_{MFDR}				94		mS
Redial Tone Inter-digit Duration	T_{TIDPR}				96		mS

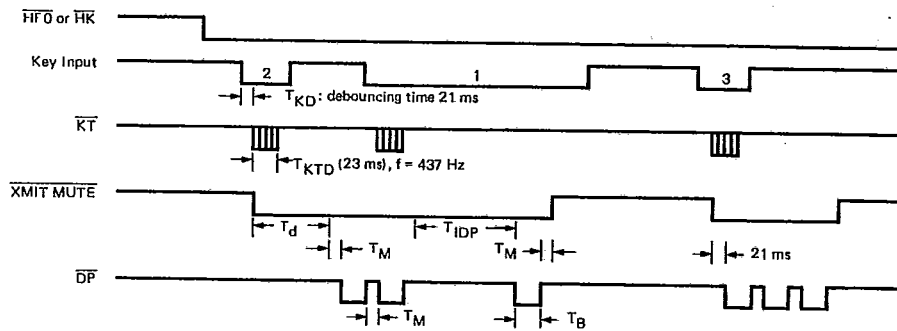| R/C	Conditions	spec.	Actual	Error (%)	Unit
$\overline{R1}$		697	699.1	+0.31	HZ
$\overline{R2}$		770	771.5	+0.19	HZ
$\overline{R3}$		852	852.3	+0.03	HZ
$\overline{R4}$	F_{OSC} = 3.579545 MHz	941	942.0	+0.10	HZ
$\overline{C1}$		1209	1,215.7	+0.57	HZ
$\overline{C2}$		1336	1,331.7	−0.32	HZ
$\overline{C3}$		1477	1,471.9	−0.35	HZ

Timing Waveform

1. Timing Waveform in pulse mode:

T_d : Delay time of Key valid to dialing signal out, typically 0 ms

T_{IDP} : Inter digit pause time
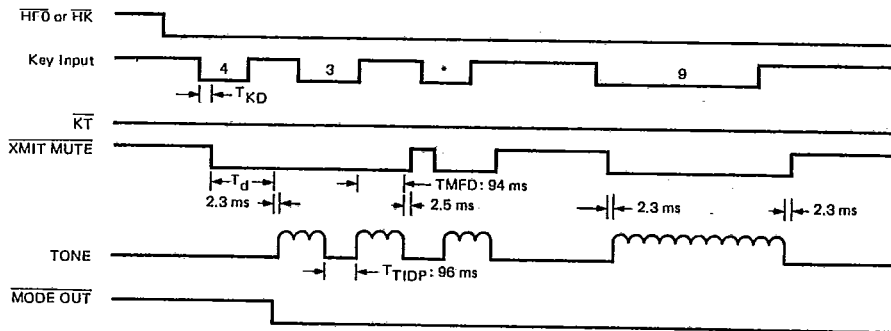
T_{KTD} : Key in tone duration

T_{KD} : Debouncing time

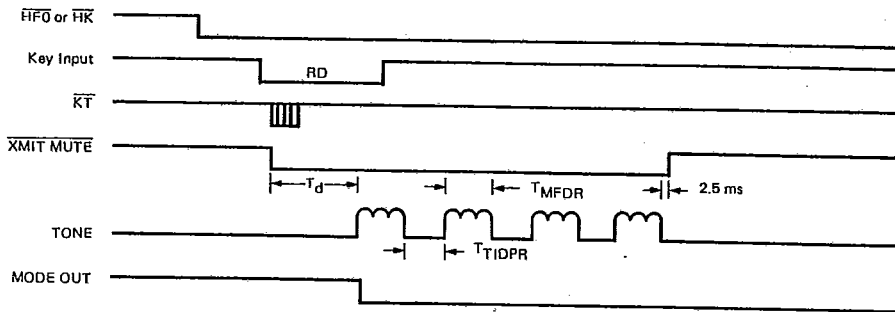Note: "HK or HFO" indicates chip works when hook switch HK goes low or hands free control output HFO goes high.

