

# BCD-To-Seven Segment Latch/Decoder/Driver

## CMOS MSI (Low-Power Complementary MOS)

The MC14513B BCD-to-seven segment latch/decoder/driver is constructed with complementary MOS (CMOS) enhancement mode devices and NPN bipolar output drivers in a single monolithic structure. The circuit provides the functions of a 4-bit storage latch, an 8421 BCD-to-seven segment decoder, and has output drive capability. Lamp test ( $\overline{LT}$ ), blanking ( $\overline{BI}$ ), and latch enable (LE) inputs are used to test the display, to turn-off or pulse modulate the brightness of the display, and to store a BCD code, respectively. The Ripple Blanking Input (RBI) and Ripple Blanking Output (RBO) can be used to suppress either leading or trailing zeroes. It can be used with seven-segment light emitting diodes (LED), incandescent, fluorescent, gas discharge, or liquid crystal readouts either directly or indirectly.

Applications include instrument (e.g., counter, DVM, etc.) display driver, computer/calculator display driver, cockpit display driver, and various clock, watch, and timer uses.

- Low Logic Circuit Power Dissipation
- High-current Sourcing Outputs (Up to 25 mA)
- Latch Storage of Binary Input
- Blanking Input
- Lamp Test Provision
- Readout Blanking on all Illegal Input Combinations
- Lamp Intensity Modulation Capability
- Time Share (Multiplexing) Capability
- Adds Ripple Blanking In, Ripple Blanking Out to MC14511B
- Supply Voltage Range = 3.0 V to 18 V
- Capable of Driving Two Low-Power TTL Loads, One Low-power Schottky TTL Load to Two HTL Loads Over the Rated Temperature Range.

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

| Rating                                                      | Symbol      | Value                   | Unit |
|-------------------------------------------------------------|-------------|-------------------------|------|
| DC Supply Voltage                                           | $V_{DD}$    | - 0.5 to + 18           | V    |
| Input Voltage, All Inputs                                   | $V_{in}$    | - 0.5 to $V_{DD} + 0.5$ | V    |
| DC Current Drain per Input Pin                              | I           | 10                      | mA   |
| Operating Temperature Range                                 | $T_A$       | - 55 to + 125           | °C   |
| Power Dissipation, per Package†                             | $P_D$       | 500                     | mW   |
| Storage Temperature Range                                   | $T_{stg}$   | - 65 to + 150           | °C   |
| Maximum Continuous Output Drive Current (Source) per Output | $I_{OHmax}$ | 25                      | mA   |
| Maximum Continuous Output Power (Source) per Output ‡       | $P_{OHmax}$ | 50                      | mW   |

‡ $P_{OHmax} = I_{OH} (V_{DD} - V_{OH})$

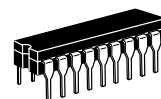
\* Maximum Ratings are those values beyond which damage to the device may occur.

† Temperature Derating:

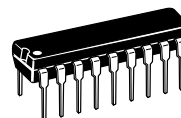
Plastic "P" and D/DW" Packages: - 7.0 mW/°C From 65°C To 125°C

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

## MC14513B



**L SUFFIX**  
CERAMIC  
CASE 726



**P SUFFIX**  
PLASTIC  
CASE 707

### ORDERING INFORMATION

MC14XXXBCP

Plastic

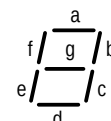
MC14XXXBCL

Ceramic

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

### PIN ASSIGNMENT

|                 |   |    |          |
|-----------------|---|----|----------|
| B               | 1 | 18 | $V_{DD}$ |
| C               | 2 | 17 | f        |
| $\overline{LT}$ | 3 | 16 | g        |
| $\overline{BI}$ | 4 | 15 | a        |
| LE              | 5 | 14 | b        |
| D               | 6 | 13 | c        |
| A               | 7 | 12 | d        |
| RBI             | 8 | 11 | e        |
| $V_{SS}$        | 9 | 10 | RBO      |



