



UM91531

Parallel Input Tone/Pulse Dialer

Features

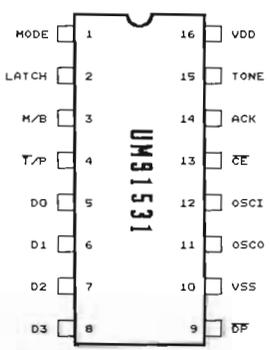
- 4-bit parallel data input from microcomputer
- TTL compatible inputs and outputs
- Uses TV crystal standard (3.58 MHz) to derive all frequencies, providing high accuracy and stability
- Operating voltage: 2.5 to 5.5 Volts
- Selectable M/B ratio
- 10 PPS dial rate
- DTMF signaling of digits 0-9, *, #, A, B, C, and D
- Pulse signaling of 0-9, *, #, and A
- High group tone pre-emphasis: 2 dB
- Low total harmonic distortion in DTMF signaling
- RS-470 and CEPT compatible

General Description

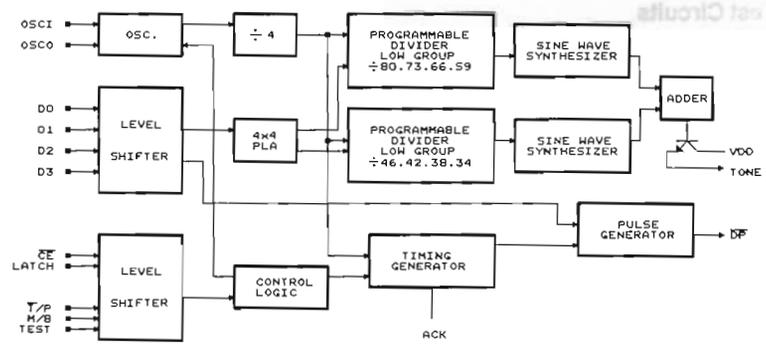
The UM91531 provides a 4-bit data input and a handshaking signal to serve as microcomputer interfaces. Under microcomputer control, the UM91531 generates both a DTMF signal and a pulse output for telephone dialing. All necessary dual-tone frequencies and dial pulse outputs are derived from the widely

used TV crystal standard, providing high accuracy and stability. The required sinusoidal waveform for individual tones is digitally synthesized on the chip, resulting in a waveform with very low total harmonic distortion.

Pin Configuration



Block Diagram



Absolute Maximum Ratings*

Power Supply Voltage (VDD - VSS) . . . -0.3V to +10.0V
 Input Voltage (V_{IN}) -0.3V to VDD +0.3V
 Maximum Power Dissipation (at 25°C) 600mW
 Operating Temperature (Top) -20°C to +70°C
 Storage Temperature (TSTG) -55°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 = 3.5V, VSS = 0V, Fosc = 480 KHz, TOP = 25 °C)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Test CKT.
Operating Voltage	VDD	2.5		5.5	V		B
Supply Operating Current	I _{DDP}		0.42	1	mA	$\overline{CE} = VSS$ All outputs unloaded	B
	I _{DDT}		0.42	1			
Stand-by Current	I _{SD}		5	8	μA	$\overline{CE} = VDD$. All outputs unloaded	A
\overline{DP} Output Sink Current	I _{OL1}	1			mA	VDD = 2.5V, V _{OL} = 0.4V	C
	I _{OL2}	3			mA	VDD = 5.0V, V _{OL} = 0.4V	
Input Voltage Range	V _{IH}	0.8		1	VDD		-
	V _{IL}	0		0.2			
Input Current Range	I _{IH}		0.05		μA		-
	I _{IL}		-0.05		μA		
Mode Pull-up Resistance	R _M	40			K Ω	VDD = 2.5V	-
		20			K Ω	VDD = 5V	C
ACK Source Current	I _{OHACK}	1.6			mA	VDD = 5V, V _{OH} = 2.4V	C
ACK Sink Current	I _{OLACK}	4.0			mA	VDD = 5V, V _{OL} = 0.4V	
D0, D1, D2, D3 T/P, M/B, LATCH, \overline{CE}	These pins TTL compatible I/O						-
Single Row Tone Output Amplitude	V _{OR}	779	840	910	mV _{P-P}	VDD = 2.5V, R _L = 2.2 K Ω	B
		980	1070	1160		VDD = 2.5V, R _L = 2.2 K Ω	

