

**MOTOROLA**

# SEMICONDUCTORS

3501 ED BLUESTEIN BLVD., AUSTIN, TEXAS 78721

**MC14419**

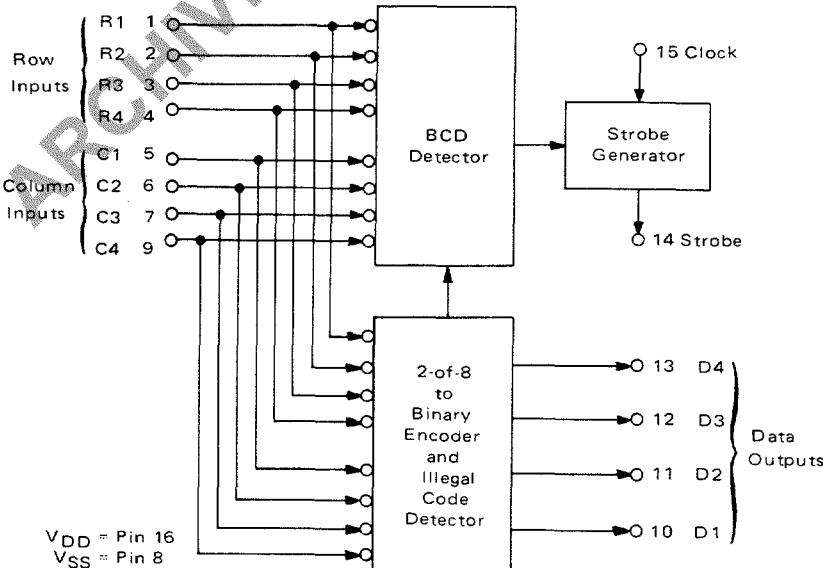
## 2-OF-8 KEYPAD-TO-BINARY ENCODER

The MC14419 is designed for phone dialer system applications, but finds many applications as a keypad-to-binary encoder. The device contains a 2-of-8 to binary encoder, a strobe generator, and an illegal state detector. The encoder has four row inputs and four column inputs, and is designed to accept inputs from 16 keyswitches arranged in a  $4 \times 4$  matrix. For an output on the four data lines, one and only one row along with one and only one column input line must be activated. All other combinations are suppressed by the illegal state detector to eliminate false data output.

The strobe generator produces a strobe pulse when any of the 10 keys corresponding to numerals 0 through 9 are depressed. The strobe output can be used to eliminate erroneous data entry due to contact bounce. For a strobe output to occur, the key row and column input lines must remain stable for 80 clock pulses after activation. When the contact bounce has settled and 80 clock pulses have occurred, the output will be a single strobe pulse equal in width to that of the clock low state. The strobe generator will output one and only one pulse each time a numerical key is depressed. After the pulse has occurred, noise and bounce due to contact break will not cause another strobe pulse. With a 16 kHz input clock frequency, the pulse occurs 5 ms after the last bounce.

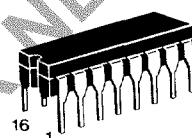
- Suppressed Output for Illegal Input Codes
- On-Chip Pullup Resistors for Row and Column Inputs
- Clock Input Conditioning Circuit
- Low Current Drain in Standby Mode  
5.0 $\mu$ A Typical @ 5.0 Vdc
- Subsystem Complement to the MC14408/14409 Phone Pulse Converter
- Codes for Numbers 0-9 Produce a Strobe Pulse
- One Key Rollover Feature

## BLOCK DIAGRAM

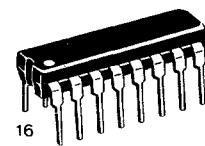
**CMOS**

(LOW-POWER COMPLEMENTARY MOS)

## 2-OF-8 KEYPAD-TO-BINARY ENCODER



**L SUFFIX**  
CERAMIC PACKAGE  
CASE 620



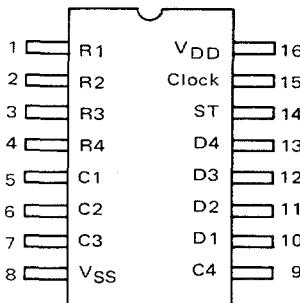
**P SUFFIX**  
PLASTIC PACKAGE  
CASE 648