### DISPLAY

|   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|

### TRUTH TABLE

| Inputs |    |                 |                 |   |   |   |   | Outputs |   |   |   |   |   |   |   |            |
|--------|----|-----------------|-----------------|---|---|---|---|---------|---|---|---|---|---|---|---|------------|
| RBI    | LE | $\overline{BI}$ | $\overline{LT}$ | D | C | B | A | RBO     | a | b | c | d | e | f | g | Display    |
| X      | X  | X               | 0               | X | X | X | X | +       | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8          |
| X      | X  | 0               | 1               | X | X | X | X | +       | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Blank      |
| 1      | 0  | 1               | 1               | 0 | 0 | 0 | 0 | 1       | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Blank<br>0 |
| 0      | 0  | 1               | 1               | 0 | 0 | 0 | 0 | 0       | 1 | 1 | 1 | 1 | 1 | 1 | 0 |            |
| X      | 0  | 1               | 1               | 0 | 0 | 0 | 1 | 0       | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1          |
| X      | 0  | 1               | 1               | 0 | 0 | 1 | 0 | 0       | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 2          |
| X      | 0  | 1               | 1               | 0 | 0 | 1 | 1 | 0       | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 3          |
| X      | 0  | 1               | 1               | 0 | 1 | 0 | 0 | 0       | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 4          |
| X      | 0  | 1               | 1               | 0 | 1 | 0 | 1 | 0       | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 5          |
| X      | 0  | 1               | 1               | 0 | 1 | 1 | 0 | 0       | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 6          |
| X      | 0  | 1               | 1               | 0 | 1 | 1 | 1 | 0       | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 7          |
| X      | 0  | 1               | 1               | 1 | 0 | 0 | 0 | 0       | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8          |
| X      | 0  | 1               | 1               | 1 | 0 | 0 | 1 | 0       | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 9          |
| X      | 0  | 1               | 1               | 1 | 0 | 1 | 0 | 0       | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Blank      |
| X      | 0  | 1               | 1               | 1 | 0 | 1 | 1 | 0       | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Blank      |
| X      | 0  | 1               | 1               | 1 | 1 | 0 | 1 | 0       | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Blank      |
| X      | 0  | 1               | 1               | 1 | 1 | 1 | 0 | 0       | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Blank      |
| X      | 0  | 1               | 1               | 1 | 1 | 1 | 1 | 0       | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Blank      |
| X      | 1  | 1               | 1               | X | X | X | X | †       | * |   |   |   |   |   | * |            |

X = Don't Care

†RBO = RBI ( $\overline{D} \overline{C} \overline{B} \overline{A}$ ), indicated by other rows of table

