

# MOTOROLA

## SEMICONDUCTOR TECHNICAL DATA

### Triple Serial Adders

The MC14032B and MC14038B triple serial adders have the clock and carry reset inputs common to all three adders. The carry is added on the positive-going clock transition for the MC14032B, and on the negative-going clock transition for the MC14038B. Typical applications include serial arithmetic units, digital correlators, digital servo control systems, datalink computers, and flight control computers.

- Buffered Outputs
- Single-Phase Clocking
- Supply Voltage Range = 3.0 Vdc to 18 Vdc
- Capable of Driving Two Low-power TTL Loads or One Low-power Schottky TTL Load Over the Rated Temperature Range.
- Pin-for-Pin Replacement for CD4032B and CD4038B.

#### MAXIMUM RATINGS\* (Voltages Referenced to $V_{SS}$ )

| Symbol               | Parameter                                          | Value                   | Unit |
|----------------------|----------------------------------------------------|-------------------------|------|
| $V_{DD}$             | DC Supply Voltage                                  | - 0.5 to + 18.0         | V    |
| $V_{in}$ , $V_{out}$ | Input or Output Voltage (DC or Transient)          | - 0.5 to $V_{DD} + 0.5$ | V    |
| $I_{in}$ , $I_{out}$ | Input or Output Current (DC or Transient), per Pin | $\pm 10$                | mA   |
| $P_D$                | Power Dissipation, per Package†                    | 500                     | mW   |
| $T_{stg}$            | Storage Temperature                                | - 65 to + 150           | °C   |
| $T_L$                | Lead Temperature (8-Second Soldering)              | 260                     | °C   |

\* Maximum Ratings are those values beyond which damage to the device may occur.

† Temperature Derating:

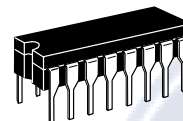
Plastic "P and D/DW" Packages: - 7.0 mW/°C From 65°C To 125°C

Ceramic "L" Packages: - 12 mW/°C From 100°C To 125°C

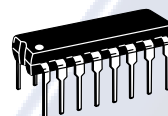
This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high-impedance circuit. For proper operation,  $V_{in}$  and  $V_{out}$  should be constrained to the range  $V_{SS} \leq (V_{in} \text{ or } V_{out}) \leq V_{DD}$ .

Unused inputs must always be tied to an appropriate logic voltage level (e.g., either  $V_{SS}$  or  $V_{DD}$ ). Unused outputs must be left open.

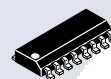
## MC14032B MC14038B



**L SUFFIX**  
CERAMIC  
CASE 620



**P SUFFIX**  
PLASTIC  
CASE 648



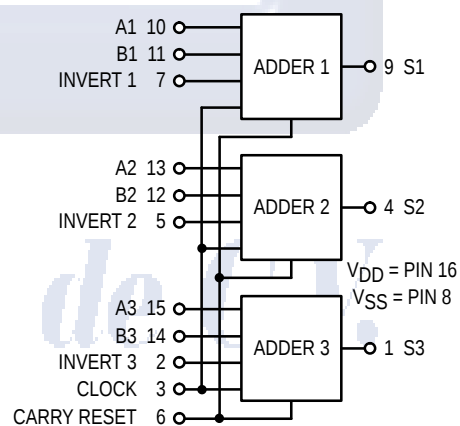
**D SUFFIX**  
SOIC  
CASE 751B

#### ORDERING INFORMATION

MC14XXXBCP Plastic  
MC14XXXBCL Ceramic  
MC14XXXBD SOIC

$T_A = -55^\circ$  to  $125^\circ\text{C}$  for all packages.

