



# DTMF Tone Generator With Redial

T-75-27-09

S2569/S2569A

### Features

- Wide Operating Supply Voltage Range (2.50-10V)
- Low Power CMOS Circuitry Allows Device Power to be Derived Directly from the Telephone Lines
- 21 Digit Memory for Redial
- Uses Standard 3x4 (S2569A) or 4x4 (S2569) SPST or X-Y Matrix Keyboard
- The Total Harmonic Distortion Is Below Industry Specification (Max. 7% Over Typical Loop Current Range)
- Separate Control Keys (S2569) for Disconnect, Pause, Redial and Flash in Column Four
- Allows Dialing of \* and # Keys on S2569. For S2569A Redial Initiated by \* or # Key as First Key Offhook, \* or # can be Dialed After First Key Offhook.

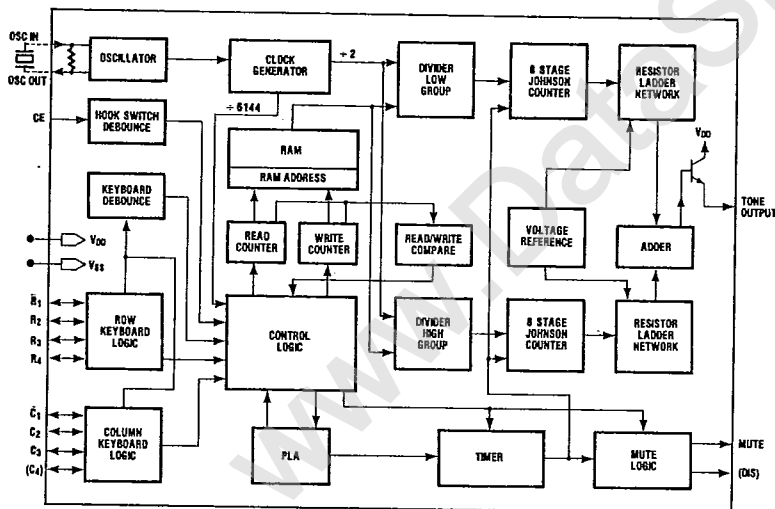
### General Description

The S2569/S2569A are members of the S2559 Tone Generator family with the added features of Redial, Disconnect, Pause and Flash. They produce the 12 dual tones corresponding to the 12 keys located on the conventional Touch-Tone<sup>®</sup> telephone keypad. The S2569 has separate keys, located in column four, which initiate the Disconnect(D), Pause(P), Redial(R), and Flash(F) functions. (Note: column four keys do not generate tones.) Only the redial feature is available on the S2569A. Redial on the S2569A is initiated by pressing \* or # as the first key offhook.

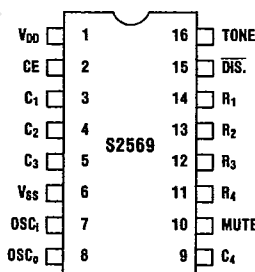
A voltage reference generated on the chip regulates the signal levels of the dual tones to meet the recommended telephone industry specifications.



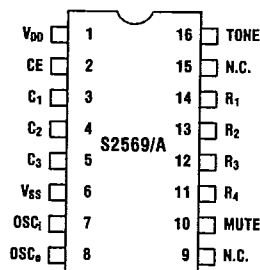
### Block Diagram



### S2569 Pin Configuration



### S2569/A Pin Configuration



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**S2569/S2569A**

**Absolute Maximum Rating:**

DC Supply Voltage ( $V_{DD}-V_{SS}$ )	+ 13.5V
Operating Temperature	0°C to + 70°C
Storage Temperature	- 65°C to + 140°C
Power Dissipation at 25°C	500mW
Input Voltage	$V_{SS} - 0.6 < V_{IN} < V_{DD} + 0.6V$

**S2569A Electrical Characteristics:** Specifications apply over the operating temperature range of 0°C to + 70°C unless otherwise noted. Absolute values of measured parameters are specified.

Symbol	Parameter/Conditions	( $V_{DD}-V_{SS}$ ) Volts	Min.	Max.	Unit
<b>Supply Voltage</b>					
$V_{DD}$	Tone Out Mode (Valid Key Depressed)		2.50	10.0	V
	Non Tone Out Mode (No Key Depressed)		1.50	10.0	V
$V_{DR}$	Data Retention Voltage		1.0		V
<b>Supply Current</b>					
$I_{DD}$	STANDBY (NO Key Depressed, Tone, Mute and Flash Outputs Unloaded, CE = low)	2.00		1	$\mu A$
		5.00		20	$\mu A$
	Operating (One Key Selected, Tone, Mute and Flash Outputs Unloaded). Operating During Flash	3.00		2.5	mA
		3.0		300	$\mu A$
<b>Tone Output</b>					
$V_{OR}$	Low Group Frequency Voltage ( $R_L = 390\Omega$ )	5.0	330	690	mVrms
dBcr	Ratio Of Column To Row Tone	2.5-5.0	1.0	3.0	dB
% DIS	Distortion*	2.5-10.0		7	%
<b>Mute and Flash Outputs</b>					
$I_{OH}$	Output Source Current	$V_{OH} = 2.7V$	3.0	1.0	mA
$I_{OL}$	Output Sink Current	$V_{OL} = 0.3V$	3.0	1.0	mA

\* Distortion measured in accordance with the specifications described as "ratio of total power of all extraneous frequencies in the voiceband above 500Hz accompanying the signal to the total power of the frequency pair".