\*Depends upon the BCD code previously applied when LE = 0



**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 — Segment Outputs<br>“0” Level<br>$V_{in} = V_{DD}$ or 0                                                                                                             | $V_{OL}$ | 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 |      |
|                                                                                                                                                                                     | $V_{OH}$ | 5.0             | 4.1    | —    | 4.1   | 5.0   | —    | 4.1   | —    | Vdc  |
|                                                                                                                                                                                     |          | 10              | 9.1    | —    | 9.1   | 10    | —    | 9.1   | —    |      |
|                                                                                                                                                                                     |          | 15              | 14.1   | —    | 14.1  | 15    | —    | 14.1  | —    |      |
| Output Voltage — RBO Output<br>“0” Level<br>$V_{in} = V_{DD}$ or 0                                                                                                                  | $V_{OL}$ | 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 |      |
|                                                                                                                                                                                     | $V_{OH}$ | 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>“0” Level<br>( $V_O = 3.8$ or $0.5$ Vdc)<br>( $V_O = 8.8$ or $1.0$ Vdc)<br>( $V_O = 13.8$ or $1.5$ Vdc)                                                          | $V_{IL}$ | 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  |      |
|                                                                                                                                                                                     | $V_{IH}$ | 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 Voltage — Segments<br>Source<br>( $I_{OH} = 0$ mA)<br>( $I_{OH} = 5.0$ mA)<br>( $I_{OH} = 10$ mA)<br>( $I_{OH} = 15$ mA)<br>( $I_{OH} = 20$ mA)<br>( $I_{OH} = 25$ mA) | $V_{OH}$ | 5.0             | 4.1    | —    | 4.1   | 4.57  | —    | 4.1   | —    | Vdc  |
|                                                                                                                                                                                     |          |                 | —      | —    | —     | 4.24  | —    | —     | —    |      |
|                                                                                                                                                                                     |          |                 | 3.9    | —    | 3.9   | 4.12  | —    | 3.5   | —    |      |
|                                                                                                                                                                                     |          |                 | —      | —    | —     | 3.94  | —    | —     | —    |      |
|                                                                                                                                                                                     |          |                 | 3.4    | —    | 3.4   | 3.70  | —    | 3.0   | —    |      |
|                                                                                                                                                                                     |          |                 | —      | —    | —     | 3.54  | —    | —     | —    |      |
|                                                                                                                                                                                     | $V_{OH}$ | 10              | 9.1    | —    | 9.1   | 9.58  | —    | 9.1   | —    | Vdc  |
|                                                                                                                                                                                     |          |                 | —      | —    | —     | 9.26  | —    | —     | —    |      |
|                                                                                                                                                                                     |          |                 | 9.0    | —    | 9.0   | 9.17  | —    | 8.6   | —    |      |
|                                                                                                                                                                                     |          |                 | —      | —    | —     | 9.04  | —    | —     | —    |      |
|                                                                                                                                                                                     |          |                 | 8.6    | —    | 8.6   | 8.90  | —    | 8.2   | —    |      |
|                                                                                                                                                                                     |          |                 | —      | —    | —     | 8.75  | —    | —     | —    |      |
|                                                                                                                                                                                     | $V_{OH}$ | 15              | 14.1   | —    | 14.1  | 14.59 | —    | 14.1  | —    | Vdc  |
|                                                                                                                                                                                     |          |                 | —      | —    | —     | 14.27 | —    | —     | —    |      |
|                                                                                                                                                                                     |          |                 | 14     | —    | 14    | 14.18 | —    | 13.6  | —    |      |
|                                                                                                                                                                                     |          |                 | —      | —    | —     | 14.07 | —    | —     | —    |      |
|                                                                                                                                                                                     |          |                 | 13.6   | —    | 13.6  | 13.95 | —    | 13.2  | —    |      |
|                                                                                                                                                                                     |          |                 | —      | —    | —     | 13.80 | —    | —     | —    |      |

(continued)

This device contains protection 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. A destructive high current mode may occur if  $V_{in}$  and  $V_{out}$  is not constrained to the range  $V_{SS} \leq (V_{in} \text{ or } V_{out}) \leq V_{DD}$ .

Due to the sourcing capability of this circuit, damage can occur to the device if  $V_{DD}$  is applied, and the outputs are shorted to  $V_{SS}$  and are at a logical 1 (See Maximum Ratings).

