UMC

UM91230C/D

Tone/Pulse Dialer

Features

- Tone/Pulse switchable (touch key or slide switch)
- 32 digit capacity for redialing
- Automatic mix redialing (last number redial) of pulse → DTMF with multiple automatic access pause
- PABX auto-pause for 3.6-sec
- Key-in-tone output for valid key entry in pulse mode (F_{KT} = 1.8 KHz, T_{KT} = 23 ms)
- Numbers dialed manually after redial are cascadeable and stored as additional numbers for next redialing
- Uses inexpensive TV crystal (3.58 MHz)
- Make/break ratio (33⅓ / 66⅔ or 40-60) pin selectable
- Touch key hooking (580 ms)
- 4 x 4 or (2 of 8) keyboard available
- Low standby current
- Low power CMOS process (2.0 to 5.5V)

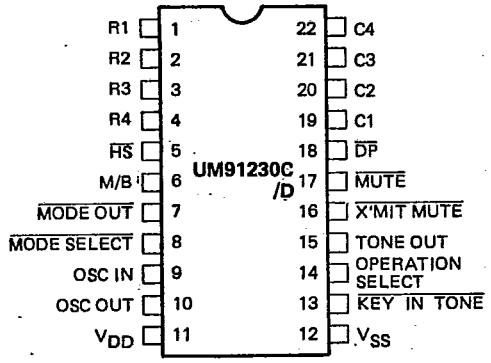
General Description

The UM91230C/D is a TONE/PULSE switchable dialer with a 32-digit redial memory. Through pin selection, switching from pulse to DTMF mode can be done using slide switch or by depressing [T] key.

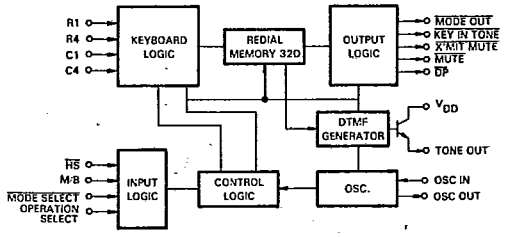
All necessary dual-tone frequencies are derived from a 3.58 MHz TV crystal, providing high accuracy and stability. The required sinusoidal wave form for each individual tone is digitally snythesized on the chip. The waveform so generated has low total harmonic distortion (7% max). A voltage reference is generated on the chip which is stable over the operating voltage and temperature range, and regulates the signal levels of the dual tones to meet telephone industry specifications.

CMOS technology is used to produce this device, resulting in low power requirements, high noise immunity, and serves as an easy interface to a variety of telephones requiring few external components.

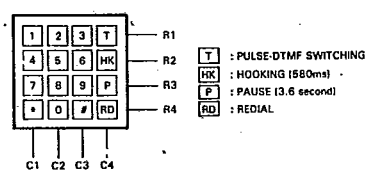
Pin Configuration



Block Diagram



Arrangement of Keyboard



Absolute Maximum Ratings*

Supply Voltage, V_{DD} ..... ⩽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}
($\overline{DP}$, $\overline{MUTE}$, $\overline{X'MIT\ MUTE}$, $\overline{MODE\ OUT}$, $\overline{KT}$) .. ⩽V_{DD}
Tone Output Current, I_{TONE} ..... ⩽50mA
Power Dissipation, P_D ..... ⩽500mW
Operating Temperature, T_{OPR} ..... −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. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

