

T-75-07-07

UM91310 Series

TONE/PULSE DIALER

Features

- Pulse and DTMF dialing
- Memory clear function
- Four extra function keys: pause, flash, redial, and pulse to DTMF dialing (mixed mode)
- DTMF dialing:
 - Manual dialing – minimum duration for bursts and pauses
 - Redialing – calibrated timing
- On-chip oscillator uses low-cost 3.579545 MHz crystal
- Keyboard entry fully debounced
- 23 digits for redial operation
- Special function for flash operation
- On-chip voltage reference for supply and temperature independent tone output
- On-chip filtering for low output distortion
- Uses standard 5 x 4 keyboard
- Flash (register recall) output

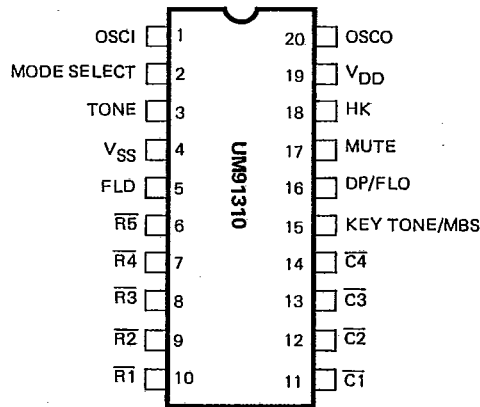
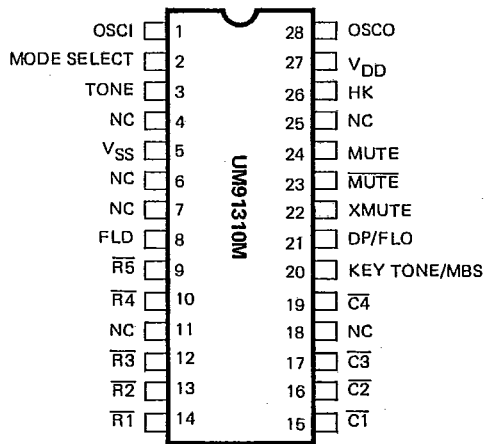
General Description

UM91310 is a single chip silicon gate CMOS integrated circuit with an on chip filter. It also provides an on chip oscillator for a 3.579545 MHz crystal.

Standard 5x4 matrix keyboard is used for either pulse dialing (PD) or dual tone multi-frequency (DTMF) mode. Up to 23 digits can be stored in on-chip RAM for redial.

In DTMF mode, minimum tone duration and minimum inter-tone pause are provided for fast key depressing. Maximum tone duration depends on the key depress time in manual dialing

Pin Configurations



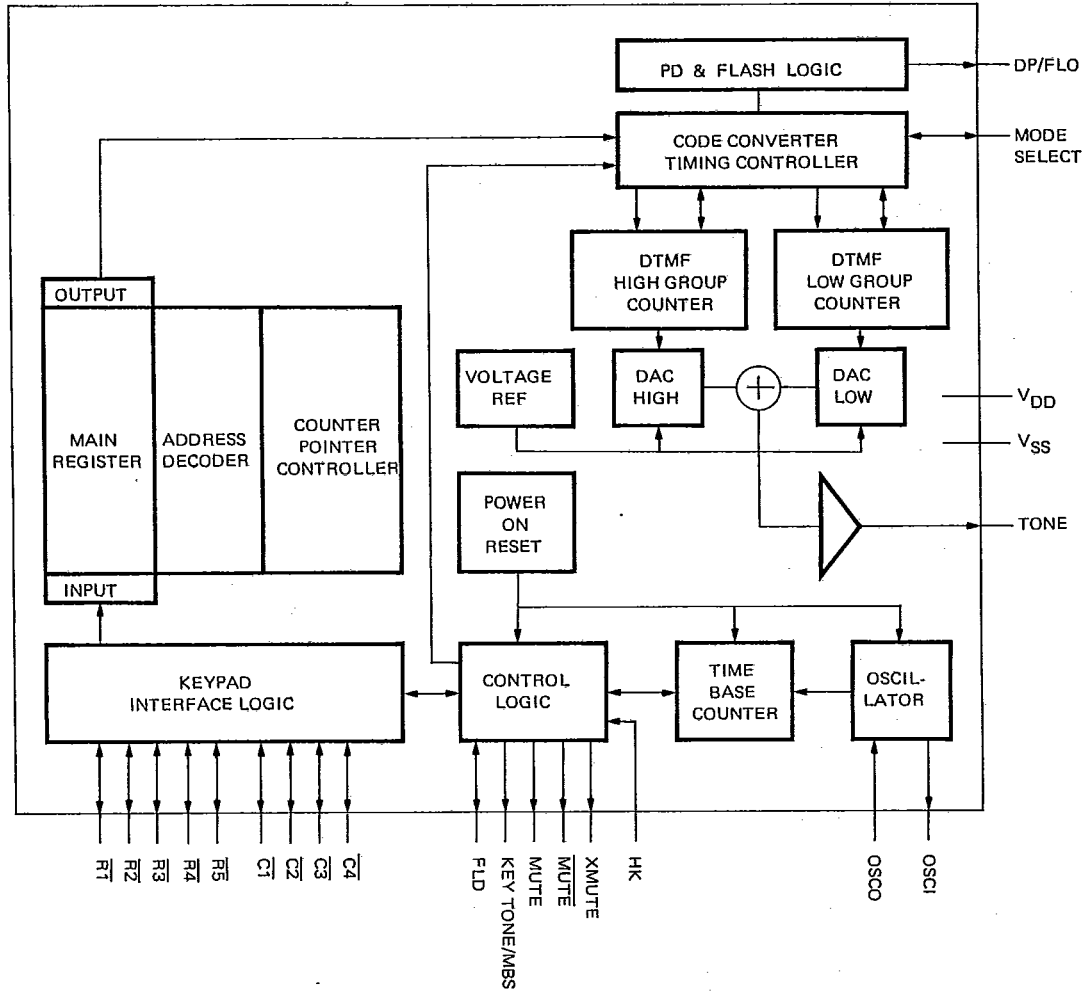
Note: The function of KEY TONE/MBS is determined by bond pad selection.