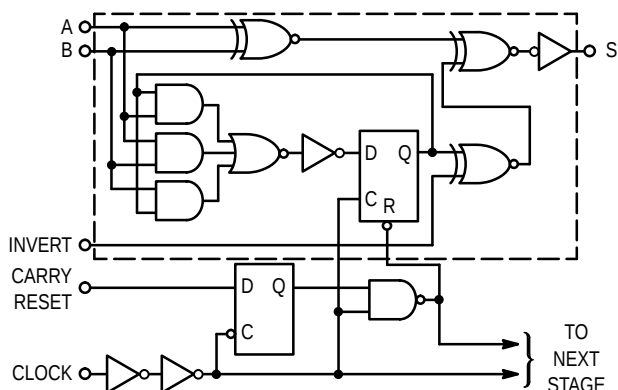
#### BLOCK DIAGRAM



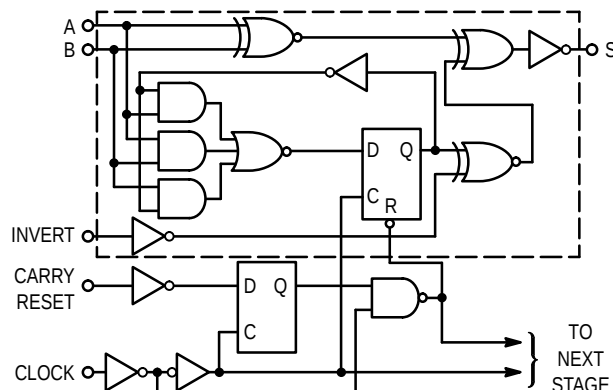
#### LOGIC DIAGRAMS

(ONE SECTION AND COMMON INPUTS SHOWN)

#### MC14032B



#### MC14038B



**ELECTRICAL CHARACTERISTICS** (Voltages Referenced to  $V_{SS}$ )

| Characteristic                                                                                                                   | Symbol             | $V_{DD}$<br>Vdc | - 55°C                                                                                                            |           | 25°C   |               |           | 125°C  |           | Unit      |
|----------------------------------------------------------------------------------------------------------------------------------|--------------------|-----------------|-------------------------------------------------------------------------------------------------------------------|-----------|--------|---------------|-----------|--------|-----------|-----------|
|                                                                                                                                  |                    |                 | Min                                                                                                               | Max       | Min    | Typ #         | Max       | Min    | Max       |           |
| Output Voltage<br>$V_{in} = V_{DD}$ or 0                                                                                         | VOL                | 5.0             | —                                                                                                                 | 0.05      | —      | 0             | 0.05      | —      | 0.05      | Vdc       |
|                                                                                                                                  |                    | 10              | —                                                                                                                 | 0.05      | —      | 0             | 0.05      | —      | 0.05      |           |
|                                                                                                                                  |                    | 15              | —                                                                                                                 | 0.05      | —      | 0             | 0.05      | —      | 0.05      |           |
|                                                                                                                                  | VOH                | 5.0             | 4.95                                                                                                              | —         | 4.95   | 5.0           | —         | 4.95   | —         | Vdc       |
|                                                                                                                                  |                    | 10              | 9.95                                                                                                              | —         | 9.95   | 10            | —         | 9.95   | —         |           |
|                                                                                                                                  |                    | 15              | 14.95                                                                                                             | —         | 14.95  | 15            | —         | 14.95  | —         |           |
| Input Voltage<br>( $V_O = 4.5$ or $0.5$ Vdc)<br>( $V_O = 9.0$ or $1.0$ Vdc)<br>( $V_O = 13.5$ or $1.5$ Vdc)                      | VIL                | 5.0             | —                                                                                                                 | 1.5       | —      | 2.25          | 1.5       | —      | 1.5       | Vdc       |
|                                                                                                                                  |                    | 10              | —                                                                                                                 | 3.0       | —      | 4.50          | 3.0       | —      | 3.0       |           |
|                                                                                                                                  |                    | 15              | —                                                                                                                 | 4.0       | —      | 6.75          | 4.0       | —      | 4.0       |           |
|                                                                                                                                  | VIH                | 5.0             | 3.5                                                                                                               | —         | 3.5    | 2.75          | —         | 3.5    | —         | Vdc       |
|                                                                                                                                  |                    | 10              | 7.0                                                                                                               | —         | 7.0    | 5.50          | —         | 7.0    | —         |           |
|                                                                                                                                  |                    | 15              | 11                                                                                                                | —         | 11     | 8.25          | —         | 11     | —         |           |
| Output Drive Current<br>( $V_{OH} = 2.5$ Vdc)<br>( $V_{OH} = 4.6$ Vdc)<br>( $V_{OH} = 9.5$ Vdc)<br>( $V_{OH} = 13.5$ Vdc)        | Source<br>$I_{OH}$ | 5.0             | - 3.0                                                                                                             | —         | - 2.4  | - 4.2         | —         | - 1.7  | —         | mAdc      |
|                                                                                                                                  |                    | 5.0             | - 0.64                                                                                                            | —         | - 0.51 | - 0.88        | —         | - 0.36 | —         |           |
|                                                                                                                                  |                    | 10              | - 1.6                                                                                                             | —         | - 1.3  | - 2.25        | —         | - 0.9  | —         |           |
|                                                                                                                                  |                    | 15              | - 4.2                                                                                                             | —         | - 3.4  | - 8.8         | —         | - 2.4  | —         |           |
|                                                                                                                                  | Sink<br>$I_{OL}$   | 5.0             | 0.64                                                                                                              | —         | 0.51   | 0.88          | —         | 0.36   | —         | mAdc      |
|                                                                                                                                  |                    | 10              | 1.6                                                                                                               | —         | 1.3    | 2.25          | —         | 0.9    | —         |           |
|                                                                                                                                  |                    | 15              | 4.2                                                                                                               | —         | 3.4    | 8.8           | —         | 2.4    | —         |           |
| Input Current                                                                                                                    | $I_{in}$           | 15              | —                                                                                                                 | $\pm 0.1$ | —      | $\pm 0.00001$ | $\pm 0.1$ | —      | $\pm 1.0$ | $\mu$ Adc |
| Input Capacitance<br>( $V_{in} = 0$ )                                                                                            | $C_{in}$           | —               | —                                                                                                                 | —         | —      | 5.0           | 7.5       | —      | —         | pF        |
| Quiescent Current<br>(Per Package)                                                                                               | $I_{DD}$           | 5.0             | —                                                                                                                 | 5.0       | —      | 0.005         | 5.0       | —      | 150       | $\mu$ Adc |
|                                                                                                                                  |                    | 10              | —                                                                                                                 | 10        | —      | 0.010         | 10        | —      | 300       |           |
|                                                                                                                                  |                    | 15              | —                                                                                                                 | 20        | —      | 0.015         | 20        | —      | 600       |           |
| Total Supply Current**†<br>(Dynamic plus Quiescent,<br>Per Package)<br>( $C_L = 50$ pF on all outputs, all<br>buffers switching) | $I_T$              | 5.0<br>10<br>15 | $I_T = (0.96 \mu A/kHz) f + I_{DD}$<br>$I_T = (1.93 \mu A/kHz) f + I_{DD}$<br>$I_T = (2.80 \mu A/kHz) f + I_{DD}$ |           |        |               |           |        |           | $\mu$ Adc |