## ORDERING INFORMATION

MC14XXX

suffix denotes  
— L = Ceramic  
— P = Plastic

## PIN ASSIGNMENT



This device contains circuitry to protect the inputs against damage due to high static voltages or electric fields; however, it is advised that normal precautions be taken to avoid application of any voltage higher than maximum rated voltages to this high impedance circuit. For proper operation it is recommended that  $V_{in}$  and  $V_{out}$  be constrained to the range  $V_{SS} \leq (V_{in} \text{ or } V_{out}) \leq V_{DD}$ .

MAXIMUM RATINGS (Voltages referenced to V<sub>SS</sub>, Pin 8.)

Rating	Symbol	Value	Unit
DC Supply Voltage	V <sub>DD</sub>	+6.0 to -0.5	Vdc
Input Voltage, All Inputs	V <sub>in</sub>	V <sub>DD</sub> + 0.5 to V <sub>SS</sub> - 0.5	Vdc
DC Current Drain per Pin	I	10	mAdc
Operating Temperature Range	T <sub>A</sub>	-40 to +85	°C
Storage Temperature Range	T <sub>stg</sub>	-65 to +150	°C

## ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	V <sub>DD</sub> Vdc	-40°C		25°C			+85°C		Unit
			Min	Max	Min	Typ	Max	Min	Max	
Supply Voltage Operating Range	V <sub>DD</sub>	—	3.0	6.0	3.0	5.0	6.0	3.0	6.0	Vdc
Output Voltage "0" Level "1" Level	V <sub>out</sub>	5.0	—	0.01	—	0	0.01	—	0.05	Vdc
		5.0	4.99	—	4.99	5.0	—	4.95	—	Vdc
Noise Immunity ( $\Delta V_{out} \leq 0.8$ Vdc)	V <sub>NL</sub>	5.0	1.5	—	1.5	2.25	—	1.4	—	Vdc
	V <sub>NH</sub>	5.0	1.4	—	1.5	2.25	—	1.5	—	Vdc
Output Drive Current (V <sub>OH</sub> = 2.5 Vdc) Source (V <sub>OL</sub> = 0.4 Vdc) Sink	I <sub>OH</sub>	5.0	-0.23	—	-0.20	-1.7	—	-0.16	—	mAdc
	I <sub>OL</sub>	5.0	0.23	—	0.20	0.78	—	0.16	—	mAdc
Input Leakage Current (V <sub>in</sub> = V <sub>DD</sub> )	I <sub>IH</sub>	5.0	—	—	—	10	—	—	—	pAdc
Pullup Resistor Source Current (Row and Column Inputs) (V <sub>in</sub> = V <sub>SS</sub> )	I <sub>IL</sub>	5.0	265	460	190	250	330	125	215	μAdc
Input Capacitance (V <sub>in</sub> = V <sub>SS</sub> )	C <sub>in</sub>	—	—	—	—	5.0	—	—	—	pF
Standby Supply Current (f <sub>clock</sub> = 16 kHz, No Keys Depressed)	I <sub>DDS</sub>	3.0	—	3.0	—	1.0	3.0	—	6.0	μAdc
		5.0	—	15	—	5.0	15	—	30	
		6.0	—	60	—	20	60	—	120	
Standby Supply Current as a Function of Clock Frequency* (No Keys Depressed)	I <sub>DDS</sub>	5.0	I <sub>DDS</sub> = 0.09 μA/kHz + 3.0 μA						μAdc	

\*The formula given is for the typical characteristics only.

