

# MM5393, MM5394, MM53143, MM53144 Push Button Pulse Dialer Circuits

## General Description

The MM5393, MM5394, MM53143 and MM53144 are low threshold voltage, ion-implanted, metal-gate CMOS integrated circuits that convert pushbutton inputs into a series of pulses to simulate a telephone rotary dial. Pushbutton inputs require the use of a simple, low cost single contact calculator type keypad. An inexpensive R/C oscillator network is used as the frequency reference. Storage is provided for 21 digits. A redial feature via use of the # key is included. An interdigit pause can be externally selected as either 420 or 840 ms. A mute output is provided to mute receiver noise during outpulsing. No muting occurs during the interdigit pause, thereby allowing the user to hear any busy or error condition arising during the call. The MM5393 and MM53143 provide a pacifier tone of 600 Hz every time

a key is depressed. The MM5393 and MM5394 provide a 1.6:1 break/make ratio. The MM53143 and MM53144 provide a 2:1 break/make ratio.

## Features

- Direct line powered operation
- Low voltage operation to 2V
- Low cost R/C oscillator
- Single contact keypad
- 21-digit storage
- Selectable interdigital pause
- Redial of last number
- 600 Hz tone (available in MM5393 and MM53143)

## Block and Connection Diagrams

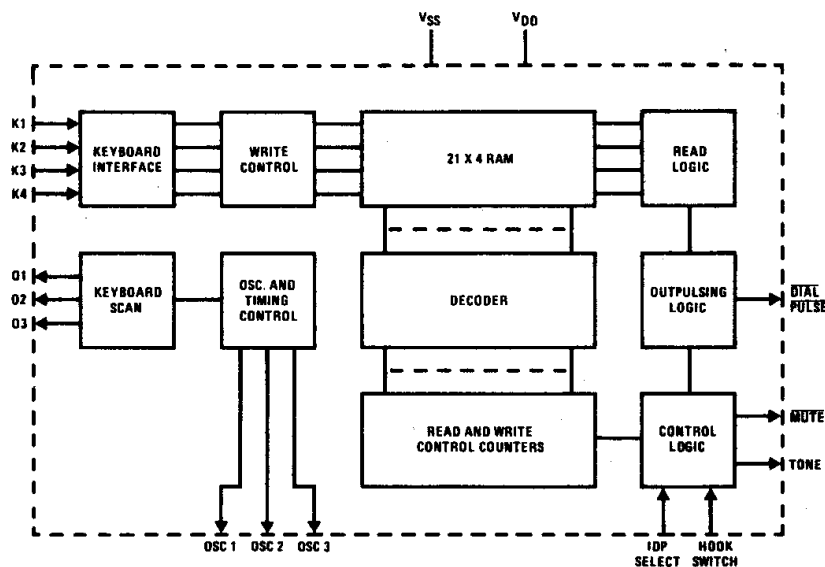
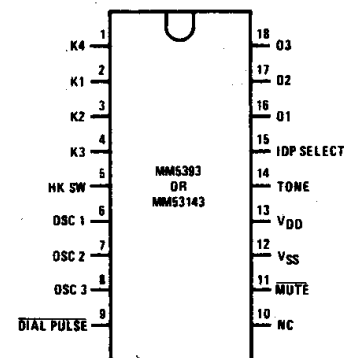


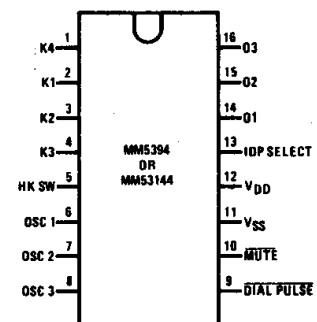
FIGURE 1

### Dual-In-Line Package



TOP VIEW  
Order Number **MM5393J**  
or **MM53143J**  
See Package 12

### Dual-In-Line Package



TOP VIEW  
Order Number **MM5394J**  
or **MM53144J**  
See Package 11

FIGURE 2

MM5393, MM5394, MM53143, MM53144

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## Absolute Maximum Ratings

Voltage at Any Pin	$V_{SS} - 0.3V$ to $V_{DD} + 0.3V$
Operating Temperature Range	$-30^{\circ}C$ to $+70^{\circ}C$
Storage Temperature Range	$-55^{\circ}C$ to $+150^{\circ}C$
$V_{DD} - V_{SS}$	6.5V Max
Lead Temperature (soldering, 10 seconds)	$300^{\circ}C$