Electrical Characteristics

(V_{SS} = 0V, V_{DD} = 3.5V, $F_{X'tal}$ = 3.58 MHz, T_{op} = 25°C unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions		
V_{DD} P	Operating Voltage Range	2.0		5.5	V	Pulse mode	All inputs connected to V_{DD} or V_{SS}	
V_{DD} T		2.0		5.5		Tone mode		
V_{DR}	Memory Retention Voltage	1.0			V	$\overline{HS}$=V_{DD}		
I_{DD} P	Operating Supply Current		0.3	0.5	mA	One key selected $\overline{HS}$ = V_{SS} All outputs unloaded		$\overline{MODE}$=V_{DD}
I_{DD} T			0.5	1.0	mA			$\overline{MODE}$=V_{SS}
I_{SD1}	Standby Current		0.03	0.05	μA	No key selected All outputs unloaded		$\overline{HS}$=V_{DD}=1.5V
I_{SD2}			30	50				$\overline{HS}$=V_{SS}
I_{OL1}	Output Current	1.7	5.0		mA	$\overline{DP}$, $\overline{MUTE}$	V_{OL}=0.4V	V_{DD}=3.5V
I_{OL2}		0.5	1.5			$\overline{XMIT\ MUTE}$		V_{DD}=2.5V
I_{OFF}	Input Leakage Current			1.0	μA	$\overline{MODE\ OUT}$, $\overline{KT}$	V_{OUT}=2.5V	
V_{IH}	Input Voltage	0.8 V_{DD}		V_{DD}	V	R1-R4, C1-C3, $\overline{HS}$, M/B		
V_{IL}		V_{SS}		0.2 V_{DD}		OPERATION SELECT, $\overline{MODE\ SELECT}$		
	Input Current		116		μA	R1-R4	V_{DD}=3.5V, V_{IN}=0V	
			50				V_{DD}=2.5V, V_{IN}=0V	
Tkd	Valid Key Entry Time	23		25.3	mS			
Fcr	Column and Row Scanning Frequency		445		Hz			
T_{KT}	Key-In Tone Output Duration		23		mS			
F_{KT}	Key-In Tone Frequency		1.8		KHz			
Tap	Auto Access Pause Time		3.6		sec			
Vor	Tone Output	−16.0		−12.0	dBV	Row tone only	V_{DD}=2.5V, RL=5K	
		−14.0		−11.0	dBV		V_{DD}=3.5V, RL=5K	
dBcr	Ratio of Column to Row Tone		2.0		dB	V_{DD}=3.5V		
%DIS	Distortion			10	%	V_{DD}=3.5V		
T psd	Tone Output Delay Time		1.5		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	1,209	1,215.7	+0.57
C2	1,336	1,331.7	−0.32
C3	1,477	1,471.9	−0.35

Tone Duration & Pause in Redial

Parameter	Symbol	Typ.	Unit
Tone Duration	TD	110	ms
Minimum Pause	ITP	110	ms
Cycle Time	TC	220	ms

Pin Description

Keyboard (R_1, R_2, R_3, R_4, C_1, C_2, C_3, C_4)

These inputs can serve as an interface to an XY matrix keyboard. $C_1 \sim C_4$ & $R_1 \sim R_4$ are set to low at On Hook ($\overline{HS}$ = high). $C_1 \sim C_4$ key inputs are set to low and $R_1 \sim R_4$ are set to high at Off Hook (HS = low) which enables the key-input operation.

Oscillator starts running when a keypress is detected. Scanning signals are presented at both column and row inputs (Typ.: 445 Hz) until the input key is released. Key inputs are compatible with standard 2-of-8 form or signle-contact keyboard. Debouncing is provided to avoid false entry (typ.: 23 ms)

Hook Switch ($\overline{HS}$)

This input detects the state of the hook switch contact. "Off Hook" corresponds to V_{SS} condition. "On Hook" corresponds to V_{DD} condition.

Make/Break Ratio (M/B)

This input provides the selection of the Make/Break ratio (33 1/3:66 2/3/40:60) when M/B is connected to V_{DD}/V_{SS}.

Oscillator Input/Output (OSC IN, OSC OUT)

These pins are provided to connect an external 3.58 MHz crystal. Oscillation starts (at Off Hook) and is sustained until pulse or DTMF signal are finished.