SWITCHING CHARACTERISTICS (C<sub>L</sub> = 50 pF, T<sub>A</sub> = 25°C)

Characteristic	Symbol	V <sub>DD</sub>	Min	Typ	Max	Unit
Output Rise and Fall Times, D1 thru D4 (Figure 1)	t <sub>r,tf</sub>	5.0	—	300	—	ns
Propagation Delay Time, Row or Column Input to Data Output (Figure 1)	t <sub>PLH</sub> , t <sub>PHL</sub>	5.0	—	1000	—	ns
Clock Pulse Frequency Range	PRF	3.0 to 6.0	4.0	16	80	kHz

FIGURE 1 – SWITCHING TIME WAVEFORMS

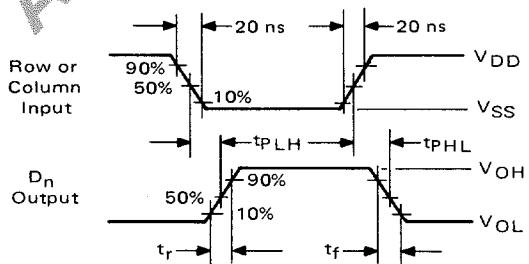


FIGURE 2 – TYPICAL STROBE PULSE DELAY TIMES

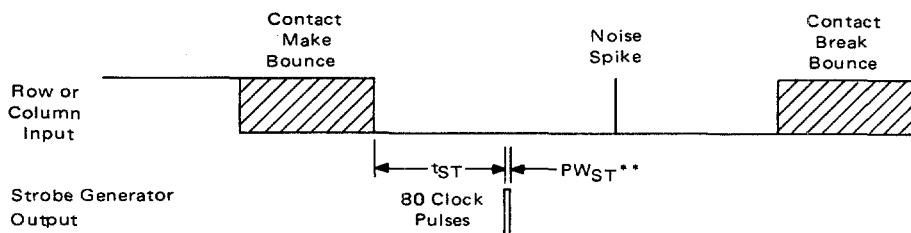
PRF Clock Frequency kHz	t <sub>ST</sub> * Strobe Pulse Delay Time ms
4.0	20
8.0	10
16	5.0
32	2.5
80	1.0

\* t<sub>ST</sub> = (1/PRF) • 80, with PRF in kHz, t<sub>ST</sub> in ms.



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FIGURE 3 – STROBE GENERATOR TIMING DIAGRAM

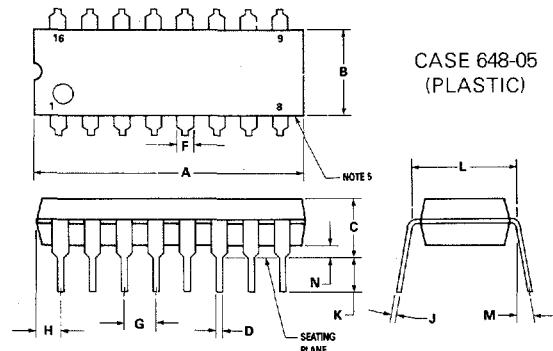
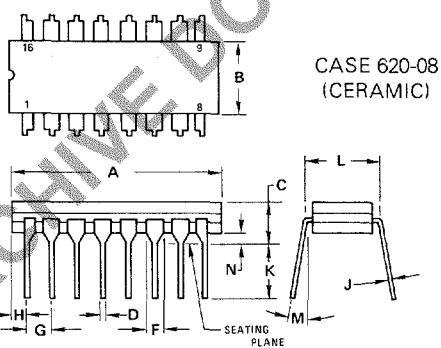


TRUTH TABLE

Key **	Inputs					Outputs							
	Row		Column			D4 D3 D2 D1				Strobe			
	R4	R3	R2	R1	C4	C3	C2	C1	D4	D3	D2	D1	Strobe
1	1	1	1	0	1	1	1	0	0	0	0	1	
2	1	1	1	0	1	1	0	1	0	0	1	0	
3	1	1	1	0	1	0	1	1	0	0	1	1	
A	1	1	1	0	0	1	1	1	1	1	0	0	0
4	1	1	0	1	1	1	1	0	0	1	0	0	
5	1	1	0	1	1	1	0	1	0	1	0	1	
6	1	1	0	1	1	0	1	1	0	1	1	0	
B	1	1	0	1	0	1	1	1	1	1	0	1	0
7	1	0	1	1	1	1	1	0	0	1	1	1	
8	1	0	1	1	1	1	0	1	1	0	0	0	
9	1	0	1	1	1	0	1	1	1	0	0	1	
C	1	0	1	1	0	1	1	1	1	1	1	0	0
*	0	1	1	1	1	1	1	0	1	0	1	0	0
0	0	1	1	1	1	1	0	1	0	0	0	0	
#	0	1	1	1	1	0	1	1	1	0	1	1	0
D	0	1	1	1	0	1	1	1	1	1	1	1	0
	All Other Combinations					0	0	0	0	0	0	0	

\*\*See Figure 4 for keypad designation.