DC Electrical Characteristics (continued)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Test CKT.
Single Column Tone Output Amplitude	VOR	980	1060	1160	mVp-p	VDD = 2.5V, RL = 2.2 K Ω	B
		1250	1350	1450		VDD = 5.5V, RL = 2.2 K Ω	
Pre-emphasis	Twist	1	2	3	dB		B
Valley of Single Tone	Vv		0.35		VDD	VDD = 3.5V	B
Distortion	DIS		1	5	%	See note	B

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

- 1). V_1, \dots, V_n are the intermodulations or the harmonic frequencies in the 500 Hz to 3400 Hz band and,
- 2). V_{IH} and V_{IL} are the individual frequency components of the DTMF signal.

AC Characteristics (VDD = 3.5V, VSS = 0V, Fosc = 3.579 MHz, Top = 25°C, unless otherwise specified.)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
PULSE						
Make/Break Ratio	M/B		1/2			M/B = VDD
			2/3			M/B = VSS
Make Time	TM		33.3		ms	M/B = 1/2
			40			M/B = 2/3
Break Time	TB		66.6		ms	M/B = 1/2
			60			M/B = 2/3
Inter-digit Pause Time	TIDP		790		ms	M/B = 1/2
			783			M/B = 2/3
Predigit Pause	TPDP		15		ms	M/B = 1/2
			15			M/B = 2/3

AC Characteristics (continued)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
TONE						
Minimum Tone Duration	T _{MFD}		70		ms	
Minimum Tone Inter-digit Pause	T _{TIDP}		70		ms	
Tone Output Pre-digit Pause	T _{TPDP}		0		ms	
Oscillator Set-up Time	T _{START}		5		ms	

Pin Description

Pin No.	Designation	Description
1	MODE	Tone mode select input When this input is high, the tone output and ACK output are normal. When this input is low, a DTMF signal will be generated continuously and any new input data will be ignored This input affects the tone output mode only
2	LATCH	Latch input When input on this pin changes from low to high (at the rising edge), the UM91531 latches the 4-bit input data and T/P input. The latch input should not be changed back from low to high again until the ACK output falls low, and new data must not be latched while the ACK output is still low
3	M/B	Make/Break ratio select input This pin is used to select one of two available make/break ratios. A high input selects the 2/3 make/break ratio; a low input selects the 1/2 ratio. This input should be connected to VDD or VSS only. Changing the state of this pin when CE is active (low) enables the test mode
4	T̄/P	Tone/pulse mode select input This input determines whether tone or pulse mode will be activated. It is latched together with the 4-bit data input
5 - 8	D0 - D3	4-bit data input pins This 4-bit parallel input is used to receive data generated by the microcomputer. (Input data vs. output signal is shown in table 1.) Valid input data should be presented at these inputs before and during the rising edge of the latch signal

Pin Description (continued)

