

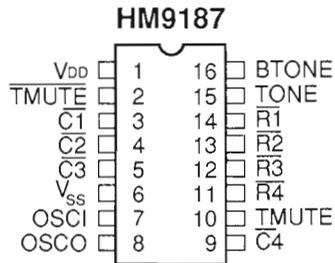
General Description

The HM9187 are tone dialer, which are fabricated in CMOS technology with wide operating voltage for tone mode, and consumes very low current in on hook state.

Features

- * Tone dialer.
- * Uses 3.579545 MHz crystal or ceramic resonator.
- * Power on reset circuit is provided.
- * Package in DIP 16.

Pin Configurations

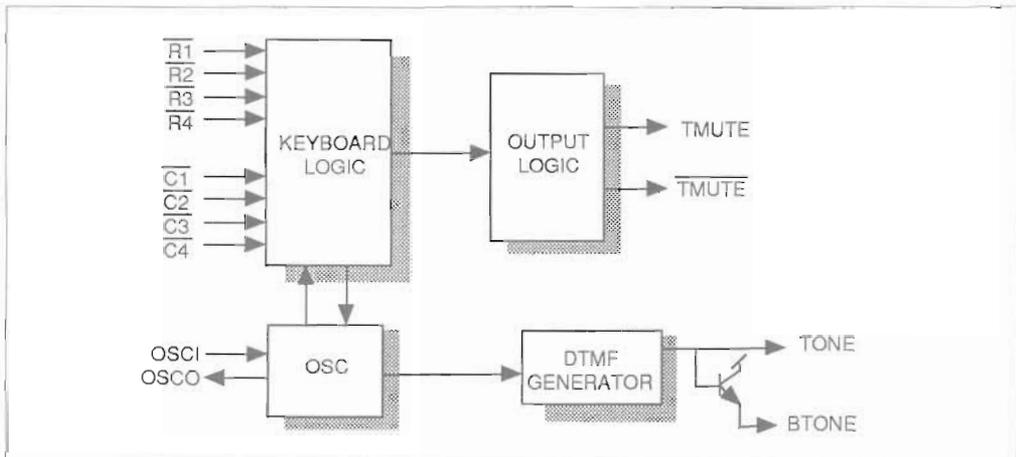


Keyboard Assignment

	C1	C2	C3	C4
R1	1	2	3	A
R2	4	5	6	B
R3	7	8	9	C
R4	*	0	#	D

1). A, B, C, D, : Another DTMF signal key as 0 9

Functional Block Diagram



Pin Description

Pin	Symbol	Function
3	$\overline{C1}$	* Provides keyboard scanning . a. Keyboard scanning: * While power on, the column group stays in "HIGH" state and row group stays in "LOW" state. * The key pad is compatible with the standard dual contact matrix keyboard (as Figure 1b.), the inexpensive single contact keyboard (as Figure 1a.), and electronic input (as Figure 1c.). * A valid key entry is defined by related Row & Column connection or by electronic input; (as show in Figure 1c). * Activation of two or more keys will result in no response, except for single key. * To avoid keyboard bouncing error, this chip provides built-in debounce circuit. (The debounce time = 20 ms.)
4	$\overline{C2}$	
5	$\overline{C3}$	
9	$\overline{C4}$	
14	$\overline{R1}$	
13	$\overline{R2}$	
12	$\overline{R3}$	
11	$\overline{R4}$	



Figure 1a: Single contact form keyboard configuration

Pin	Symbol	Function
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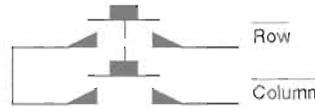


Figure 1b: Dual contact form keyboard configuration

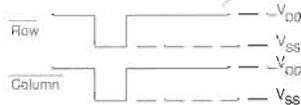


Figure 1c: Electronic signal input keyboard configuration

7	OSCI	* Oscillator input & Oscillator output pins.
8	OSCO	* The 3.579545 MHz oscillator is formed by a built-in inverter inside of this chip and by connecting a 3.579545 MHz crystal or a ceramic resonator across the OSCI and OSCO pins. (built-in feedback resistor and capacitor).
6	V _{SS}	* Negative power supply pin.
1	V _{DD}	* Positive power supply pin.
15	TONE	* Dual Tone Multi-frequency output pin. * In TONE mode, when a entry of digit key (include *, # key), this pin will sent out a corresponding DTMF signal.
10	TMUTE	* Tone mute output pin. * Inverter output structure.
2	$\overline{\text{TMUTE}}$	* Tone mute output pin. * NMOS open drain output structure.
16	BTONE	* Buffer TONE output pin. * Emitter follow output structure.