Mode Output ($\overline{MODE\ OUT}$)

This output indicates whether the chip is operating in pulse or tone mode. Pulse/Tone mode corresponds to OFF/ON state (N channel open drain). Mode state is controlled with Operation Select, $\overline{Mode\ Select}$ and [T] key inputs.

Key-In Tone Output ($\overline{KEY\ IN\ TONE}$)

Key-in-tone signal is provided only in pulse mode for all key-ins except [T] key-in. No $\overline{KEY\ IN\ TONE}$ generated in DTMF mode. F_{KT}: 1.8 KHz, T_{KT}: 23 ms. (N channel open drain).

Dial Pulse Out ($\overline{DP}$)

The normal output will be "OFF" during Break and "ON" during make at "Off Hook" (HS = V_{SS}). The Output will be "ON" at "ON HOOK". (N channel open drain).

DTMF Signal Output (TONE OUT)

When a valid keypress is detected in DTMF Mode appropriate low group and high group frequencies are generated which hybridize the Dual Tone Output. Tone out is Off state in pulse mode.

X'mit Mute Output (X'MIT MUTE)

HS	X'MIT MUTE Output
V_{DD}	OFF
V_{SS}	Normally "OFF" "ON" during Pulse and DTMF Dialing

(N channel open drain)

Mute Output (MUTE)

$\overline{HS}$	MUTE Output
V_{DD}	OFF
V_{SS}	Normally "OFF" in DTMF mode, "ON" during pulse dialing

(N channel open drain)

Power (V_{DD}, V_{SS})

These are the power supply inputs. This device is designed to operate on 2.0V to 5.5V.

Operation Select Input (OPERATION SELECT)

Mode switching (from Pulse to DTMF) entry is selectable with this input, i.e. whether [T] key entry or $\overline{\text{MODE SELECT}}$ input entry is selectable via this pin.

Mode Select Input ($\overline{\text{MODE SELECT}}$)

Pulse/DTMF mode is selected as shown in the following table. Initial Mode means the state after going Off Hook ($\overline{HS} \rightarrow V_{SS}$).

Operation Select	$\overline{\text{MODE SELECT}}$	Initial Mode	Switching Entry Mode	Notes
V_{DD}	V_{DD}	Pulse	[T] key-IN	$\overline{\text{Mode Select}}$ defines only initial mode after going Off Hook and is latched at first key entry.
	V_{SS}	Tone	N/A	
V_{SS}	V_{DD}	Pulse	$\overline{\text{MODE SELECT}}$ input=V_{SS}	[T] key is disabled under this condition.
	V_{SS}	Tone	N/A	

If choice of switching method is desired (either [T] key or $\overline{\text{MODE SELECT}}$), OPERATION SELECT should be connected to $\overline{\text{MODE SELECT}}$ in order to avoid false operation.

Single Tone Operation in DTMF Mode (Test Mode)

The [*] and [#] keys are used to trigger the chip into test mode by depressing them simultainously at "Off" "Hook" The single tone is shown in the following table which contrast with normal mode.

Normal mode

R_1	1	2	3
R_2	4	5	6
R_3	7	8	9
R_4	*	0	#
	C_1	C_2	C_3

Single tone mode

R_1	R_1	C_2	C_3
R_2	C_1	C_2	R_2
R_3	R_3	C_2	C_3
R_4	C_1	R_4	C_3
	C_1	C_2	C_3

Keyboard Operation

SINGLE MODE OPERATION

Pulse Mode Operation

[Off Hook] [D_1] ..... [D_n]

Pulse mode is defined by the initial mode after going Off Hook and latched at [D_1] key-entry. This is the condition under $\overline{\text{MODE SELECT}} = V_{DD}$.

Tone Mode Operation

1) [Off Hook] [D_1] ..... [D_n]

Tone mode is defined by the initial mode after going Off Hook and latched at [D_1] key entry. This condition is under $\overline{\text{MODE SELECT}} = V_{SS}$.