## Electrical Characteristics

$T_A$  within operating temperature range,  $V_{SS} = \text{Gnd}$ ,  $2V \leq V_{DD} \leq 5.5V$

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage Levels at IDP Select, Hook Switch, K1–K4					
Logical "1"		$V_{DD} - 0.25$		$V_{DD}$	V
Logical "0"		$V_{SS}$		$V_{SS} + 0.25$	V
Input Pull-Up Resistor Currents at K1–K4, Source	$V_{DD} = 3V, V_{IN} = V_{SS}$		1	3	$\mu A$
Input Pull-Down Resistor Current at HK SW, Sink	$V_{DD} = 3V, V_{IN} = 3V$		1.5	3	$\mu A$
Keypad Contact Resistance				1	$k\Omega$
Output Current Levels					
Dial Pulse					
Logical "1", Source	$V_{DD} = 3V, V_{OUT} = V_{DD} - 0.9$	150			$\mu A$
Logical "0", Sink	$V_{DD} = 3V, V_{OUT} = V_{SS} + 0.9$	150			$\mu A$
Mute					
Logical "1", Source	$V_{DD} = 3V, V_{OUT} = V_{DD} - 0.9$	100			$\mu A$
Logical "0", Sink	$V_{DD} = 3V, V_{OUT} = V_{SS} + 0.9$	100			$\mu A$
Tone					
Logical "1", Source	$V_{DD} = 3V, V_{OUT} = V_{DD} - 0.5$	10			$\mu A$
Logical "0", Sink	$V_{DD} = 3V, V_{OUT} = V_{SS} + 0.5$	10			$\mu A$
01, 02, 03					
Logical "1", Source	$V_{DD} = 3V, V_{OUT} = V_{DD} - 0.5$	20			$\mu A$
Logical "0", Sink	$V_{DD} = 3V, V_{OUT} = V_{SS} + 0.5$	150			$\mu A$
Supply Current	$V_{DD} = 3.3V, \text{Osc Freq} = 20 \text{ kHz}$ $V_{DD} = 5.5V, \text{"ON Hook"} \text{ Osc Stopped}$			100 5	$\mu A$ $\mu A$
Outpulsing Frequency	Osc = 20 kHz	9		11	Hz

## Functional Description

A block diagram of the MM5393, MM5394, MM53143 and MM53144 integrated circuit is shown in *Figure 1* and package connection diagrams for the 2 package options are shown in *Figure 2*.

**Oscillator (Pins 6, 7, and 8):** The time base for the pulse dialer integrated circuit is an R/C-controlled oscillator like that shown in *Figure 3*, typically tuned to 20 kHz by the R1 and C1 combination. Stability of  $\pm 10\%$  of typical frequency can be maintained over the voltage range 3.0 – 5.5V and temperature range  $-30^{\circ}\text{C}$  to  $+70^{\circ}\text{C}$ . At fixed voltage and temperature, part to part variation is less than 5%.

This clock is successively divided to derive the necessary timing for outpulsing and interdigit pause.

**Keyboard (Pins 1–4 and 16–18 or 14–16):** The MM5393, MM5394, MM53143 and MM53144 utilize an inexpensive single contact (Form A, *Figure 7*) keypad. A valid key closure is recorded when a single row ( $K_X$  input) is connected to a single column ( $O_Y$  input). Key closures are protected from contact bounce for 5 ms.

**Dial Pulse Output (Pin 9):** The  $\overline{\text{Dial Pulse}}$  output drives an external bipolar transistor that sequentially opens (breaks) the telephone loop a number of times equal to the input digit selected. For example, key 5 will generate 5 loop current breaks. The break/make ratio of the MM5393 and MM5394 is 1.6:1.0 (i.e. 61.5%:38.5%). The break/make ratio of the MM53143 and MM53144 is 2.0:1.0 (i.e. 67%:33%).

**IDP Select (Pin 15 or 13):** The IDP select input is used to select an interdigit separation of either 420 ms (logic "0" =  $V_{SS}$ ) or 840 ms (logic "1" =  $V_{DD}$ ). An interdigit delay precedes the first digit outpulse sequence.