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Block Diagram



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Absolute Maximum Ratings *

Power Supply Voltage V_{DD} (With respect to V_{SS}) -0.8 to 6V
 Supply Current I_{DD} 50 mA
 All Input Voltages -0.8V to $V_{DD} + 0.8V$
 DC Current Into Any Input or Output 10 mA
 Operating Temperature 0 to 70°C
 Storage Temperature -60 to 150°C
 Total Power Dissipation 300 mW
 Power Dissipation Per Output 50 mW

***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

($V_{DD} = 3V$, $V_{SS} = 0V$, Crystal: 3.579545 MHz; $R_S = 100 \Omega$ max.; $T_A = 25^\circ C$; unless otherwise specified.)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Supply Voltage						
Operating supply voltage	V_{DD}	2.5	—	5.0	V	
Memory retention voltage	V_{MR}	1.8	—	5.0	V	
Operating Supply Current						
Conversation mode	I_{DDC}	—	—	150	μA	Osc. ON
Pulse dialing or Flash	I_{DDP}	—	—	400	μA	
DTMF dialing	I_{DDT1}	—	0.6	1.2	mA	Tone ON
DTMF dialing	I_{DDT2}	—	—	200	μA	Tone OFF
Standby Supply Current	I_{SD}	—	—	5	μA	$V_{DD} = 1.8V$; $T_{AMB} = 25^\circ C$ Osc. OFF (Note 1)
Inputs						
Input voltage Low of any pin	V_{IL}	0	—	$0.3 V_{DD}$	V	
Input Voltage HIGH of any pin	V_{IH}	$0.7 V_{DD}$	—	V_{DD}	V	
Input leakage current of HK	I_{IL}	—	—	± 1	μA	
Keyboard on Current	I_{ON}	—	—	45	μA	
Outputs						
Output sink current for MUTE, \overline{MUTE} , XMUTE, DP/FLO, KEY TONE, FLD	I_{OL1}	0.7	—	—	mA	at $V_{OL} = V_{SS} + 0.5V$
MODE SELECT (note 2)	I_{OL2}	—	1	—	mA	
Output source current for MUTE, \overline{MUTE} , XMUTE, DP/FLO, KEY TONE, FLD	I_{OH1}	0.6	—	—	mA	at $V_{OH} @ V_{DD} - 0.5V$
MODE SELECT (note 2)	I_{OH2}	—	10	—	μA	
FLD (note 3)	I_{OH3}	—	100	—	nA	



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DC Electrical Characteristics (Continued)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
TONE OUTPUT						
DTMF output voltage levels (r. m. s.) for						at $V_{DD} = 2.5$ to $5V$
HIGH group	V_{OC} (rms)	158	192	205	mV	
LOW group	V_{OR} (rms)	125	150	160	mV	
D. C. voltage level	V_{DD}	—	$\frac{1}{2} V_{DD}$	—	V	
Output impedance	$ Z_o $	—	—	1.5	$K\Omega$	
Pre-emphasis of group	T_{WIST}	1.85	2.1	2.35	db	
Total harmonic distortion (note 4)	T_{HD}	—	-20	—	db	