## PACKAGE DIMENSIONS



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	19.05	19.94	0.750	0.785
B	6.10	7.49	0.240	0.295
C	—	5.08	—	0.200
D	0.38	0.53	0.015	0.021
F	1.40	1.78	0.055	0.070
G	2.54 BSC	—	0.100 BSC	—
H	0.51	1.14	0.020	0.045
J	0.20	0.30	0.008	0.012
K	3.18	4.32	0.125	0.170
L	7.62 BSC	—	0.300 BSC	—
M	—	15°	—	15°
N	0.51	1.02	0.020	0.040

1. LEADS WITHIN 0.13 mm (0.005) RADIUS OF TRUE POSITION AT SEATING PLANE AT MAXIMUM MATERIAL CONDITION.
2. PACKAGE INDEX: NOTCH IN LEAD NOTCH IN CERAMIC OR INK DOT.
3. DIM "L" TO CENTER OF LEADS WHEN FORMED PARALLEL.
4. DIM "A" AND "B" DO NOT INCLUDE GLASS RUN-OUT.
5. DIM "F" MAY NARROW TO 0.76 mm (0.030) WHERE THE LEAD ENTERS THE CERAMIC BODY.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	18.80	21.34	0.740	0.840
B	6.10	6.60	0.240	0.260
C	4.06	5.08	0.160	0.200
D	0.38	0.53	0.015	0.021
F	1.02	1.78	0.040	0.070
G	2.54 BSC	—	0.100 BSC	—
H	0.38	2.41	0.015	0.095
J	0.20	0.38	0.008	0.016
K	2.92	3.43	0.115	0.135
L	7.62 BSC	—	0.300 BSC	—
M	0°	10°	0°	10°
N	0.51	1.02	0.020	0.040

1. LEADS WITHIN 0.13 mm (0.005) RADIUS OF TRUE POSITION AT SEATING PLANE AT MAXIMUM MATERIAL CONDITION.
2. DIMENSION "L" TO CENTER OF LEADS WHEN FORMED PARALLEL.
3. DIMENSION "B" DOES NOT INCLUDE MOLD FLASH.
4. "F" DIMENSION IS FOR FULL LEADS. "HALF" LEADS ARE OPTIONAL AT LEAD POSITIONS 1, 8, 9, AND 16.
5. ROUNDED CORNERS OPTIONAL.