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

**ELECTRICAL CHARACTERISTICS — continued** (Voltages Referenced to V<sub>SS</sub>)

| Characteristic                                                                                                                                                                                                                         | Symbol          | V <sub>DD</sub><br>Vdc | – 55°C                                                                                                                                                      |       | 25°C   |           |       | 125°C  |       | Unit |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|--------|-----------|-------|--------|-------|------|
|                                                                                                                                                                                                                                        |                 |                        | Min                                                                                                                                                         | Max   | Min    | Typ #     | Max   | Min    | Max   |      |
| Output Drive Current — RBO Output<br>(V <sub>OH</sub> = 2.5 V)<br>Source<br>(V <sub>OH</sub> = 9.5 V)<br>(V <sub>OH</sub> = 13.5 V)<br><br>(V <sub>OL</sub> = 0.4 V)<br>Sink<br>(V <sub>OL</sub> = 0.5 V)<br>(V <sub>OL</sub> = 1.5 V) | I <sub>OH</sub> | 5.0                    | – 0.40                                                                                                                                                      | —     | – 0.32 | – 0.64    | —     | – 0.22 | —     | mAdc |
|                                                                                                                                                                                                                                        |                 | 10                     | – 0.21                                                                                                                                                      | —     | – 0.17 | – 0.34    | —     | – 0.12 | —     |      |
|                                                                                                                                                                                                                                        |                 | 15                     | – 0.81                                                                                                                                                      | —     | – 0.66 | – 1.30    | —     | – 0.46 | —     |      |
|                                                                                                                                                                                                                                        | I <sub>OL</sub> | 5.0                    | 0.18                                                                                                                                                        | —     | 0.15   | 0.29      | —     | 0.10   | —     | mAdc |
|                                                                                                                                                                                                                                        |                 | 10                     | 0.47                                                                                                                                                        | —     | 0.38   | 0.75      | —     | 0.26   | —     |      |
|                                                                                                                                                                                                                                        |                 | 15                     | 1.80                                                                                                                                                        | —     | 1.50   | 2.90      | —     | 1.0    | —     |      |
| Output Drive Current — Segments<br>(V <sub>OL</sub> = 0.4 V)<br>Sink<br>(V <sub>OL</sub> = 0.5 V)<br>(V <sub>OL</sub> = 1.5 V)                                                                                                         | I <sub>OL</sub> | 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 <sub>in</sub> | 15                     | —                                                                                                                                                           | ± 0.1 | —      | ± 0.00001 | ± 0.1 | —      | ± 1.0 | μAdc |
| Input Capacitance                                                                                                                                                                                                                      | C <sub>in</sub> | —                      | —                                                                                                                                                           | —     | —      | 5.0       | 7.5   | —      | —     | pF   |
| Quiescent Current<br>(Per Package) V <sub>in</sub> = 0 or V <sub>DD</sub> ,<br>I <sub>out</sub> = 0 μA                                                                                                                                 | I <sub>DD</sub> | 5.0                    | —                                                                                                                                                           | 5.0   | —      | 0.005     | 5.0   | —      | 150   | μAdc |
|                                                                                                                                                                                                                                        |                 | 10                     | —                                                                                                                                                           | 10    | —      | 0.010     | 10    | —      | 300   |      |
|                                                                                                                                                                                                                                        |                 | 15                     | —                                                                                                                                                           | 20    | —      | 0.015     | 20    | —      | 600   |      |
| Total Supply Current**†<br>(Dynamic plus Quiescent,<br>Per Package)<br>(C <sub>L</sub> = 50 pF on all outputs, all<br>buffers switching)                                                                                               | I <sub>T</sub>  | 5.0<br>10<br>15        | I <sub>T</sub> = (1.9 μA/kHz) f + I <sub>DD</sub><br>I <sub>T</sub> = (3.8 μA/kHz) f + I <sub>DD</sub><br>I <sub>T</sub> = (5.7 μA/kHz) f + I <sub>DD</sub> |       |        |           |       |        |       | μAdc |

#Noise immunity specified for worst-case input combination.

Noise Margin for both “1” and “0” level =

1.0 Vdc min @ V<sub>DD</sub> = 5.0 Vdc

2.0 Vdc min @ V<sub>DD</sub> = 10 Vdc

2.5 Vdc min @ V<sub>DD</sub> = 15 Vdc

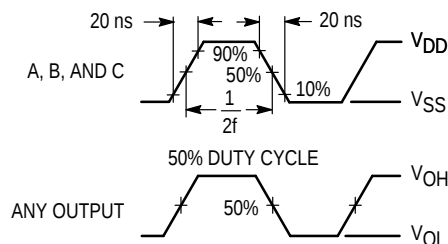
\*\*The formulas given are for the typical characteristics only at 25°C.

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

$$I_T(C_L) = I_T(50 \text{ pF}) + 3.5 \times 10^{-3} (C_L - 50) V_{DD} f$$

where: I<sub>T</sub> is in μA (per package), C<sub>L</sub> in pF, V<sub>DD</sub> in Vdc, and f in kHz is input frequency.

Input LE and RBI low, and Inputs D,  $\overline{\text{BI}}$  and  $\overline{\text{LT}}$  high.  
f in respect to a system clock.  
All outputs connected to respective C<sub>L</sub> loads.