Keyboard Operation

Symbol definitions:

- \uparrow : OFF-HOOK .
- \downarrow : ON-HOOK .
- D₁, ..., D_n : Digit key; 1,2,3,4,5,6,7,8,9,0,*,#
- D_{1t}, ..., D_{nt} : Tone digit ; 1,2,3,4,5,6,7,8,9,0,*,#

A. Normal Dialing

- Digit Dialing
 Procedure : \uparrow D1, D2, Dn \downarrow
 Dial out : Dt1, Dt2, Dtn in tone mode

Absolute Maximum Ratings (Ambient Temperature is 25°C, All voltage referenced to V_{SS} .)

Characteristics	Sym.	Ratings	Unit
Power Supply Voltage	V_{DD}	6.0	V
Input Voltage Range	V_{in}	-0.3 ~ $V_{DD} + 0.3$	V
Operating Temperature	T_{OPR}	-25 ~ 70	°C
Storage Temperature	T_{STO}	-55 ~ 150	°C
Power Dissipation	P_d	500	mw

Electrical Characteristics (I) (Ambient Temperature is 25°C, All voltage referenced to V_{SS} , $V_{DD} = 2.5V$, unless otherwise noted.)

(General purpose specification, fosc. = 3.579545 MHz)

Parameter	Sym.	Conditions	Limit			Unit
			Min.	Typ.	Max.	
Operating Voltage	V_{DD}	Tone	2.0	-	5.5	V
Operating Current	I_{op}	Tone OFF-HOOK, Keypad entry, no load	-	1.0	2.0	mA
Standby Current	I_s	Power on, no keypad entry, no load	-	1.0	20	μA
Control pin input voltage	V_{il}		V_{SS}	-	$0.3V_{DD}$	V
	V_{ih}		$0.7V_{DD}$	-	V_{DD}	V
TMute pin						
leakage current	I_{mth}		-	-	1	μA
sink current	I_{mtl}	$V_{tmute} = 12.0V$ $V_{tmute} = 0.5V$	1	1.5	-	mA
Keyboard scanning pin						
drive current	I_{kbd}					
sink current	I_{kbs}	* $V_n = 0V$, * $V_n = 2.5V$,	4 200	10 400	30 -	μA μA
Key-in debounce time	t_{DB}		-	20	-	ms

 * V_n : Input voltage of any keyboard scanning pin (Row group, Column group).

Electrical Characteristics (II) (Ambient Temperature is 25°C, All voltage referenced to V_{SS} , $V_{DD} = 2.5V$, unless otherwise noted.)

(TONE mode specification, fosc. = 3.579545 MHz)

Parameter	Sym.	Conditions	Limitation			Unit
			Min.	Typ.	Max.	
TONE output pin						
DC level	V_{dc}	$V_{DD} = 2.0V \sim 5.5V$	$0.5V_{DD}$	-	$-0.7V_{DD}$	V
sink current	I_{tl}	$V_{dtmf} = 0.5V$	0.2	-	-	mA
AC level	V_{dtmf}	Row group, $R_L = 10K\Omega$	150	-	220	mVrms
Load resistor	R_L	Dist. $\leq -23dB$	10	-	-	KΩ
DTMF signal:						
pre-emphasis	twist	$V_{DD} = 2.0 \sim 5.5V$, Column-Row group	1	2	3	dB
*distortion	Dist.	$R_L = 10K\Omega$	-	-	-23	dB

 * Distortion (dB) = $20 \log \{ [(V_1^2 + V_2^2 + V_3^2 + \dots + V_n^2)^{1/2}] / [(V_L^2 + V_H^2)^{1/2}] \}$.

 V_L, V_H : Row group and Column group signal.

 V_1, V_2, \dots, V_n : Harmonic signal (BW = 300 Hz ~ 3500 Hz).

* Actual frequency output (fosc. = 3.579545 MHz)

KEYBOARD SCANNING PIN	STANDARD (Hz)	OUTPUT (Hz)	DEVIATION (%)
R1 f1	697	699	+0.28
R2 f2	770	766	-0.52
R3 f3	852	848	-0.47
R4 f4	941	948	+0.74
C1 f5	1209	1216	+0.57
C2 f6	1336	1332	-0.30
C3 f7	1477	1472	-0.34
C4 f8	1633	1645	+0.73

Timing Diagram