NOTE:  $R_L$  = load resistor connected from output to  $V_{SS}$ .

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**S2569/S2569A**

**Basic Chip Operation**

The dual tone signal consists of linear addition of two voice frequency signals. One of four signals is selected from a group of frequencies called "low group" and the other is selected from a group of frequencies called "high group". The low group consists of four frequencies; 697, 770, 852 and 941 Hz. The high group consists of three frequencies; 1209, 1336 and 1477 Hz.

When a push button corresponding to a digit (0 thru 9, \*, #) is pushed, one appropriate row (R<sub>1</sub> thru R<sub>4</sub>) and one appropriate column (C<sub>1</sub> thru C<sub>3</sub>) is selected. The active row input selects one of the low group frequencies and active column input selects one of the high group frequencies.

**Tone Generation**

When a valid key closure is detected, the keyboard logic programs the high and low group dividers with appropriate divider ratios so that the output of these dividers cycle at 16 times the desired high group and low group frequencies. The outputs of the programmable dividers drive two 8-stage Johnson counters. The symmetry of the clock input to the two divide-by-16 Johnson counters allows 32 equal time segments to be generated within each output cycle. The 32 segments are used to digitally synthesize a stair-step waveform to approximate the sine wave function. This is done by connecting a weighted resistor ladder network between the outputs of the Johnson counter, V<sub>DD</sub> and V<sub>REF</sub>. V<sub>REF</sub> closely tracks V<sub>DD</sub> over the operating voltage and temperature range and therefore the peak-to-peak amplitude V<sub>P</sub> (V<sub>DD</sub>-V<sub>REF</sub>) of the stairstep function is fairly constant. V<sub>REF</sub> is chosen so that V<sub>P</sub> falls within the allowed range of the high group and low group tones.

**Normal Dialing**

Tone dialing starts as soon as the first digit is entered and debounced. The entered digits are stored sequentially in the internal memory. Pauses may be entered when required in the dial sequence by pressing the "P" key, which provides access pause for future redial. Any number of access pauses may be entered as long as the total entries do not exceed the total number of available digits. Numbers up to 21 digits can be redialed. Numbers exceeding 21 digits will clear redial buffer. Note that only the S2569 has "Pause" capability and the access pause is included in the 21 digit maximum number.

**Redial**

The last number dialed is retained in the memory and therefore can be redialed by going off hook and pressing the "R" key on the S2569 (located at column 4 and row 3). The S2569A does not use column four and Redial is initiated by "\*" or "#" key as the first key off-hook. Tone dialing will start when the key is depressed and finish after the entire number is dialed out unless an access pause is detected. In such a case, the tone dialing output will stop and will resume only after the user pushes any key except Flash and Disconnect keys. During redial all keys are ignored until 70ms after the last digit is dialed (except Disconnect). (Note that the "Pause" function is not available on the S2569A.)

**Disconnect/Flash Functions**

The S2569 has a push-pull buffer for Disconnect output. With no keys depressed the Disconnect output is high. When the Disconnect key is depressed the Disconnect output goes low until the key is released. Disconnect output can also be used to implement a "Flash" function. When the Flash key is depressed the Disconnect output goes low for 608ms.

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Figure 1

1	2	3	D
4	5	6	P
7	8	9	R
*	0	#	F

S2569 Keypad

1	2	3
4	5	6
7	8	9
*	0	#

S2569A Keypad

**Keyboard Interface**

The S2569/A employs a scanning circuitry to determine key closures. When no key is depressed active pull down resistors are on on the row inputs and active pull up resistors are on on the column inputs. When a key is pushed a high level is seen on one of the row inputs, the oscillator starts and the keyboard scan logic turns on. The active pull up or pull down resistors are selectively switched on and off as the keyboard scan logic determines the row and the column inputs that are selected. The value of pull down and pull up resistors will vary with supply voltage. Typical values of pull up and pull down resistors are shown in Table 1.