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FIGURE 4 – TYPICAL KEYPAD INTERFACE APPLICATION

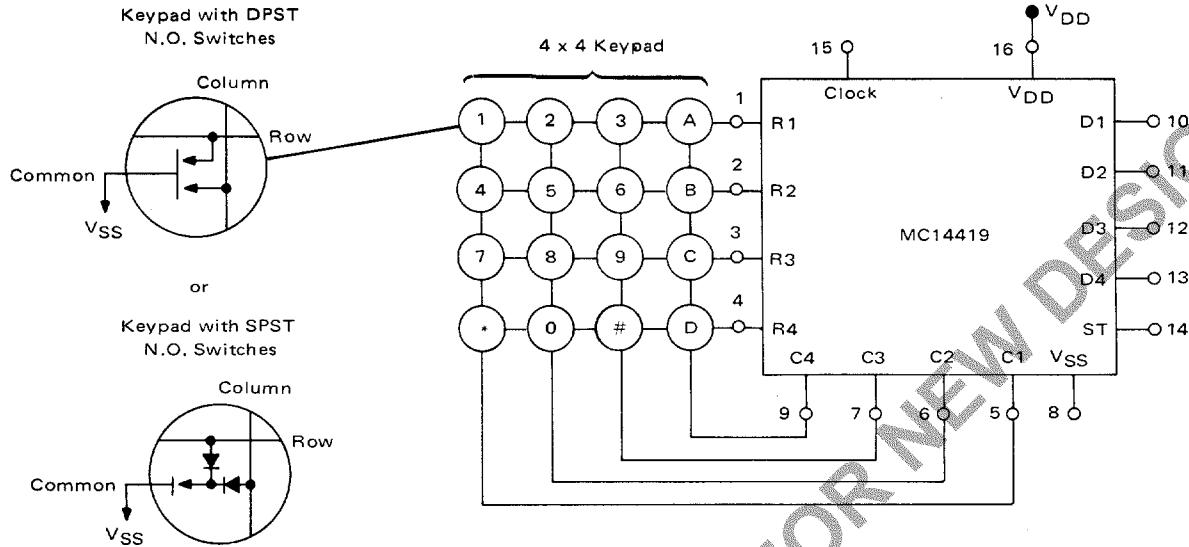
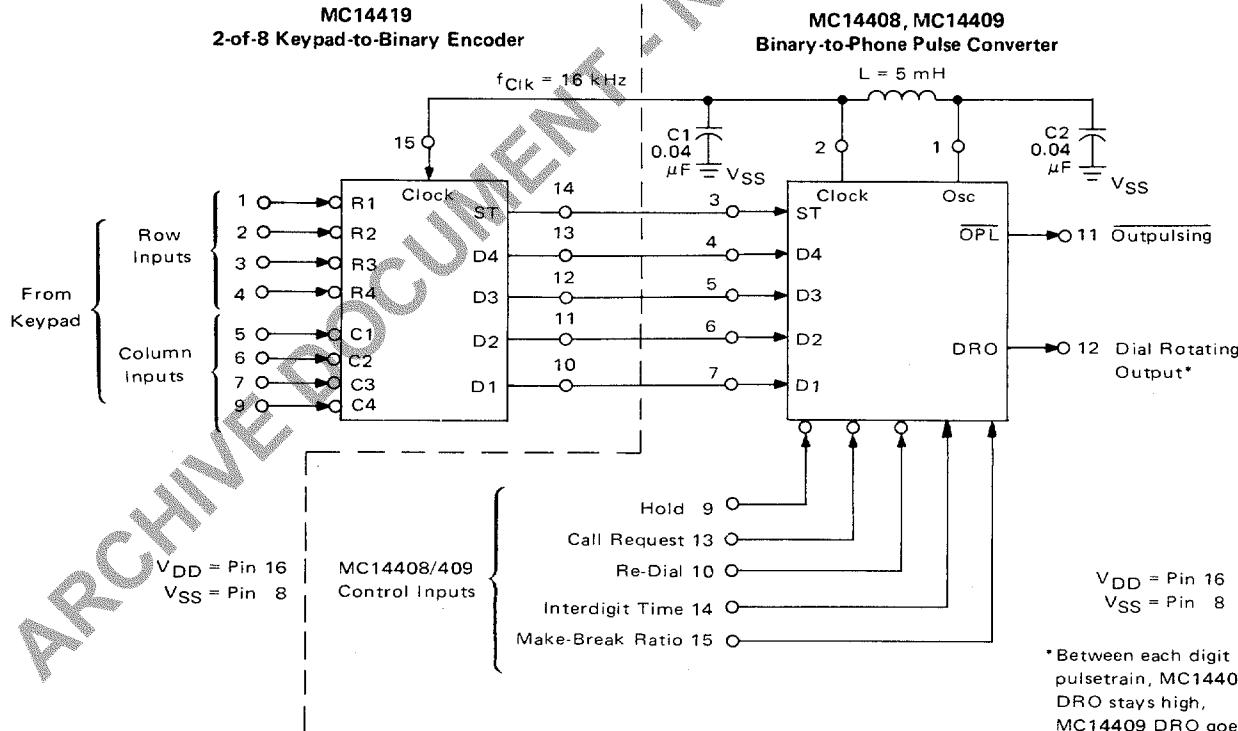


FIGURE 5 – PHONE DIALER SYSTEM



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