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AC Electrical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Tone Output Frequency deviation	df/f	-0.6	—	0.6	%	at $V_{DD} = 2.5$ to $5V$
Timing and Frequency						
Oscillator start-up time	T_P	—	10	—	ms	
Key pad debounce time	T_{KD}	—	15	—	ms	
Reset delay time	T_{RD}	—	160	—	ms	
Transmission and pause Time						
Tone duration for	T_{MFD} T_{TIDP}					
Manual dialing		68	—	—	ms	
Redialing		68	70	72	ms	
Flash pulse duration	T_{FL}	98	100	102	ms	
Flash hold-over time	T_{FLH}	29	30	31	ms	
Hold-over time (muting on MUTE)	T_H	78	80	81	ms	
Pulse Dialing (PD)						
Dial pulse rate	DR	9.8	10	10.4	Hz	
Inter-digit pause	T_{IDP}	828	840	844	ms	
Break time MBS = V_{DD}	TB1	65	67	68	ms	
MBS = V_{SS}	TB2	59	60	61	ms	
Make time MBS = V_{DD}	TM1	31	33	34	ms	
MBS = V_{SS}	TM2	39	40	41	ms	

Notes to the DC and AC Electrical characteristics

1. Crystal connected between OSCI and OSCO; HK at V_{SS} and all other pins open-circuited.
2. [10 mA] dynamic current to set/reset MODE SELECT pin (mixed mode)
3. Flash inactive; $V_{OH} = V_{SS}$.
4. Related to the level of the LOW group frequency component (PTT ELR 305).



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Pin Description

28 (20) Pin No.	Symbol	I/O	Description
1 (1) 28 (20)	OSCI OSCO	I O	Oscillator input and output pins: The time base for UM91310 is a crystal controlled on-chip oscillator which is completed by connecting a 3.579545 MHz crystal between the OSCI and OSCO pins.
2 (2)	MODE SELECT	I	<p>Mode selection: There are three operating modes in UM91310 – PD mode, DTMF mode, and mixed mode. This pin selects which mode the UM91310 will operate on.</p> <p>PD mode If MODE SELECT = V_{SS}, then pulse mode is selected. Entries of non-numeric keys are neglected, and neither stored in the redial register nor transmitted.</p> <p>DTMF mode If MODE SELECT = V_{DD}, then DTMF mode is selected. Each non-function pushbutton activated corresponds to a combination of two tones, each one of four possible low and high group frequencies. These frequencies are transmitted with a constant amplitude, regardless of power supply variations, and filtered off harmonic constant.</p> <p>The transmission time is calibrated for redial. In manual operation the duration of bursts and pauses is the actual pushbutton depress time, but not less than the minimum transmission time (TMFD) and or minimum pause time (TTIDP).</p> <p>Mixed mode When the MODE SELECT is open-circuited, then mixed mode is selected. After activation of HK or FL, the circuit starts as a pulse dialer and remains in this state until a non-numeric (A, B, C, D, *, #) or the ">" key is activated. Then the circuit changes to DTMF dialing and remains there until FL is activated or after a static standby condition, HK is re-activated.</p> <p>A touch between MODE SELECT pin and V_{DD} also initiates DTMF dialing. Hook switch HK, flash FL or a connection of MODE SELECT pin to V_{SS} sets the circuit back to pulse dialing.</p>
3 (3)	TONE	O	<p>Tone output: The single and dual tones which are provided at the TONE output are filtered by an on chip filter. The total harmonic distortion of the DTMF tone falls within PTT ELR 305 recommendations. An on-chip reference voltage provides output tone levels independent of the supply voltage. Table 1 shows the frequency tolerance of the output tones for DTMF signaling.</p> <p>When the DTMF mode is selected output tones are timed in manual dialing with a minimum duration of bursts and pauses, and in redial with calibrated timing. Single tones may be generated for test purposes (HK = high). Each row and column has one corresponding frequency. By connecting the column/row to V_{SS}, the corresponding high/low single tone frequency is generated. The single tone frequency will be transmitted during activation time, but it is neither calibrated nor stored.</p>



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Pin Description (Continued)