#Data labelled "Typ" is not to be used for design purposes but is intended as an indication of the IC's potential performance.

\*\*The formulas given are for the typical characteristics only at 25°C.

†To calculate total supply current at loads other than 50 pF:

$$I_T(C_L) = I_T(50 \text{ pF}) + (C_L - 50) V f k$$

where:  $I_T$  is in  $\mu A$  (per package),  $C_L$  in pF,  $V = (V_{DD} - V_{SS})$  in volts,  $f$  in kHz is input frequency, and  $k = 0.003$ .

**PIN ASSIGNMENT**

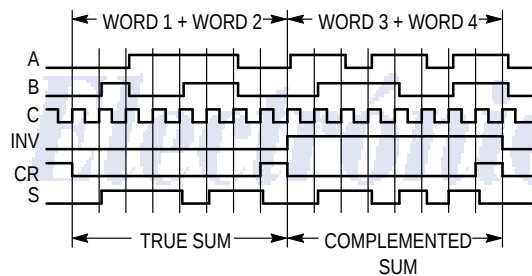
|                |   |    |          |
|----------------|---|----|----------|
| S3             | 1 | 16 | $V_{DD}$ |
| INV 3          | 2 | 15 | A3       |
| C              | 3 | 14 | B3       |
| S2             | 4 | 13 | A2       |
| INV 2          | 5 | 12 | B2       |
| CARRY<br>RESET | 6 | 11 | B1       |
| INV 1          | 7 | 10 | A1       |
| $V_{SS}$       | 8 | 9  | S1       |