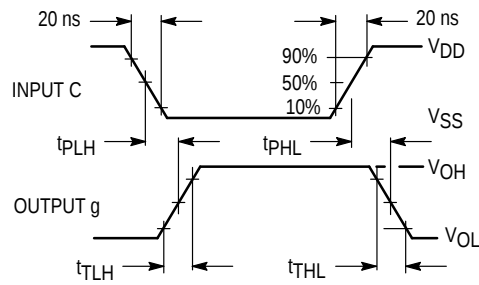


**Figure 1. Dynamic Power Dissipation Signal Waveforms**

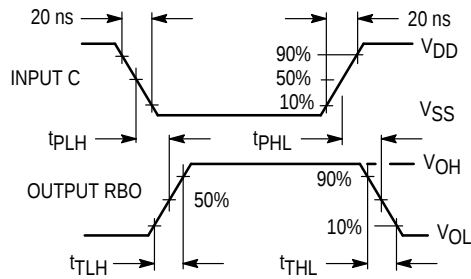
**SWITCHING CHARACTERISTICS\*** ( $C_L = 50 \text{ pF}$ ,  $T_A = 25^\circ\text{C}$ )

| Characteristic                                                                                                                                                                                                                                                                                                                                                                                                               | Symbol       | $V_{DD}$<br>Vdc | All Types         |                   |                    | Unit |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-----------------|-------------------|-------------------|--------------------|------|
|                                                                                                                                                                                                                                                                                                                                                                                                                              |              |                 | Min               | Typ               | Max                |      |
| Output Rise Time — Segment Outputs                                                                                                                                                                                                                                                                                                                                                                                           | $t_{TLH}$    | 5.0<br>10<br>15 | —<br>—<br>—       | 40<br>30<br>25    | 80<br>60<br>50     | ns   |
| Output Rise Time — RBO Output                                                                                                                                                                                                                                                                                                                                                                                                | $t_{TLH}$    | 5.0<br>10<br>15 | —<br>—<br>—       | 480<br>240<br>190 | 960<br>480<br>380  | ns   |
| Output Fall Time — Segment Outputs*<br>$t_{THL} = (1.5 \text{ ns/pF}) C_L + 50 \text{ ns}$<br>$t_{THL} = (0.75 \text{ ns/pF}) C_L + 37.5 \text{ ns}$<br>$t_{THL} = (0.55 \text{ ns/pF}) C_L + 37.5 \text{ ns}$                                                                                                                                                                                                               | $t_{THL}$    | 5.0<br>10<br>15 | —<br>—<br>—       | 125<br>75<br>65   | 250<br>150<br>130  | ns   |
| Output Fall Time — RBO Outputs<br>$t_{THL} = (3.25 \text{ ns/pF}) C_L + 107.5 \text{ ns}$<br>$t_{THL} = (1.35 \text{ ns/pF}) C_L + 67.5 \text{ ns}$<br>$t_{THL} = (0.95 \text{ ns/pF}) C_L + 62.5 \text{ ns}$                                                                                                                                                                                                                | $t_{THL}$    | 5.0<br>10<br>15 | —<br>—<br>—       | 270<br>135<br>110 | 540<br>270<br>220  | ns   |
| Propagation Delay Time — A, B, C, D Inputs*<br>$t_{PLH} = (0.40 \text{ ns/pF}) C_L + 620 \text{ ns}$<br>$t_{PLH} = (0.25 \text{ ns/pF}) C_L + 237.5 \text{ ns}$<br>$t_{PLH} = (0.20 \text{ ns/pF}) C_L + 165 \text{ ns}$<br><br>$t_{PHL} = (1.3 \text{ ns/pF}) C_L + 655 \text{ ns}$<br>$t_{PHL} = (0.60 \text{ ns/pF}) C_L + 260 \text{ ns}$<br>$t_{PHL} = (0.35 \text{ ns/pF}) C_L + 182.5 \text{ ns}$                     | $t_{PLH}$    | 5.0<br>10<br>15 | —<br>—<br>—       | 640<br>250<br>175 | 1280<br>500<br>350 | ns   |
|                                                                                                                                                                                                                                                                                                                                                                                                                              | $t_{PHL}$    | 5.0<br>10<br>15 | —<br>—<br>—       | 720<br>290<br>200 | 1440<br>580<br>400 | ns   |
| Propagation Delay Time — RBI and $\overline{BI}$ Inputs*<br>$t_{PLH} = (1.05 \text{ ns/pF}) C_L + 547.5 \text{ ns}$<br>$t_{PLH} = (0.45 \text{ ns/pF}) C_L + 177.5 \text{ ns}$<br>$t_{PLH} = (0.30 \text{ ns/pF}) C_L + 135 \text{ ns}$<br><br>$t_{PHL} = (0.85 \text{ ns/pF}) C_L + 442.5 \text{ ns}$<br>$t_{PHL} = (0.45 \text{ ns/pF}) C_L + 177.5 \text{ ns}$<br>$t_{PHL} = (0.35 \text{ ns/pF}) C_L + 142.5 \text{ ns}$ | $t_{PLH}$    | 5.0<br>10<br>15 | —<br>—<br>—       | 600<br>200<br>150 | 750<br>300<br>220  | ns   |
|                                                                                                                                                                                                                                                                                                                                                                                                                              | $t_{PHL}$    | 5.0<br>10<br>15 | —<br>—<br>—       | 485<br>200<br>160 | 970<br>400<br>320  | ns   |
| Propagation Delay Time — $\overline{LT}$ Input*<br>$t_{PLH} = (0.45 \text{ ns/pF}) C_L + 290.5 \text{ ns}$<br>$t_{PLH} = (0.25 \text{ ns/pF}) C_L + 112.5 \text{ ns}$<br>$t_{PLH} = (0.20 \text{ ns/pF}) C_L + 80 \text{ ns}$<br><br>$t_{PHL} = (1.3 \text{ ns/pF}) C_L + 248 \text{ ns}$<br>$t_{PHL} = (0.45 \text{ ns/pF}) C_L + 102.5 \text{ ns}$<br>$t_{PHL} = (0.35 \text{ ns/pF}) C_L + 72.5 \text{ ns}$               | $t_{PLH}$    | 5.0<br>10<br>15 | —<br>—<br>—       | 313<br>125<br>90  | 625<br>250<br>180  | ns   |
|                                                                                                                                                                                                                                                                                                                                                                                                                              | $t_{PHL}$    | 5.0<br>10<br>15 | —<br>—<br>—       | 313<br>125<br>90  | 625<br>250<br>180  | ns   |
| Setup Time                                                                                                                                                                                                                                                                                                                                                                                                                   | $t_{su}$     | 5.0<br>10<br>15 | 100<br>40<br>30   | —<br>—<br>—       | —<br>—<br>—        | ns   |
| Hold Time                                                                                                                                                                                                                                                                                                                                                                                                                    | $t_h$        | 5.0<br>10<br>15 | 60<br>40<br>30    | —<br>—<br>—       | —<br>—<br>—        | ns   |
| Latch Enable Pulse Width                                                                                                                                                                                                                                                                                                                                                                                                     | $t_{WL(LE)}$ | 5.0<br>10<br>15 | 520<br>220<br>130 | 260<br>110<br>65  | —<br>—<br>—        | ns   |