28 (20) Pin No.	Symbol	I/O	Description
27 (19) 5 (4)	V _{DD} V _{SS}	P P	<p>Positive and negative power supply: The positive power supply for the circuit must meet the voltage requirements indicated in the electrical characteristics table.</p> <p>To avoid undefined states of the device when powered on, an internal reset circuit clears the control logic and counters.</p> <p>If V_{DD} drops below the minimum memory retention supply voltage of 1.8 volts, the memory may be destroyed.</p> <p>The power-on-reset signal has the highest priority. It blocks and resets the complete circuit without delay, regardless of the state of Hook switch HK.</p>
8 (5)	FLD	I/O	<p>Flash duration control: Flash (or register recall) is activated by the FL key and can be used in DTMF and pulse dialing modes. Pressing the FL key will produce a timed line break of 100 ms (min.) at the DP/FLO output. While in the conversation mode, the flash pulse entry will act as a chip enable. The flash pulse duration (TFL) is calibrated and can be prolonged with an external resistor and capacitor connected to the FLD input/output (see Fig. 2).</p> <p>The FL key has special functions in the redial mode (see redial procedure with the flash inserted telephone number).</p>
9 (6) 10 (7) 12 (8) 13 (9) 14 (10) 19 (14) 17 (13) 16 (12) 15 (11)	R ₅ R ₄ R ₃ R ₂ R ₁ C ₄ C ₃ C ₂ C ₁	I/O I/O I/O I/O I/O I/O I/O I/O I/O I/O	<p>Keyboard inputs/outputs: The keyboard layout of UM91310 is shown in Fig. 3.</p> <p>All keyboard entries are debounced for an approximate time of TKD. Each entry is tested for validity.</p> <p>When a pushbutton is pressed, keyboard scanning begins and the chip returns to the sense mode only after the pushbutton is released.</p> <p>Rt of the keyboard contains the following special function keys:</p> <ul style="list-style-type: none"> * P Auto pause * FL Flash or register recall * R Redial * > Changes of dial mode from PD to DTMF in mixed dialing <p>In pulse dialing mode, the valid keys are the 10 numeric keys (0 to 9). The non-numeric keys (A, B, C, D, *, #) have no effect on dialing or redial storage. The valid function keys are P, FL, and R.</p> <p>In the DTMF mode, all nonfunction keys are valid. They are transmitted as dual-tone combinations and, at the same time are stored in the redial register. P, FL, and R are valid function keys.</p> <p>In mixed mode dialing, all key entries are valid and are executed accordingly.</p> <p>The P key executes a pause for 2.5 to 3 seconds. If the key is pressed again during the pause period, it will release the pause function.</p>

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Pin Description (Continued)

28 (20) Pin No.	Symbol	I/O	Description
20 (15)	KEY TONE MBS	O or I	<p>Key in tone output or Make break ratio selection: The function of this pin is selected by bonding option.</p> <p>A 1.19 KHz key-in tone output is provided to produce audible feedback for key entries. UM91310B and UM91310BM do not provide this key-in tone output.</p> <p>This input pin is used to select the pulse dialing make/break ratio. When MBS is equal to V_{DD}, the make/break ratio is 1:2. When MBS = V_{SS}, the make/break ratio is 2:3. The 28-pin package is provided with these bonding options.</p>
21 (16)	DP/FLO	O	<p>Dial pulse and flash output: This is a combined output which provides control signals for proper timing in pulse dialing or for a calibrated break in both dialing modes (flash or register recall).</p>
22	XMUTE	O	<p>Strobe output: This output remains active high during actual dialing: i. e., during break or make time in pulse dialing, or during tone on in DTMF dialing.</p>
23 24 (17)	$\overline{\text{MUTE}}$ MUTE	O O	<p>$\overline{\text{MUTE}}$ and MUTE output: In pulse dialing mode, the mute output becomes active high for the period of the inter-digit pause, break time and make time. In tone dialing mode, the mute output becomes active high during DTMF on and hold-over time. It remains at this level until the last digit has been output.</p> <p>$\overline{\text{MUTE}}$ the inverted output of MUTE.</p>
26 (18)	HK	I	<p>Hook switch: The HK input enables the circuit and is used to initialize the IC.</p> <p>HK is Low during the static standby condition. In this state, the clock oscillator is disabled and all registers and logic are reset, with the exception of Write Address Counter (WAC). The Write Address Counter (WAC) points to the last entered digit. The keyboard input is inhibited, but the data previously entered is saved to the redial register as long as V_{DD} is higher than VMR (min.)</p> <p>The current drawn is ISD (standby current) and serves to retain data in the redial register while the phone is in an on-hook condition.</p> <p>If HK is high, the clock oscillator is activated and the circuit changes from a static standby condition to the conversation mode. The current is IDDC until the first digit is entered from the keyboard. Then, a dialing or redialing operation is initiated. The operating current is IDDP if in the pulse dialing mode or IDDF in the DTMF dialing mode.</p> <p>If the HK input is taken low for more than time TRD (see Fig. 5a Fig. 5b and timing data), an internal reset pulse will be generated at the end of the TRD period. The system changes to the static standby state. A short HK pulse of less than TRD will not affect the operation of the circuit and reset pulses are not produced.</p>



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Table 1. Frequency tolerance of the output tones for DTMF signaling.

Row/ Column	Standard Frequency (Hz)	Tone Output Frequency (Hz)	Frequency Deviation	
			Hz	%
Row 1	697	696.95	-0.05	-0.01
Row 2	770	768.80	-1.20	-0.16
Row 3	852	852.27	+0.27	-0.03
Row 4	941	943.97	+2.97	+0.32
Col 1	1209	1212.58	+3.58	+0.30
Col 2	1336	1331.68	-4.32	-0.32
Col 3	1477	1476.71	-0.29	-0.02
Col 4	1633	1638.99	+5.99	+0.37