**SWITCHING CHARACTERISTICS\*** ( $C_L = 50 \text{ pF}$ ,  $T_A = 25^\circ\text{C}$ )

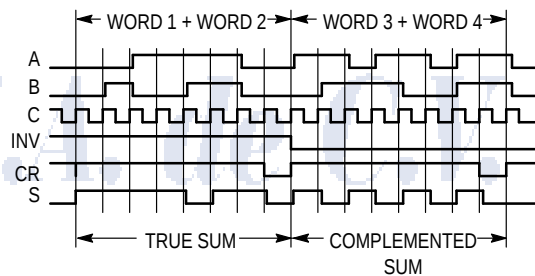
| Characteristic                                                                                                                                                                                                                                             | Symbol                   | $V_{DD}$<br>Vdc | Min            | Typ #             | Max                | Unit          |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|-----------------|----------------|-------------------|--------------------|---------------|
| Output Rise and Fall Time<br>$t_{TLH}$ , $t_{THL} = (1.5 \text{ ns/pF}) C_L + 25 \text{ ns}$<br>$t_{TLH}$ , $t_{THL} = (0.75 \text{ ns/pF}) C_L + 12.5 \text{ ns}$<br>$t_{TLH}$ , $t_{THL} = (0.55 \text{ ns/pF}) C_L + 9.5 \text{ ns}$                    | $t_{TLH}$ ,<br>$t_{THL}$ | 5.0<br>10<br>15 | —<br>—<br>—    | 100<br>50<br>40   | 200<br>100<br>80   | ns            |
| Propagation Delay Time<br>A, B or Invert to Sum<br>$t_{PLH}$ , $t_{PHL} = (1.7 \text{ ns/pF}) C_L + 195 \text{ ns}$<br>$t_{PLH}$ , $t_{PHL} = (0.66 \text{ ns/pF}) C_L + 87 \text{ ns}$<br>$t_{PLH}$ , $t_{PHL} = (0.5 \text{ ns/pF}) C_L + 65 \text{ ns}$ | $t_{PLH}$ ,<br>$t_{PHL}$ | 5.0<br>10<br>15 | —<br>—<br>—    | 280<br>120<br>90  | 1400<br>300<br>230 | ns            |
| Clock to Sum<br>$t_{PLH}$ , $t_{PHL} = (1.7 \text{ ns/pF}) C_L + 415 \text{ ns}$<br>$t_{PLH}$ , $t_{PHL} = (0.66 \text{ ns/pF}) C_L + 147 \text{ ns}$<br>$t_{PLH}$ , $t_{PHL} = (0.5 \text{ ns/pF}) C_L + 110 \text{ ns}$                                  |                          | 5.0<br>10<br>15 | —<br>—<br>—    | 500<br>180<br>135 | 2400<br>600<br>450 | ns            |
| Input Setup Time                                                                                                                                                                                                                                           | $t_{su}$                 | 5.0<br>10<br>15 | 10<br>10<br>10 | -10<br>0<br>0     | —<br>—<br>—        | ns            |
| Clock Pulse Frequency                                                                                                                                                                                                                                      | $f_{cl}$                 | 5.0<br>10<br>15 | —<br>—<br>—    | 4.0<br>10<br>12   | 1.0<br>2.5<br>4.0  | MHz           |
| Clock Rise and Fall Times                                                                                                                                                                                                                                  | $t_{THL}$ , $t_{TLH}$    | 5.0<br>10<br>15 | —<br>—<br>—    | —<br>—<br>—       | 15<br>5<br>4       | $\mu\text{s}$ |

\* The formulas given are for the typical characteristics only at  $25^\circ\text{C}$ .

#Data labelled "Typ" is not to be used for design purposes but is intended as an indication of the IC's potential performance.

**TIMING DIAGRAMS****MC14032B**

|                         |                         |
|-------------------------|-------------------------|
| WORD 1: 0.0111100 = +60 | WORD 3: 1.1011011 = -37 |
| WORD 2: 0.0110010 = +50 | WORD 4: 1.1001110 = -50 |
| 0.1101110 = +110        | 1.0101001 = -87         |

**MC14038B**

|                         |                         |
|-------------------------|-------------------------|
| WORD 1: 1.1000011 = -61 | WORD 3: 0.0100100 = +36 |
| WORD 2: 1.1001101 = -51 | WORD 4: 0.0110001 = +49 |
| 1.0010000 = -112        | 0.1010101 = +85         |

NOTE: Unused input pins must be connected to either  $V_{DD}$  or  $V_{SS}$ .