2) [Off Hook] [T] [D_1] ..... [D_n]
If initial mode is at pulse mode after going Off Hook and $\overline{\text{MODE SELECT}}$ = V_{DD}. Switching mode from pulse to tone can be done by [T] key entry and latched at [D_1] key entry.

Manual Dialing with Automatic Access Pause

[Off Hook] [O] [P] [D_1] ..... [D_n]
Multiple pause key entries can be accepted and stored in the redial memory, each as on digit. Each [P] key provides 3.5 seconds pause time, but [P] key entry as first digit after going Off Hook is ignored.

[*] key can also be used as pause key in pulse mode. Pause(s) can be cancelled with [P] [T] or [RD] key during pause time in redialing.

Redial

[Off Hook] [RD]
Up to 32 digits can be dialed with [RD] key. [RD] key is disabled while pulse or DTMF signals are transmitting. When more than 32 digits are stored in redial memory, redial is also inhibited.

[#] key can be used as [RD] key in pulse mode.

Inhibiting Redial

[Off Hook] [D_1] ..... [D_n] [RD] [RD]
Redial can be inhibited by depressing [RD] [RD] keys after DTMF or pulse signals are transmitted.

PULSE/TONE SWITCHABLE OPERATION

Mode Switching by $\overline{\text{MODE SELECT}}$ Input (OPERATION SELECT = V_{SS})

[Off Hook] [D_1] ..... [D_n] [P] [Switching $\overline{\text{MODE}}$]
Pulse Mode
$\overline{\text{SELECT}}$ to V_{SS} [D_{n+1}] ..... [D_{n+m}]
DTMF Mode

Pulse mode is initially defined with $\overline{\text{MODE SELECT}}$ = V_{DD}. Mode switching to DTMF can be accepted by $\overline{\text{MODE SELECT}}$ = V_{SS}. DTMF Mode will be set up after pulse mode is finished. In this mode, digits [D_{n+1}] ..... [D_{n+m}] are transmitted from Tone Out as DTMF signals by depressing corresponded keys.

If no [P] key is contained serially before or after mode switching.

[Off Hook] [D_1] ..... [D_n] [Switching $\overline{\text{MODE}}$]
Pulse Mode
$\overline{\text{SELECT}}$ to V_{SS} [D_{n+1}] ..... [D_{n+m}] (D_n, D_{n+1} ≠ Pause)
DTMF Mode

It results the next condition:

(1) If digit [D_{n+1}] is depressed after pulse mode is finished, DTMF mode will be set up after last pulse signal ([D_n]) is output. In this mode, digits [D_{n+1}] ..... [D_{n+m}] are transmitted from Tone Out as DTMF signals by depressing corresponded keys.

(2) If digit [D_{n+1}] is depressed during dialing pulse signals, DTMF mode but in Hold state will be set up after last pulse signal [D_n] is finished. MODE OUT will flash to indicate this Hold state, [D_{n+1}] ..... [D_{n+m}] are stored in redial memory as DTMF data and not transmitted from Tone Out. When it is ready to transmit DTMF data in redial memory, [T] [RD] or [P] keys is depressed to reset this Hold state and [D_{n+1}] ..... [D_{n+m}] data are serially transmitted.

Mode Switching by [T] key (OPERATION SELECT = V_{DD}).

[Off Hook] [D_1] ..... [D_n] [P] [T] [D_{n+1}]
Pulse Mode
Tone Mode
..... [D_{n+m}]

Pulse mode is initially defined with $\overline{\text{MODE SELECT}}$ = V_{DD}. Mode switching to DTMF can be accepted by [T] key. In DTMF mode, digits [D_{n+1}] ..... [D_{n+m}] are transmitted from Tone Out as DTMF signals by depressing corresponded key.

If no [P] key is contained serially before or after [T] key.