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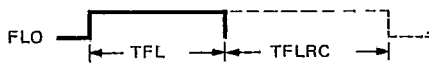
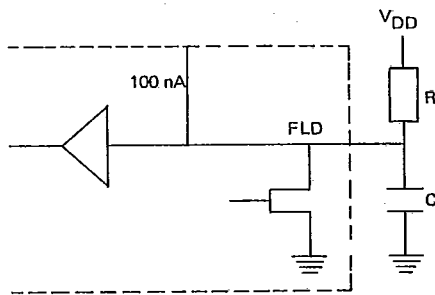
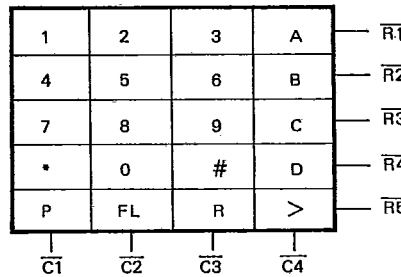


Fig. 2. Flash pulse duration setting



P: Pause
 FL: Flash
 R: Radial
 >: Changes dial mode from PD to DTMF in Mixed

Fig. 3. Keyboard layout

Functional Description

Part 1. Operation procedures

Dialing

After HK has risen to V_{DD} the oscillator starts running and the Read Address Counter (RAC) is set to the first address (see Fig. 4). When the first valid digit is entered, the Temporary Write Address Counter (TWAC) is set to the first address, the decoded digit is stored in the register, and the TWAC is incremented to the next address. Any subsequent keyboard entry is then decoded and stored in the radial register after validation. The first five valid entries have no effect on the main register and its associated write address counter.

After the sixth valid digit is entered, TWAC indicates an overflow condition. The data from the temporary

register will be copied to the five least significant places of the main register and TWAC to the WAC. All the following digits (including the sixth digit) are stored in the main register (up to a total of 23). If more than 23 digits are entered, radial will be inhibited. If five digits or less are entered, only the temporary register and the associated TWAC are affected. All entries are debounced for at least the amount of time shown in Fig. 5. Each entry is tested for validity before being deposited in the radial register.

- * In DTMF mode, all non-function keys are valid.
- * In PD mode, only numeric keys are valid.

At the same time that they are accepted and depending on the mode selected (PD, DTMF or mixed), the entries are transmitted as PD pulse trains or as DTMF frequencies



in accordance with postal requirements. Entries other than numeric are ignored during pulse dialing. They are neither stored nor transmitted.

Redialing

After HK has risen to V_{DD} the oscillator starts running and the Read Address Counter (RAC) is set to the first address. The UM91310 is in the conversation mode.

If "R" is the first keyboard entry the circuit starts transmitting the contents of the temporary register. If the overflow flag on the TWAC was set to the number previously dialed, dialing continues from the main register. If the flag was not set, the number residing in the temporary register will only be redialed until the temporary read and write registers are equal.

Before the "R" is pressed, a dialing sequence of up to five digits is possible. If these digits are equal to the corresponding digits in the main register, redial continues with the main register until the last digit stored is transmitted.

In the DTMF mode, timing is calibrated for both tone bursts and pauses.

In mixed mode, only the first part entered (the pulses that were dialed as part of the stored number) can be redialed.



When redial is active, keyboard entries (both function- and numeric) will not be accepted until the circuit returns to the conversation mode after redial is complete.

No redial activity can be performed when any of the following events take place:

- * The power-on test.
- * Memory clear ("R" or "FL" without additional data entry).
- * Memory overflow (more than 23 valid data entries).

Part 2. Keyboard and switches operation

1. Symbol Definition:

- a. Dp : PULSE dialing digit data: 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, P.
- b. Dt : TONE dialing digit data: *, #, 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, A, B, C, D, P.
- c. → : PULSE to DTMF key in mixed mode: >, *, #, A, B, C, D.
- d. zizizi : Conversation mode.
- e. 0-0 ↑ : Off-Hook.
- f. 0-0 ↓ : On-Hook.
- g.  : Input level from low to high.
- h.  : Input level from high to low.