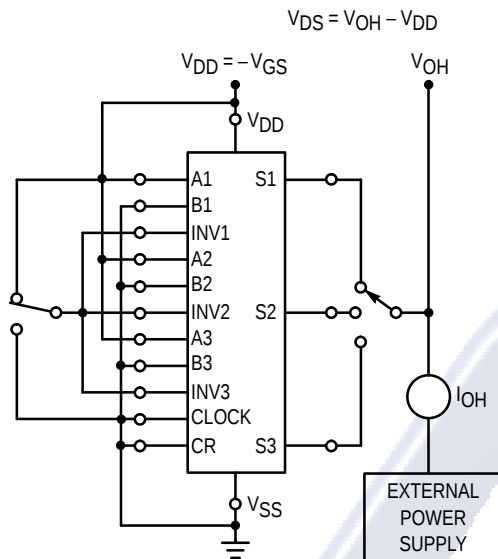


Figure 1. Typical Output Source Test Circuit

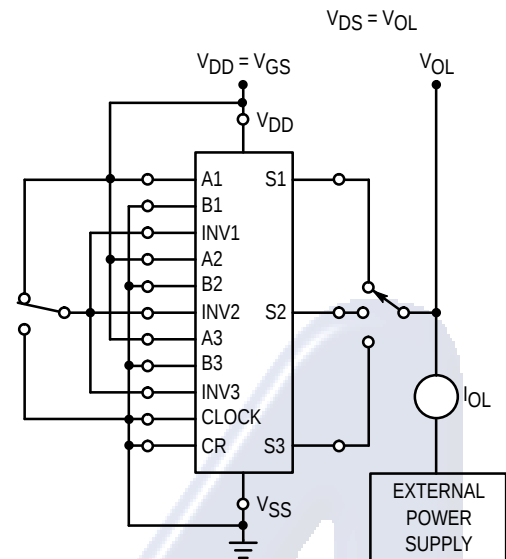


Figure 2. Typical Output Sink Test Circuit