[Off Hook] [D_1] ..... [D_n] [T] [D_{n+1}] ..... [D_{n+m}] (D_n, $D_{n+1} \neq$ [P])

Pulse Mode → ← Tone Mode

it results the next condition:

(1) If digit [D_{n+1}] is depressed after pulse mode is finished, DTMF mode will be set up after last pulse signal [D_n] is output. In this mode, digits [D_{n+1}] ..... [D_{n+m}] are transmitted from TONE OUT as DTMF signals by depressing corresponded key.

(2) If digit [D_{n+1}] is depressed during dialing pulse signals, DTMF mode but in Hold state will be set up after last pulse signal [DN] is finished. $\overline{\text{MODE OUT}}$ will flash to indicate this Hold State, digits [D_{n+1}] ..... [D_{n+m}] are stored in redial memory as DTMF data and not transmitted from Tone Out. When it is ready to transmit DTMF data in redial memory, [T], [RD] or [P] keys is depressed to reset this Hold state and [D_{n+1}] ..... [D_{n+m}] data are serially transmitted.

Redial with Hold State Cancel

[Off Hook] [RD] [T] (or [P], [RD] key)

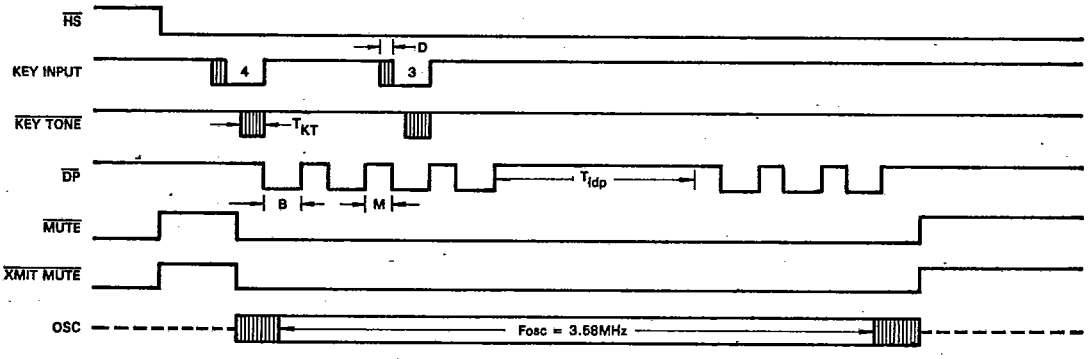
(1) Pause time can be cancelled with [P], [T] or [RD] keys during pause time in redialing. Any pause in series with corresponding pause is also cancelled.

(2) When any pause is not stored before or after mode switching, chip will go into the Hold state when DTMF mode is set up. $\overline{\text{MODE OUT}}$ will flash to indicate this Hold state. DTMF data are stored in redial memory and not transmitted from tone out.

[T] [RD] or [P] keys is depressed to reset this Hold state and DTMF data are serially transmitted.

Timing Diagram

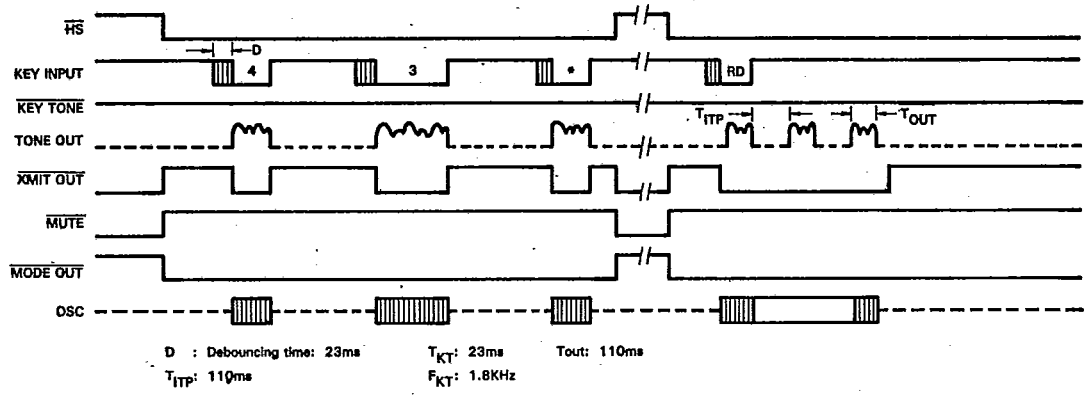
TIMING DIAGRAM IN PULSE MODE: ($\overline{\text{MODE SELECT}}$ = V_{DD})