**Mute (Pin 11 or 10):** The  $\overline{\text{Mute}}$  output is used to drive an external bipolar transistor that is used to mute the receiver during the outpulse period. System timing between key closure, mute and dial pulse is shown by the timing diagram in *Figure 4*.

**Tone (Pin 14 MM5393 and MM53143 Only):** The MM5393 and MM53143 provide a tone output to provide audio feedback to the user. The output is a 600 Hz tone that requires an external bipolar driver to activate the telephone receiver.

**Hook Switch Input (Pin 5):** The function of the hook switch input is to properly initialize the circuitry for proper memory and redial operation. In the "ON Hook", logic "0" or  $V_{SS}$  condition, the hook switch input

- Stops the 20 kHz oscillator
- Sets the memory pointer back to digit 1
- Clamps the dial pulse and mute outputs to logic "1" or  $V_{DD}$
- Resets all control logic

When the telephone is taken "OFF-Hook", this input must be taken to logic "1" or  $V_{DD}$  to release the oscillator and enable the memory and various outputs. For a non-redial application it is necessary to provide an RC delay of approximately 10  $\mu\text{s}$  to the hook switch input in order to provide a proper power-on clear sequence.

Schematic diagrams for use of the MM5393, MM5394, MM53143 and MM53144 in typical applications are shown in *Figures 5 and 6*.

### Redial Feature

Pushbutton inputs are accepted at an asynchronous rate. If only 1 key is detected for 5 ms, the decoded key will be loaded into a first-in-first-out memory and outpulsing of the correct number of pulses will immediately begin. After the first digit has been completed, outpulsing will cease unless another key has been entered. This allows use in a PBX system to insure receipt of a dial tone after an access code has been entered and before entering the remainder of the number. If the call was not successful, it can be redialed at a later time by pressing the redial (#) key. If an access code is required, as in a PBX system, it can be manually entered, the dial tone established, and then the redial key pushed to automatically dial the remainder of the number. Only 1 key can be entered before pushing the redial key.

An example of this operation is shown here:

	KEY INPUTS	OUTPULSES	MEMORY
First Try	9 P 4087375000	94087375000	94087375000
Second Try	9 P #	94087375000	94087375000
Third Try	9 P #	94087375000	94087375000

Where P implies a user pause

Functional Description (Continued)

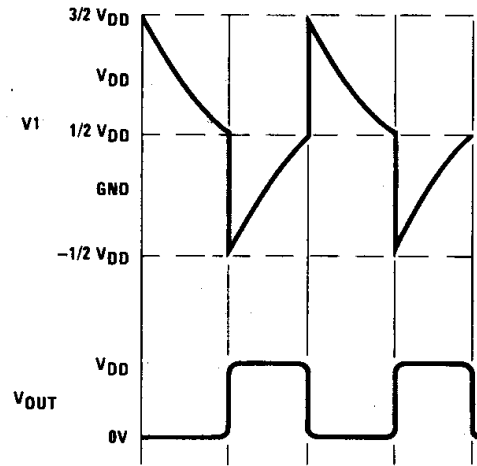
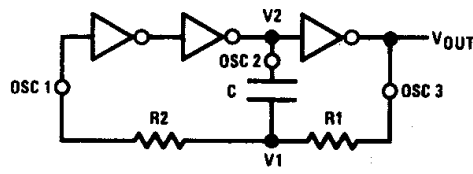