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**S2569/S2569A**

**Table 1. Typical Resistance Values**

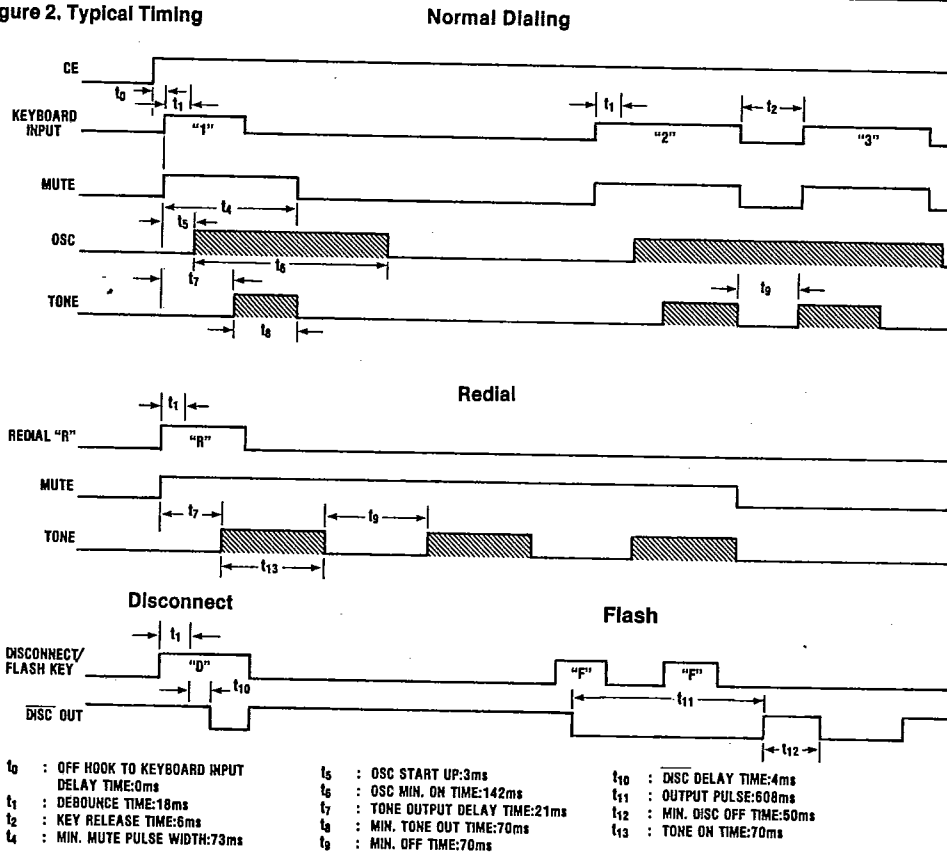
V <sub>DD</sub>	PULL UP RESISTANCE (TYP.)
2.0V	3.3 K ohm
5.0V	1.5 K ohm
10.0V	1.3 K ohm
V <sub>DD</sub>	PULL DOWN RESISTANCE (TYP.)
2.0V	340 K ohm
5.0V	36.6 K ohm
10.0V	16.6 K ohm

**Table 2. Comparisons of Specified Vs. Actual Tone Frequencies Generated by S2569/A**

ACTIVE INPUT	OUTPUT FREQUENCY HZ		% ERROR
	SPECIFIED	ACTUAL	
R1	697	699.1	+0.30
R2	770	766.2	-0.49
R3	852	847.4	-0.54
R4	941	948.0	+0.74
C1	1209	1215.9	+0.57
C2	1339	1331.7	-0.32
C3	1477	1471.9	-0.35

NOTE: % error does not include oscillator drift.

**Figure 2. Typical Timing**





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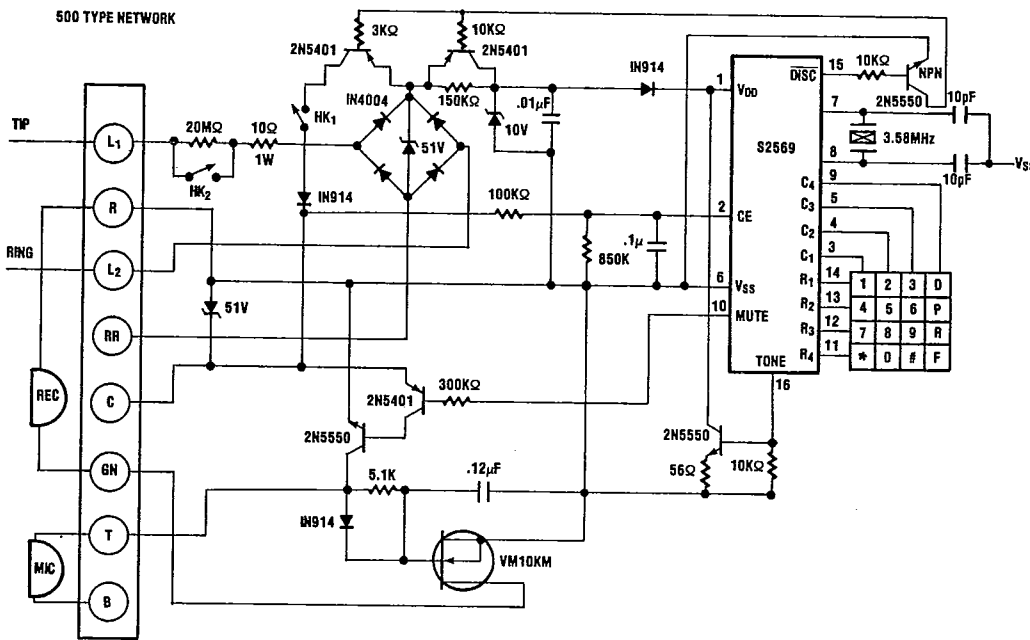
S2569/S2569A