D : Debouncing time: 23ms T_{KT}: 23ms

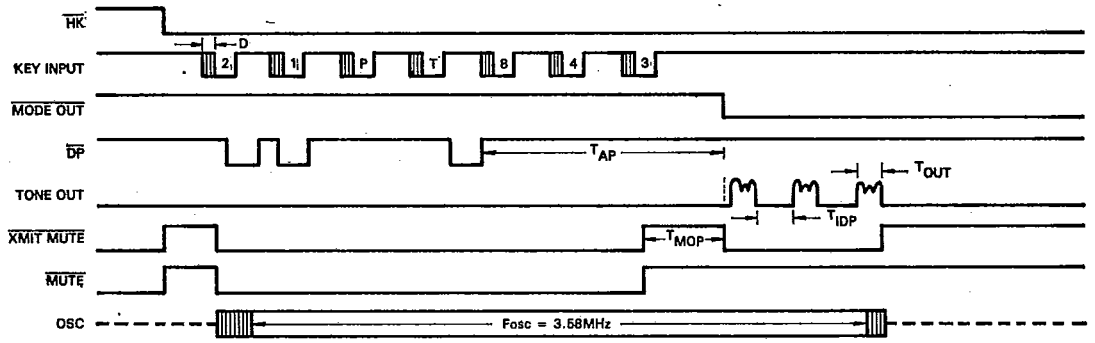
T_{idp}: Inter-digit pause: 805ms F_{KT}: 1.8KHz

TIMING DIAGRAM IN TONE MODE: ($\overline{\text{MODE SELECT}}$ = V_{SS})

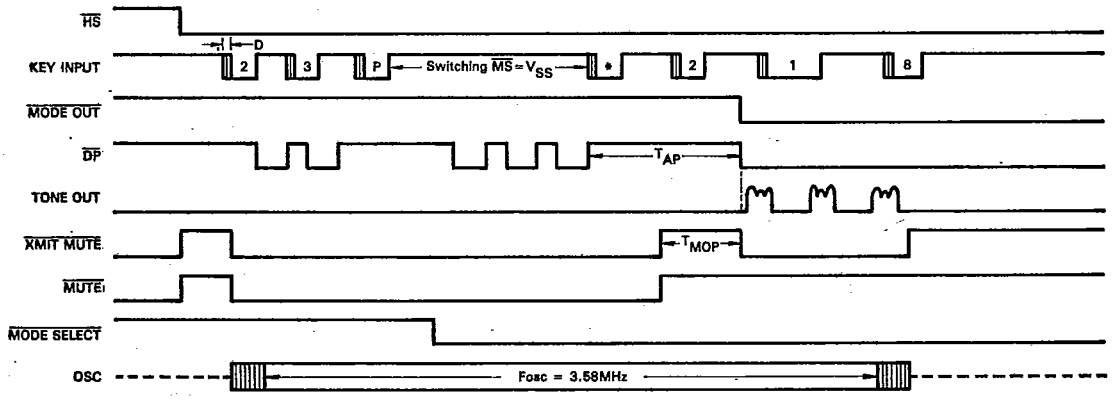


D : Debouncing time: 23ms T_{KT}: 23ms Tout: 110ms
T_{ITP}: 110ms F_{KT}: 1.8KHz

TIMING DIAGRAM FOR SWITCHING MODE OPERATION BY [T] KEY (OPERATION SELECT, $\overline{\text{MODE SELECT}}$ = V_{DD})