2. Timing Waveform in tone mode:

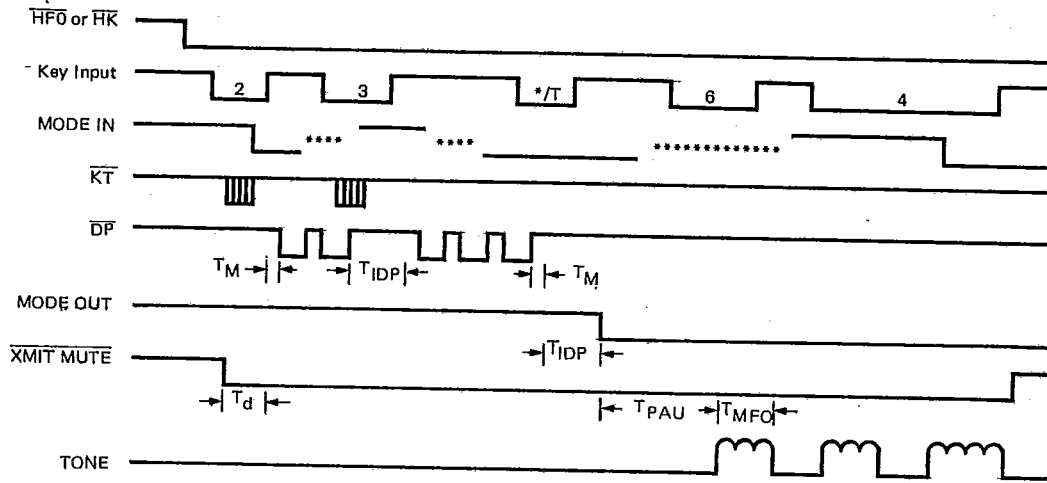(i) Normal dialing

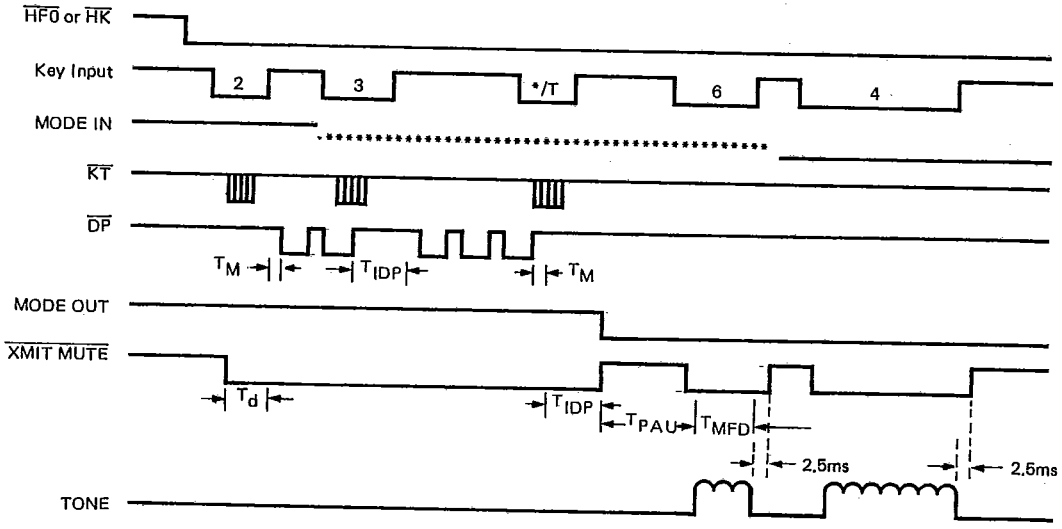(ii) After (i), redialing

UMC

UM91214/15 Series

T-75-07-07

3. Timing Waveform for switching mode operation:

(i) By mode selection pin switches

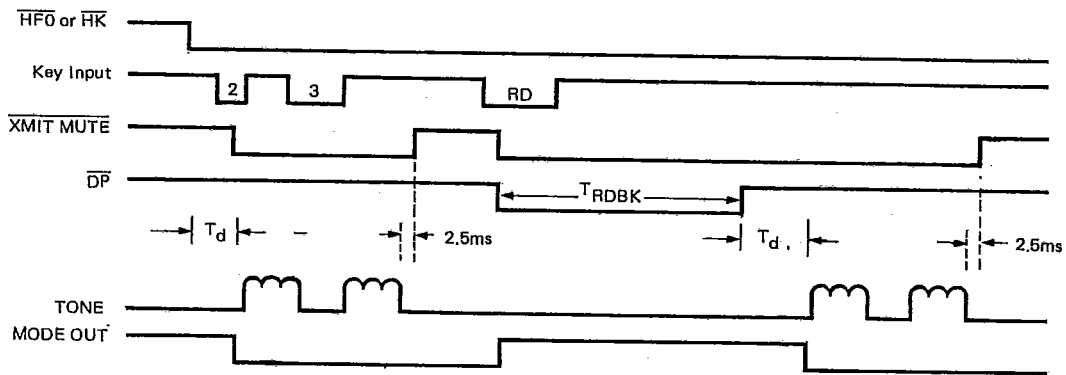$\overline{HFO}$ or $\overline{HK}$

Key Input   2   3   */T   6   4

MODE IN   ••••   ••••   ••••••••••••

$\overline{KT}$

$\overline{DP}$

T_M T_{IDP} T_M

MODE OUT

$\overline{XMIT\ MUTE}$ T_{IDP}

T_d T_{PAU} T_{MFO}

TONE

(ii) By */T key entry

$\overline{HFO}$ or $\overline{HK}$

Key Input   2   3   */T   6   4

MODE IN   •••

$\overline{KT}$

$\overline{DP}$

T_M T_{IDP} T_M

MODE OUT

$\overline{XMIT\ MUTE}$

T_d T_{IDP} T_{PAU} T_{MFD}

2.5ms   2.5ms

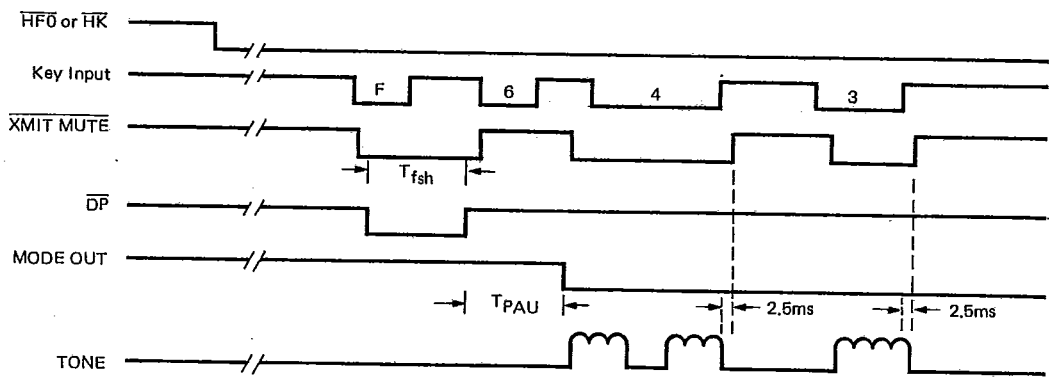TONE

T_{PAD}: Pause time (2.2 secs)

UMC

4. One key redial (DTMF mode for example):

T-75-07-07

T_{RDBK}: Break time (2.2 secs)

5. Flash dialing (DTMF mode for example):