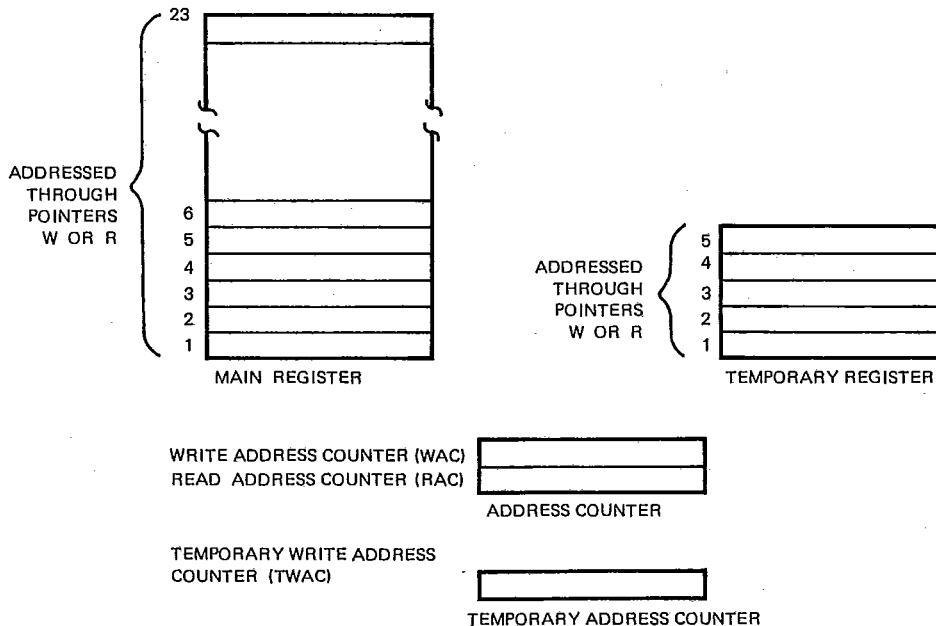


Fig. 4 Program Memory Map



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- i. \neq : not equal.
- j. $>$: greater than.
- k. \leq : less than or equal to.
- l. Dg : Dialing digit (pulse or tone).

2. Recommended Dialing, Redialing and Clear Operations:

- a. Normal dialing and redialing in pulse mode (MODE SELECT = V_{SS})
 - 0-0 ↑; Dp, . . . , Dp; zizizi; 0-0 ↓
 - 0-0 ↑; R; Dp, . . . , Dp out; zizizi; 0-0 ↓
- b. Normal dialing and redialing in tone mode (MODE SELECT = V_{DD}).
 - 0-0 ↑; Dt, . . . , Dt; zizizi; 0-0 ↓
 - 0-0 ↑; R; Dt, . . . , Dt out; zizizi; 0-0 ↓
- c. Mixed dialing via MODE SELECT pin.
 - 0-0 ↑; Dp, . . . , Dp; MODE SELECT
 - Dt, . . . , Dt; zizizi; 0-0 ↓
- d. Mixed dialing and redialing via keypad (MODE SELECT open)
 - 0-0 ↑; Dp, . . . , Dp, →; Dt, . . . , Dt; zizizi; 0-0 ↓
 - 0-0 ↑; R; Dp, . . . , Dp; zizizi; 0-0 ↓

(Note: If the digits dialed in the above dialing operations exceed 23, redialing operation will be inhibited.)
- e. Redial operations about Main register and Temporary register: power on
 - 0-0 ↑; Dga1, . . . , Dgai 0-0 ↓
 - 0-0 ↑; Dgb1, . . . , Dgbj 0-0 ↓
 - (i, j ≤ 23)
 - (1) $a_i \leq 5, b_j \leq 5$
 - 0-0 ↑; R; Dgb1, . . . , Dgbj out; or
 - 0-0 ↑; Dgc1, . . . , Dgck; R; no digit out after R key.

- (2) $a_i \leq 5, b_j > 5$
 - 0-0 ↑; R; Dgb1, . . . , Dgbj out; or
 - 0-0 ↑; Dgc1, . . . , Dgck; R;
 - If $c_k \leq 5$ and $Dgct = Dgbt$ ($t = 1 \dots k$) then Dgbk+1, . . . , Dgbj out
 - If $c_k > 5$ or $Dgct \neq Dgbt$ ($t = 1 \dots k \leq 5$) then no digit out after R key
- (3) $a_i > 5, b_j \leq 5$
 - 0-0 ↑; R; Dgb1, . . . , Dgbj out; or
 - 0-0 ↑; Dgc1, . . . , Dgck; R;
 - If $c_k \leq 5$ and $Dgct = Dgat$ ($t = 1 \dots k$) then Dgat+1, . . . , Dgai out
 - if $c_k > 5$ or $Dgct \neq Dgat$ ($t = 1 \dots k \leq 5$) then no digit out after R key
- (4) $a_i > 5, b_j > 5$
 - 0-0 ↑; R; Dgb1, . . . , Dgbj out; or
 - 0-0 ↑; Dgc1, . . . , Dgck; R;
 - if $c_k \leq 5$ and $Dgct = Dgbt$ ($t = 1 \dots k$) then Dgbk+1 . . . , Dgbj out
 - if $c_k > 5$ or $Dgct \neq Dgbt$ ($t = 1 \dots k \leq 5$) then no digit out after R key
- f. Special operation on * and #.
 - (1) 0-0 ↑; Dg1, . . . , Dgi; * or #; Dgi+1, . . . , Dgn; zizizi; 0-0
 - 0-0 ↑; R; Dg1, . . . , Dgi out 0-0 ↓
 - (2) 0-0 ↑; * or #; Dg1, . . . , Dgi; zizizi; 0-0 ↓
 - 0-0 ↑; R; * or #; Dg1, . . . , Dgi out; 0-0 ↓
- g. Special Operation on FL key:
 - 0-0 ↑; Dg, . . . , Dgi; FL; Dgi+1, . . . , Dgn; zizizi;
 - 0-0 ↓
 - 0-0 ↑; R; Dgi + 1 . . . , Dgn out; 0-0 ↓
- h. Clearing redial buffer by using R key
 - 0-0 ↑; Dg1, . . . , Dgi ($i > 5$); R; 0-0 ↓
 - 0-0 ↑; R; no digit out