TIMING DIAGRAM FOR SWITCHING MODE OPERATION BY $\overline{\text{MODE SELECT}}$ INPUT (OPERATION SELECT = V_{SS})

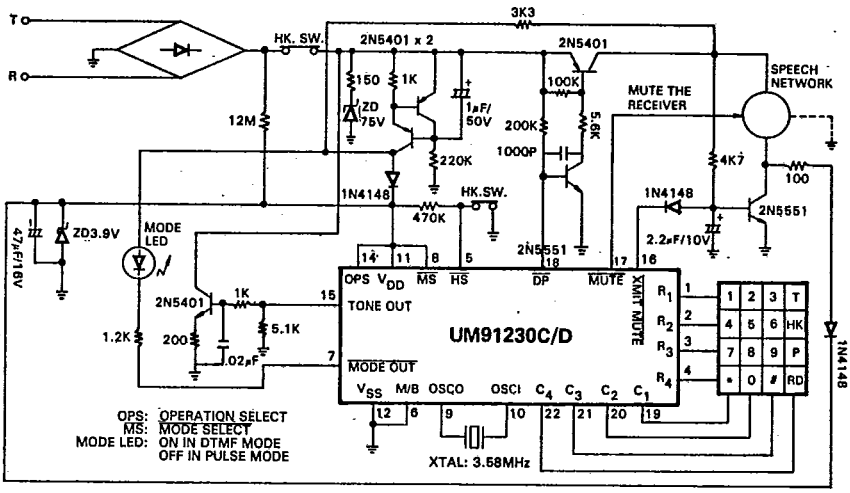


UMC

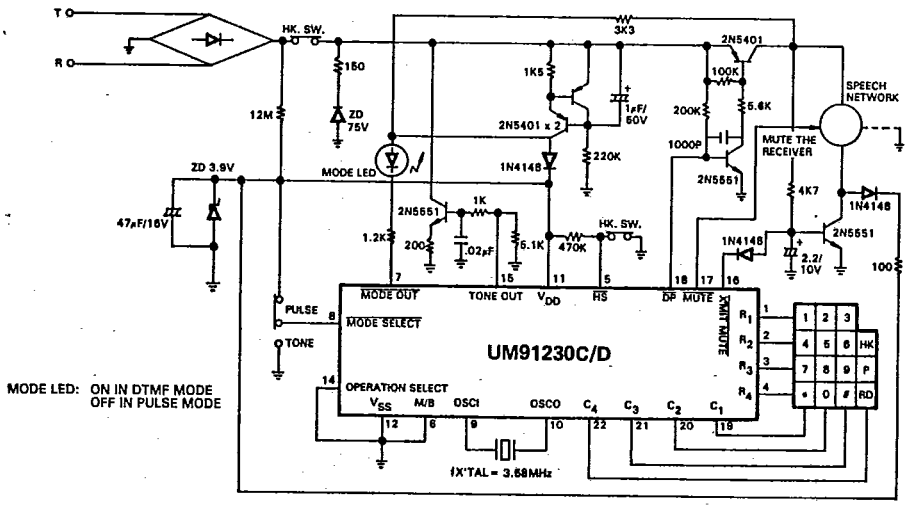
UM91230C/D

Typical Application

SWITCHING MODE BY [T] KEY ($\overline{\text{MODE SELECT}}$, OPERATION SELECT = V_{DD})



SWITCHING MODE BY $\overline{\text{MODE SELECT}}$ (OPERATION SELECT = V_{SS})



Order Information

Part Number	Dial Pulse	Dial Pulse Rate (PPs)	Tidp	Make/Break Ratio
UM91230C	$\overline{DP}$	10 PPS	805 ms	V_{DD}: 33.3/66.6
				V_{SS} : 40-60
UM91230D	$\overline{DP}$	20 PPS	805 ms	V_{DD}: 33.3/66.6
				V_{SS} : 40-60