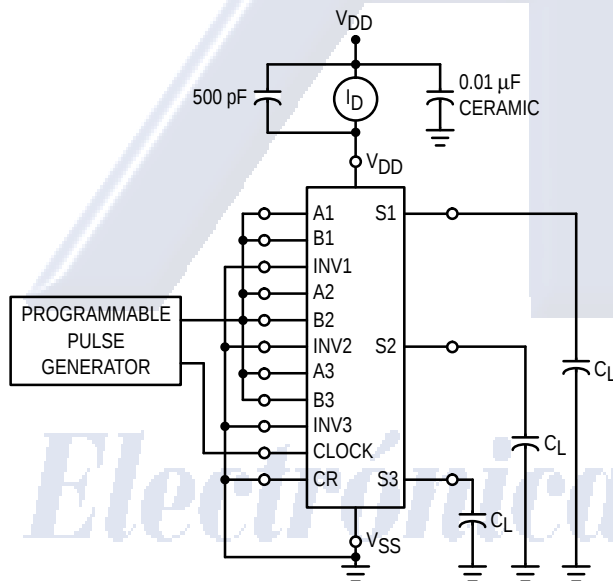


Figure 3. Power Dissipation Test Circuit and Waveforms

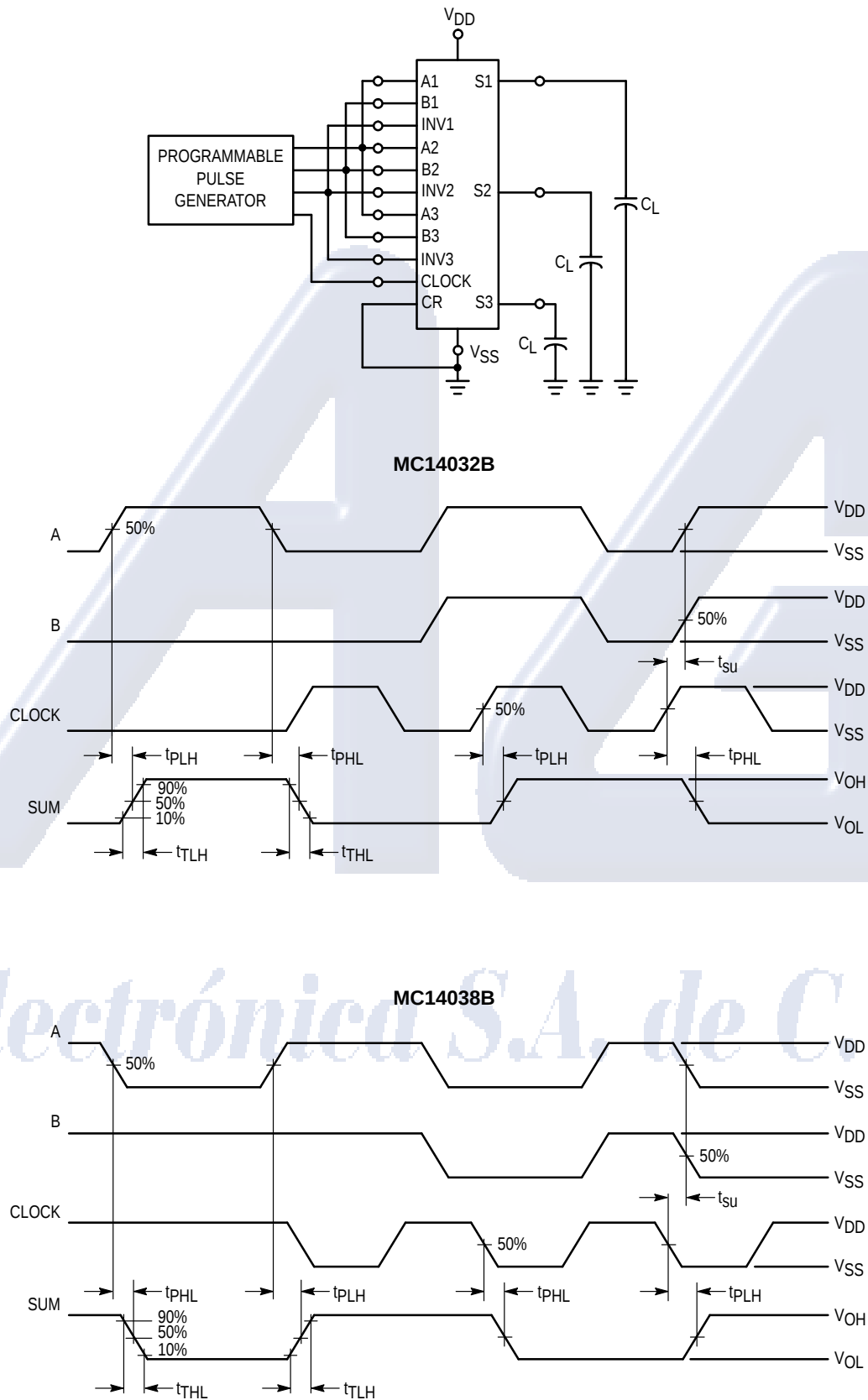
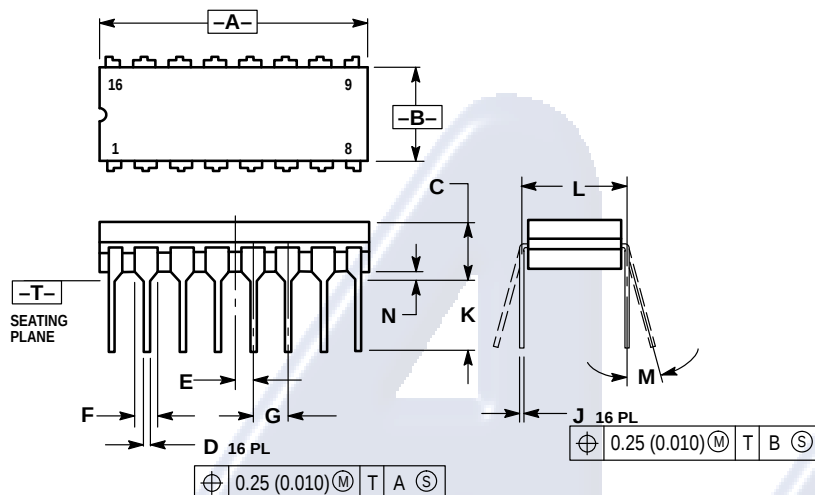