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Timing Diagrams

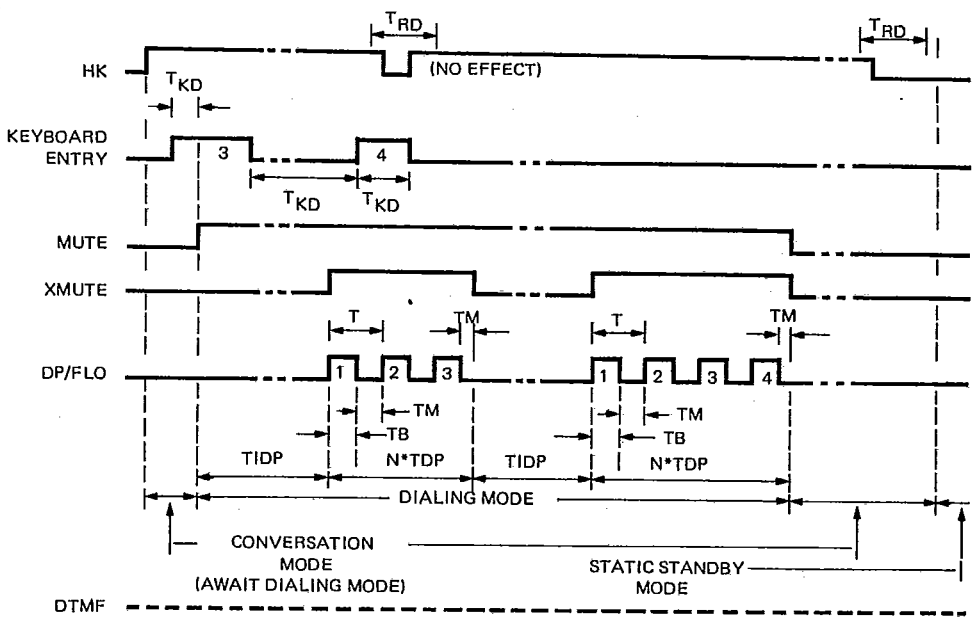


Fig. 5a Timing diagram for pulse mode (MODE SELECT = V_{SS})

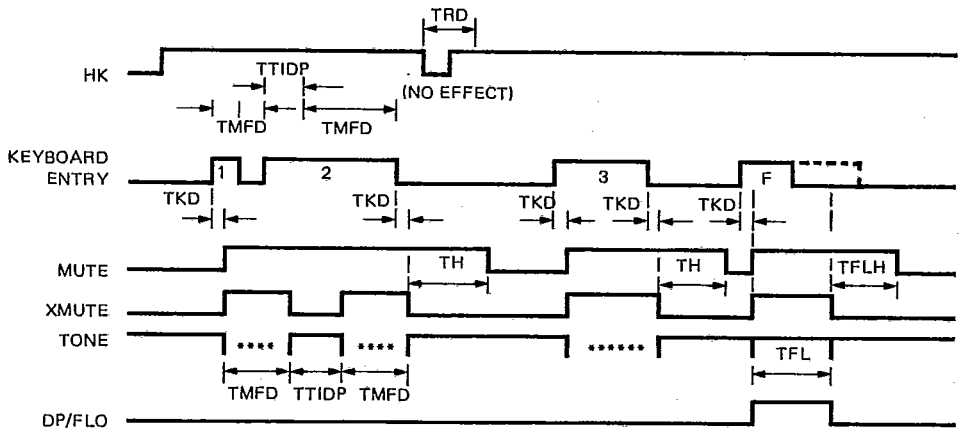


Fig. 5b Timing diagram for DTMF dialing mode (MODE SELECT = V_{DD})

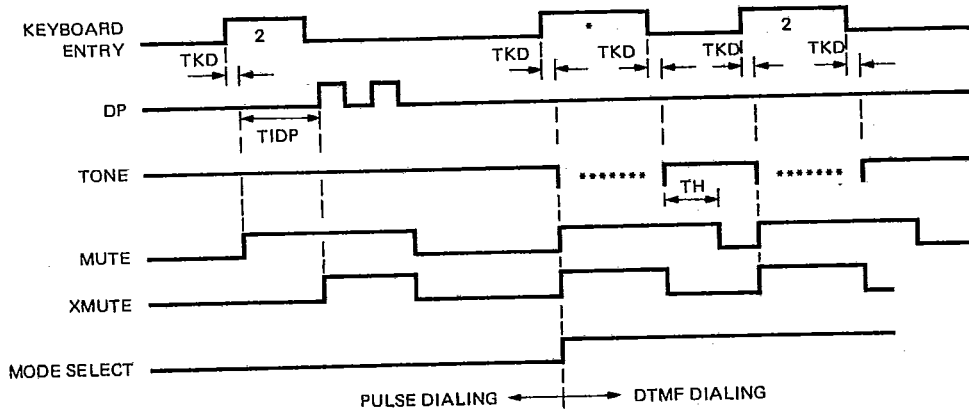


Fig. 5c Timing diagram for mixed dialing mode (MODE SELECT = open-circuit)