Logic Interface

The S2569/A can also interface with CMOS logic outputs directly. The S2569/A requires active high logic levels. Since the pull up resistors in the S2569/A are fairly low values, diodes can be used to eliminate excessive sink current flowing into the logic outputs in their low logic state.

COMMUNICATION PRODUCTS

Figure 3a. Typical Application Circuit for Line Powered DTMF Dialer With Redial S2569

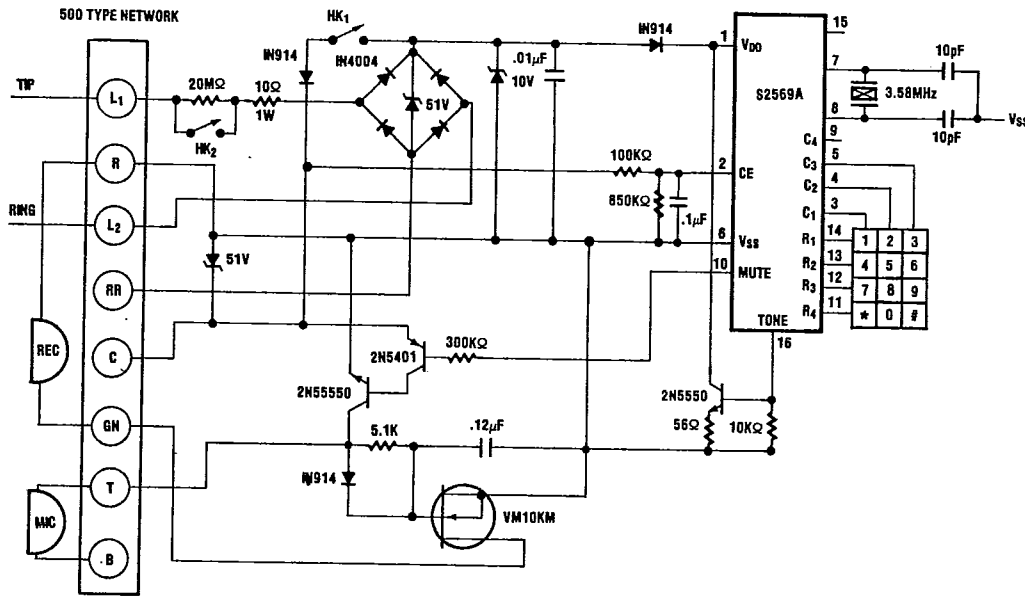




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Figure 3b. Typical Application Circuit for Line Powered DTMF Dialer With Redial S2569A





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**S2569/S2569A**

**Chip Enable**

The S2569/A has a Chip Enable input at pin 2. The Chip Enable for the S2569/A is an active "high". When the Chip Enable is "low", the Tone output goes to  $V_{SS}$ , the oscillator is inhibited and the Mute and Disconnect outputs will go into a low state.

**Mute Output**

The S2569/A has a push-pull buffer for Mute output. With no keys depressed the Mute output is low, when a key is depressed the Mute output goes high until the key is released. Note that minimum mute pulse width is 70ms.

**Oscillator**

The device contains an oscillator circuit with the necessary parasitic capacitances and feedback resistor ( $1M\Omega$ ) on chip so that it is only necessary to connect a standard 3.58MHz TV crystal across the  $OSC_i$  and  $OSC_o$  terminals to implement the oscillator function.

**Oscillator Crystal Specifications**

Quartz Crystal Specification (25°C ± 2°C)	
Operating Temperature Range	0°C to +70°C
Frequency	3.579545MHz
Frequency Calibration Tolerance	.02 ± %
Load Capacitance	18pF
Effective Series Resistance	180 Ohms, max.
Drive Level-Correlation/Operating	2mW
Shunt Capacitance	7pF, max.
Oscillation Mode	Fundamental

**Test Mode**

The S2569/A will enter the test mode if all rows are pulled high momentarily. 16 times the low group frequency will appear at mute output depending on which row is selected. Also, 16 times the high group frequency will appear at disconnect output depending upon which column is selected.