Pin No.	Designation	Description
9	$\overline{\text{DP}}$	Dial pulse output This dial pulse output consists of an N-channel open drain device. During dial pulse break periods this output is switched on (sinking current to VSS); it is switched off during all other states. Dialing rate is 9.71 PPS and post-digit pause is 823 ms. (The output of this pin during test mode is discussed below)
10 16	VSS VDD	Negative power supply input Positive power supply input (operating range 2.5 to 5.5 volts)
11 12	OSCO OSCI	Oscillator output Oscillator input The UM91531 contains an oscillator circuit with the necessary parasitic capacitance and feedback resistor on chip, making it necessary to connect only a standard 3.58 MHz TV crystal across the OSCI and OSCO terminals to implement the oscillator function. An external clock input can be applied to the OSCI pin directly. The oscillator is enabled when the $\overline{\text{CE}}$ input is low
13	$\overline{\text{CE}}$	Chip enable input This input controls the onset of oscillation and serves as the master reset for this device
14	ACK	Acknowledge output This pin provides an acknowledge signal to the microcomputer. This output is high when the device is ready to dial out the next digit; it falls low immediately after the rising edge of the latch signal
15	TONE	DTMF signal output This pin consists of an NPN transistor output, with the collector connected to VDD. This pin is also connected to the emitter output. The internally generated DTMF signal is delivered to the base of the NPN transistor and is amplified as the transistor connected in common collector or Darlington output forms. DTMF signaling output time is 70 ms and the interdigit interval is 70ms. Typical output impedance of the DTMF signal is 1.25 Kohm, and the hFE of the NPN transistor is at least 30 at Ic = 3 mA

Functional Description

Input Data vs. Output Signal

Parallel binary signals on D0-D3 pins are input from microcomputer. Output signal vs. input data is shown in table 1:

D3	D2	D1	D0	DTMF Signaling	PULSE Signal (O/P Pulse No.)
0	0	0	0	0	10
0	0	0	1	1	1
0	0	1	0	2	2
0	0	1	1	3	3
0	1	0	0	4	4
0	1	0	1	5	5
0	1	1	0	6	6
0	1	1	1	7	7
1	0	0	0	8	8
1	0	0	1	9	9
1	0	1	0	*	10
1	0	1	1	#	11
1	1	0	0	A	12
1	1	0	1	B	13
1	1	1	0	C	14
1	1	1	1	D	Forbidden input

Table 1.

Input Data vs. Output Signal in Test Mode

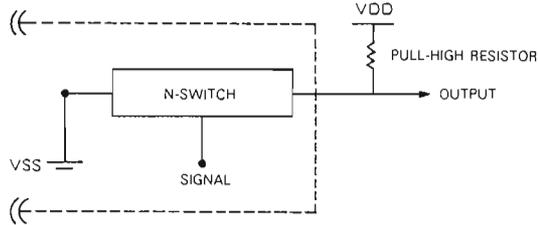
The UM91531 provides a high speed pulse/tone output for testing consideration. If the M/B input changes state after the UM91531 is enabled, the test

mode is initiated and the device will remain in test mode unless disabled. Table 2 shows input data vs. output signal in pulse/tone test mode.

D3, D2, D1, D0 Input In Hex Code	Tone O/P Frequencies and Test Mode				Pulse O/P Frequencies and Test Mode	
	Tone Pin O/P	Unit	\overline{DP} Pin O/P	Unit	\overline{DP} Pin O/P	Unit
0	948.0	Hz	1,331.7 x 8	Hz	10 x 48	Hz
1	699.1	Hz	1,215.9 x 8	Hz	1 x 48	Hz
2	1,331.7	Hz	699.1 x 8	Hz	2 x 48	Hz
3	1,417.9	Hz	699.1 x 8	Hz	3 x 48	Hz
4	1,215.9	Hz	766.2 x 8	Hz	4 x 48	Hz
5	1,331.7	Hz	766.2 x 8	Hz	5 x 48	Hz
6	766.2	Hz	1,471.9 x 8	Hz	6 x 48	Hz
7	847.4	Hz	1,215.9 x 8	Hz	7 x 48	Hz
8	1,331.7	Hz	847.4 x 8	Hz	8 x 48	Hz
9	1,471.9	Hz	847.4 x 8	Hz	9 x 48	Hz
A	1,215.9	Hz	948.0 x 8	Hz	10 x 48	Hz
B	1,471.9	Hz	948.0 x 8	Hz	11 x 48	Hz
C	1,645.0	Hz	699.1 x 8	Hz	12 x 48	Hz
D	1,645.0	Hz	766.2 x 8	Hz	13 x 48	Hz
E	1,645.0	Hz	847.4 x 8	Hz	14 x 48	Hz
F	1,645.0	Hz	948.9 x 8	Hz	0	Hz

Note: Tone Pin P/O in sine wave, \overline{DP} Pin O/P in square wave. The normal timing is reduced to 1/8 at tone test mode and 1/48 at pulse test mode.