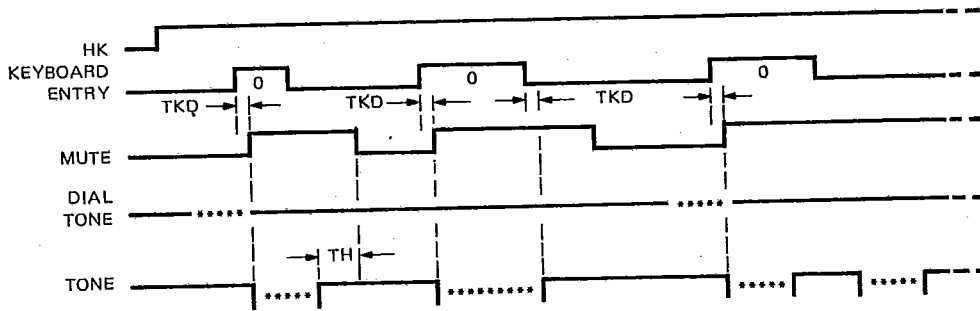


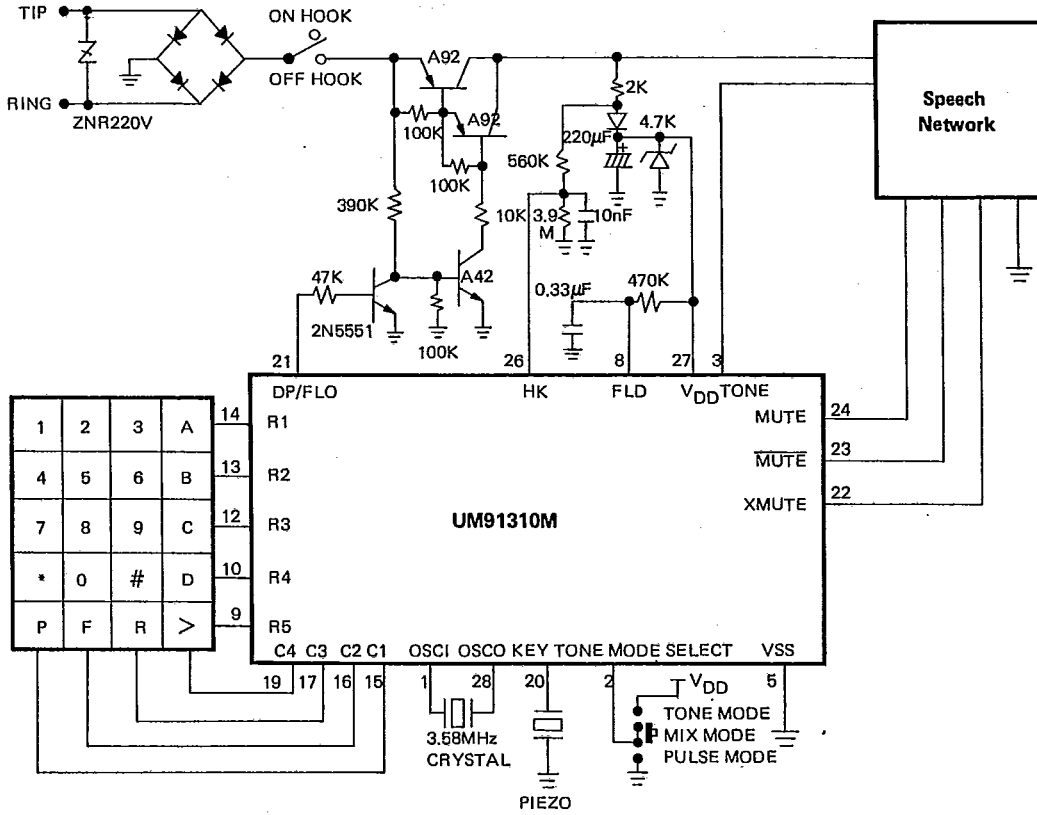
Fig. 5d Timing diagram showing REDIAL where PABX access digits are the first keyboard entries; DTMF dialing with MODE SELECT = V_{DD}



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Application Circuit



Ordering Information

Part No.	M/B Ratio	Key-In Tone	Package
UM91310	1:2	Available	20 DIP
UM91310A	2:3	Available	20 DIP
UM91310B	Pin Selectable	Not Available	20 DIP
UM91310M	1:2	Available	28 SO
UM91310AM	2:3	Available	28 SO
UM91310BM	Pin Selectable	Not Available	28 SO