Figure 4. Switching Time Test Circuit and Waveforms

## OUTLINE DIMENSIONS

**L SUFFIX**  
**CERAMIC DIP PACKAGE**  
**CASE 620-10**  
**ISSUE V**

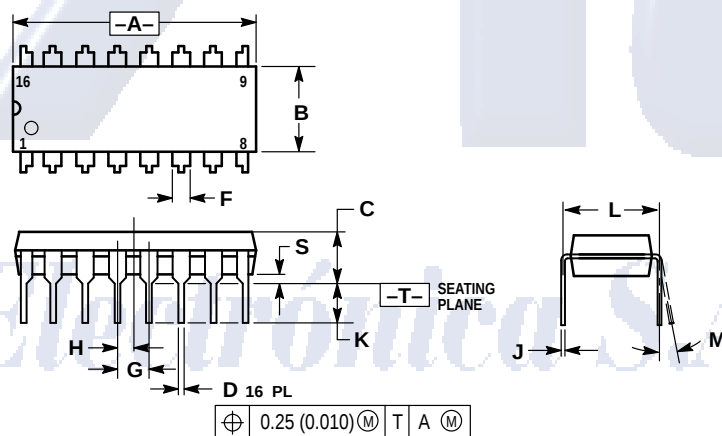


## NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
4. DIMENSION F MAY NARROW TO 0.76 (0.030) WHERE THE LEAD ENTERS THE CERAMIC BODY.

| DIM | INCHES |       | MILLIMETERS |       |
|-----|--------|-------|-------------|-------|
|     | MIN    | MAX   | MIN         | MAX   |
| A   | 0.750  | 0.785 | 19.05       | 19.93 |
| B   | 0.240  | 0.295 | 6.10        | 7.49  |
| C   | —      | 0.200 | —           | 5.08  |
| D   | 0.015  | 0.020 | 0.39        | 0.50  |
| E   | 0.050  | BSC   | 1.27        | BSC   |
| F   | 0.055  | 0.065 | 1.40        | 1.65  |
| G   | 0.100  | BSC   | 2.54        | BSC   |
| H   | 0.008  | 0.015 | 0.21        | 0.38  |
| K   | 0.125  | 0.170 | 3.18        | 4.31  |
| L   | 0.300  | BSC   | 7.62        | BSC   |
| M   | 0°     | 15°   | 0°          | 15°   |
| N   | 0.020  | 0.040 | 0.51        | 1.01  |

**P SUFFIX**  
**PLASTIC DIP PACKAGE**  
**CASE 648-08**  
**ISSUE R**



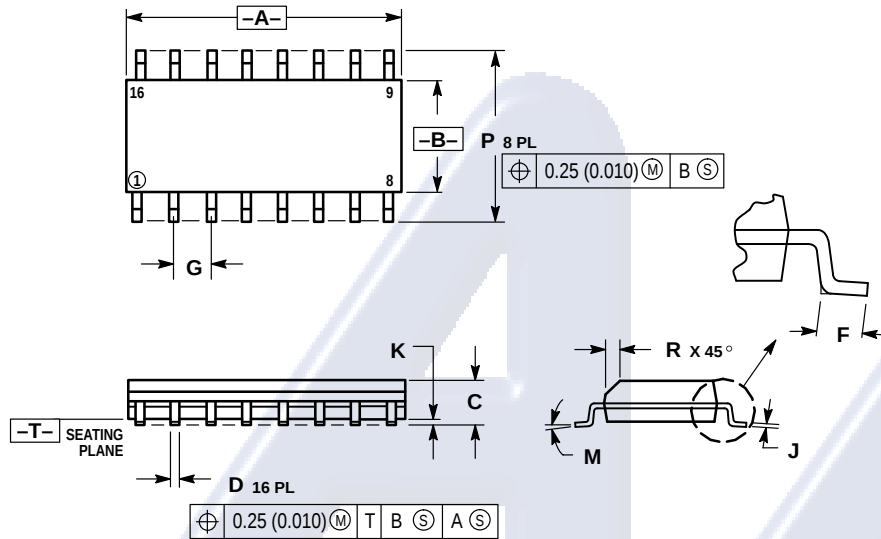
## NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