FIGURE 3. Three Gate Oscillator and Waveforms

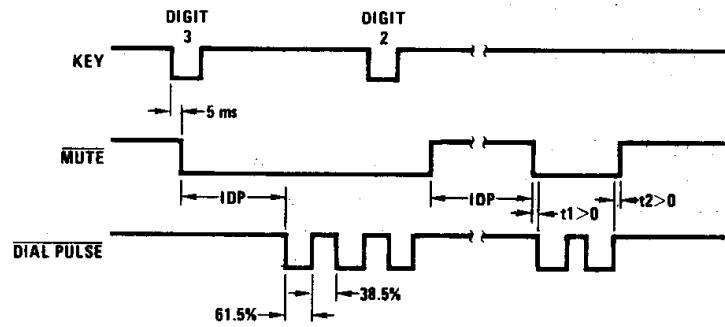
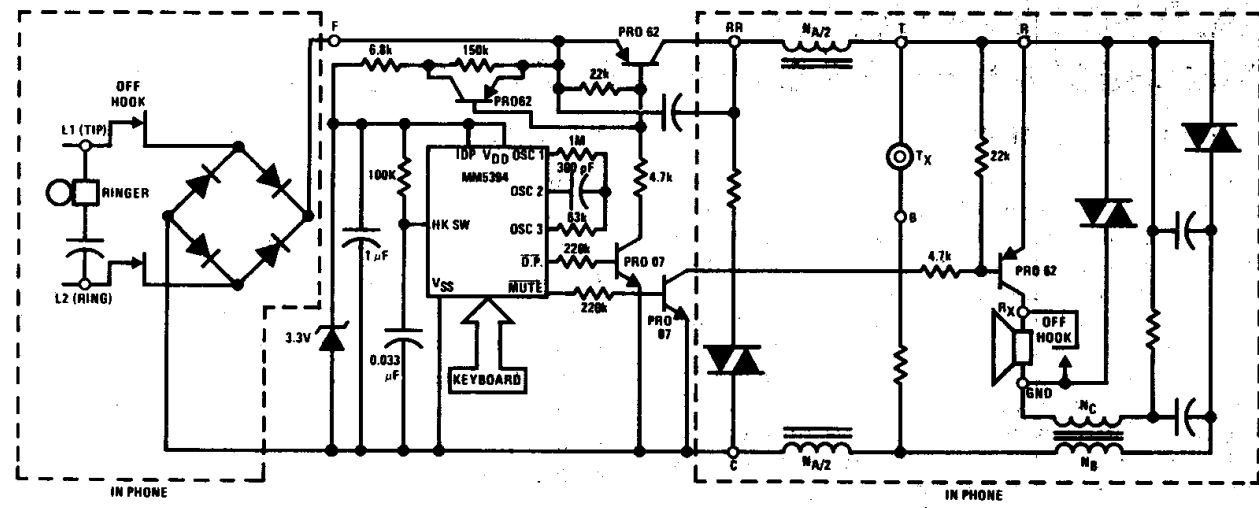


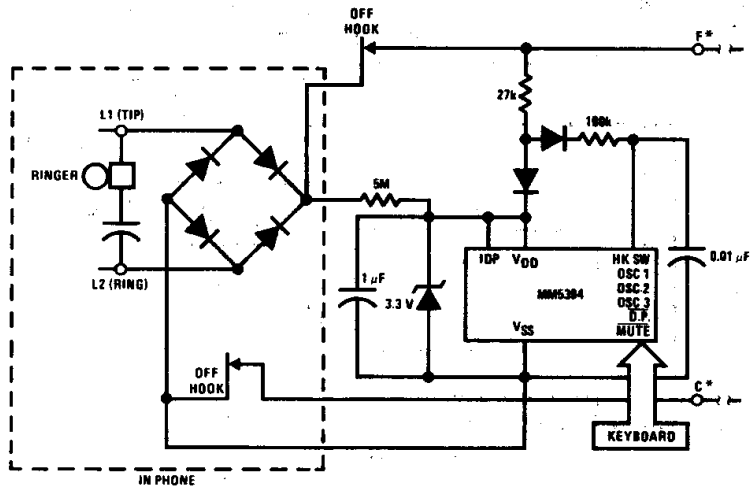
FIGURE 4. Output Timing Waveforms

Functional Description (Continued)



- Note 1: No redial.
- Note 2: Non-valued parts included in instrument.
- Note 3: Letters refer to instrument terminals.

FIGURE 5. Typical Application of MM5394 in Type 500D Telephone



\* Remainder of system is same as Figure 5.

FIGURE 6. Typical Application of MM5394 Using Redial Feature

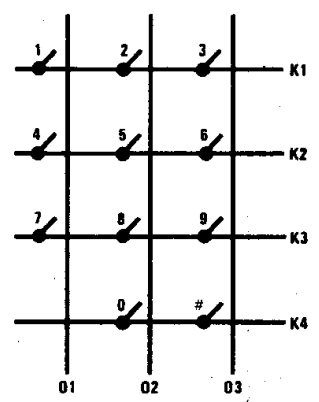


FIGURE 7. Keypad Matrix