T_{fsh}: flash time 96 or 640 ms (F1 or F2 respectively) for UM91215

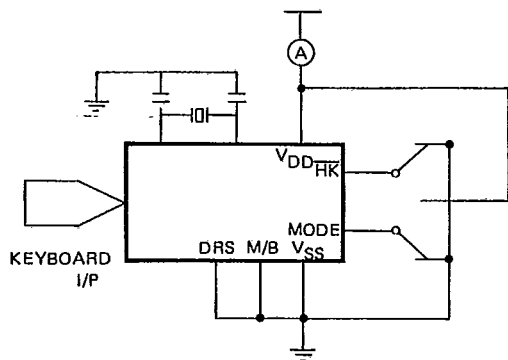flash time 297 or 640 ms (F1 or F2 respectively) for UM91214

UMC

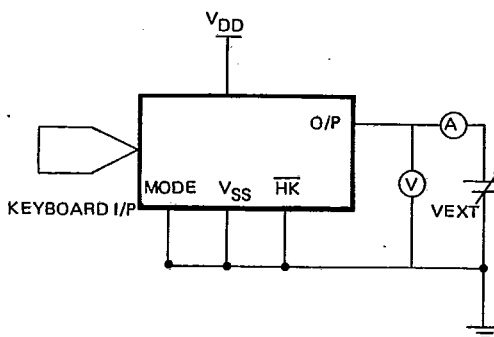**Application Circuit**

T-75-07-07

UMC

UM91214/15 Series

T-75-07-07

Test Circuits

(A)

KEYBOARD I/P

(B)

KEYBOARD I/P

Tone/Pulse Dialer

(C)

(D)

SPECTRUM ANALYZER
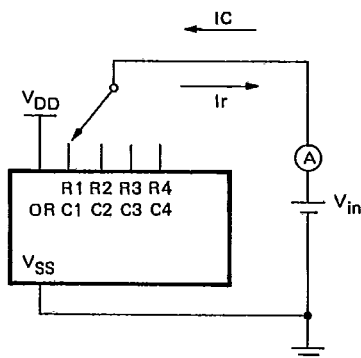
OSCILLOSCOPE
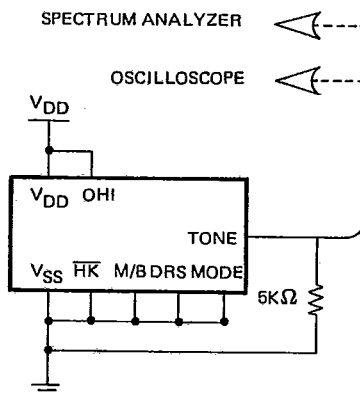
OSCILLOSCOPE: TEKTRONIX 468
SPECTRUM ANALYZER: HP 3585A

Ordering Information

Part No.	Package	Key Tone	Hands Free Control	Dial Rate	M/B ratio	Flash	
						F1	F2
UM91214A	16-pin DIP	N. A.	N. A.	10/20 pps	1/2	297 ms	640 ms
UM91214B	18-pin DIP	A	N. A.				
UM91214C	18-pin DIP	N. A.	A				
UM91214D	20-pin DIP	A	A				
UM91215A	16-pin DIP	N. A.	N. A.	10 pps	1/2, 2/3 Selectable	96 ms	640 ms
UM91215B	18-pin DIP	A	N. A.				
UM91215C	18-pin DIP	N. A.	A				
UM91215D	20-pin DIP	A	A				

N.A.: Not Available   A: Available