| DIM | INCHES |       | MILLIMETERS |       |
|-----|--------|-------|-------------|-------|
|     | MIN    | MAX   | MIN         | MAX   |
| A   | 0.740  | 0.770 | 18.80       | 19.55 |
| B   | 0.250  | 0.270 | 6.35        | 6.85  |
| C   | 0.145  | 0.175 | 3.69        | 4.44  |
| D   | 0.015  | 0.021 | 0.39        | 0.53  |
| F   | 0.040  | 0.70  | 1.02        | 1.77  |
| G   | 0.100  | BSC   | 2.54        | BSC   |
| H   | 0.050  | BSC   | 1.27        | BSC   |
| J   | 0.008  | 0.015 | 0.21        | 0.38  |
| K   | 0.110  | 0.130 | 2.80        | 3.30  |
| L   | 0.295  | 0.305 | 7.50        | 7.74  |
| M   | 0°     | 10°   | 0°          | 10°   |
| S   | 0.020  | 0.040 | 0.51        | 1.01  |

## OUTLINE DIMENSIONS

**D SUFFIX**  
**PLASTIC SOIC PACKAGE**  
**CASE 751B-05**  
**ISSUE J**



## NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

| DIM | MILLIMETERS |       | INCHES    |       |
|-----|-------------|-------|-----------|-------|
|     | MIN         | MAX   | MIN       | MAX   |
| A   | 9.80        | 10.00 | 0.386     | 0.393 |
| B   | 3.80        | 4.00  | 0.150     | 0.157 |
| C   | 1.35        | 1.75  | 0.054     | 0.068 |
| D   | 0.35        | 0.49  | 0.014     | 0.019 |
| F   | 0.40        | 1.25  | 0.016     | 0.049 |
| G   | 1.27 BSC    |       | 0.050 BSC |       |
| J   | 0.19        | 0.25  | 0.008     | 0.009 |
| K   | 0.10        | 0.25  | 0.004     | 0.009 |
| M   | 0°          | 7°    | 0°        | 7°    |
| P   | 5.80        | 6.20  | 0.229     | 0.244 |
| R   | 0.25        | 0.50  | 0.010     | 0.019 |

# Electrónica S.A. de C.V.

Motorola reserves the right to make changes without further notice to any products herein. Motorola makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does Motorola assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages. "Typical" parameters which may be provided in Motorola data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. Motorola does not convey any license under its patent rights nor the rights of others. Motorola products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the Motorola product could create a situation where personal injury or death may occur. Should Buyer purchase or use Motorola products for any such unintended or unauthorized application, Buyer shall indemnify and hold Motorola and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that Motorola was negligent regarding the design or manufacture of the part. Motorola and  are registered trademarks of Motorola, Inc. Motorola, Inc. is an Equal Opportunity/Affirmative Action Employer.

## How to reach us:

**USA/EUROPE/Locations Not Listed:** Motorola Literature Distribution;  
P.O. Box 20912; Phoenix, Arizona 85036. 1-800-441-2447 or 602-303-5454

**MFAX:** RMFAX0@email.sps.mot.com – TOUCHTONE 602-244-6609  
**INTERNET:** http://Design-NET.com

**JAPAN:** Nippon Motorola Ltd.; Tatsumi-SPD-JLDC, 6F Seibu-Butsuryu-Center,  
3-14-2 Tatsumi Koto-Ku, Tokyo 135, Japan. 03-81-3521-8315

**ASIA/PACIFIC:** Motorola Semiconductors H.K. Ltd.; 8B Tai Ping Industrial Park,  
51 Ting Kok Road, Tai Po, N.T., Hong Kong. 852-26629298



**MOTOROLA**

MC14032B/D