Table 2.

N-Channel Open Drain Output

DTMF Generator

The DTMF signal is produced from the tone frequency generator circuit with an NPN transistor-emitter-follower output buffer (Figure 1). The digitally synthesized sinewave has a 7-level, 16 segment (1.1V + 1.3V) reference voltage (Figure 2). The DTMF's

total harmonic distortion is 5% maximum. Total harmonic distortion (THD) vs. operating voltage and DTMF output vs. operating voltage is shown in Figures 3 and 4.

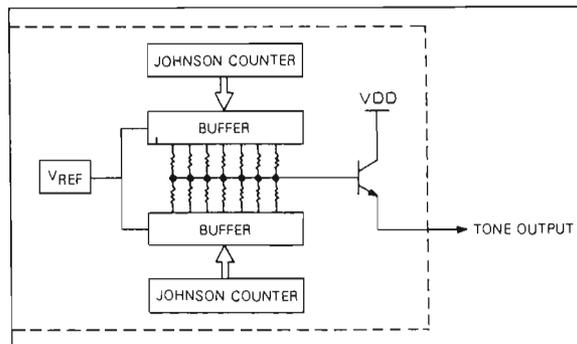


Figure 1.

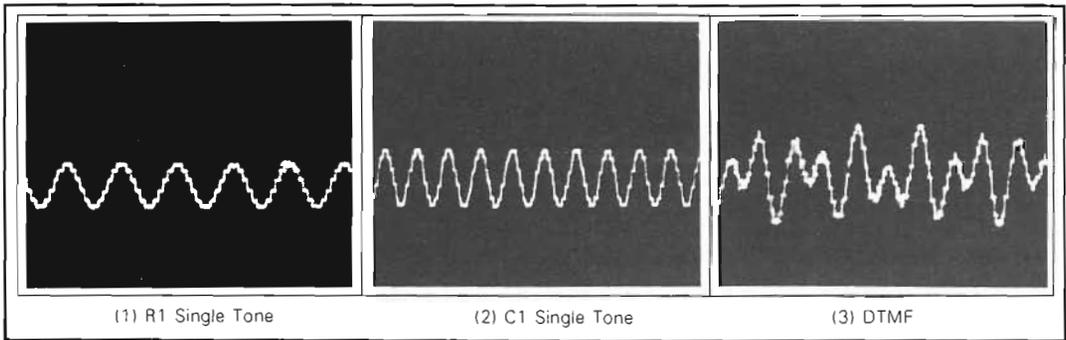


Figure 2. DTMF Waveforms

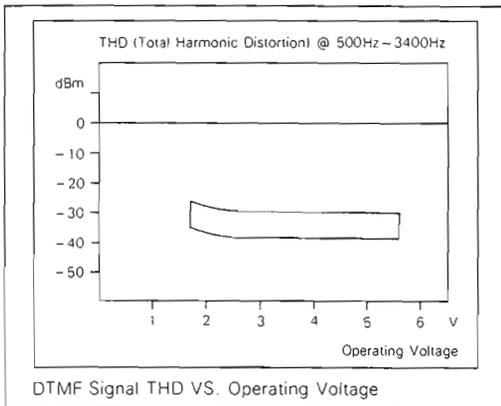


Figure 3

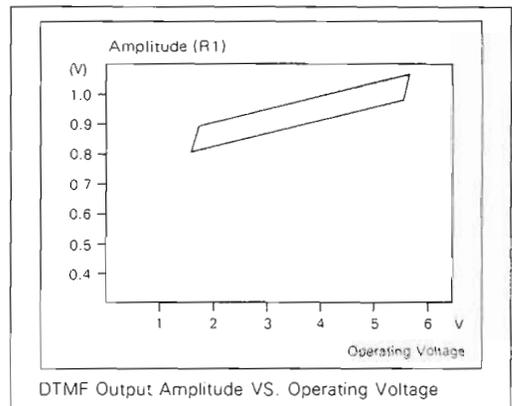
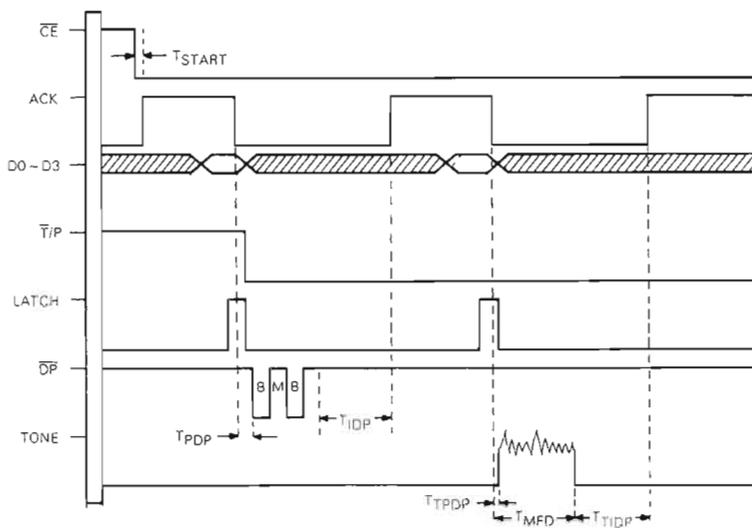
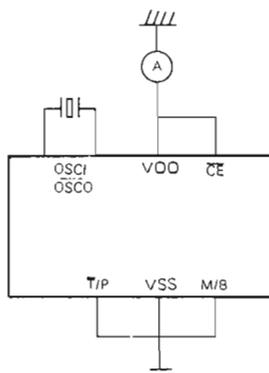
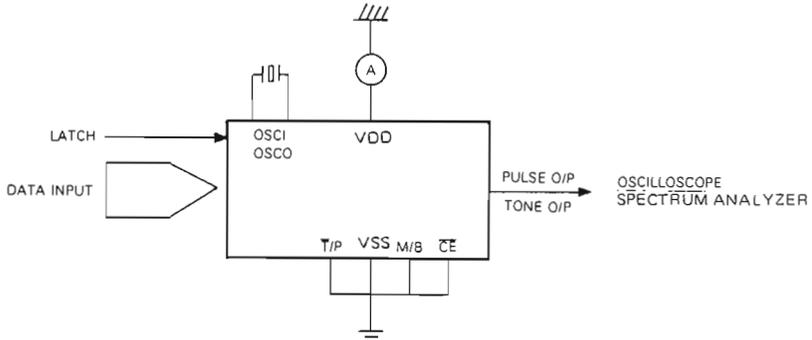
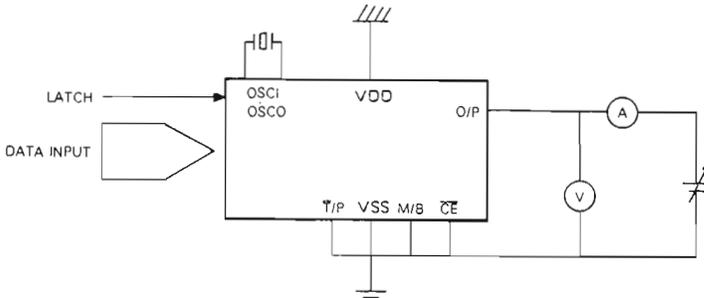


Figure 4

Timing Waveform

Test Circuits
(A)


Dialer

(B)

(C)

Ordering Information

Part No.	Package
UM91531	16L DIP