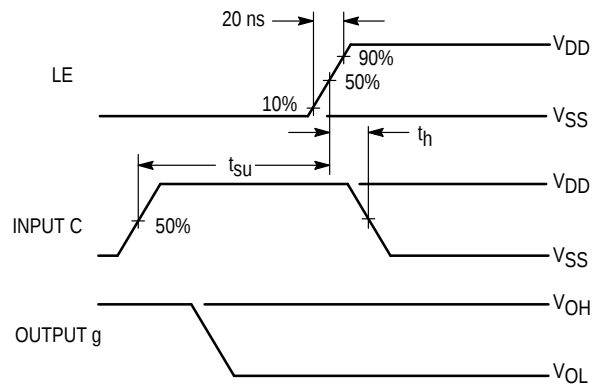
\* The formulas given are for the typical characteristics only.



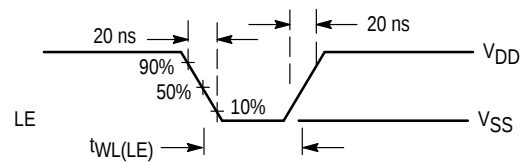
**a. Data Propagation Delay: Inputs RBI, D and LE low, and Inputs A, B,  $\overline{BI}$  and  $\overline{LT}$  high.**



**b. Inputs A, B, D and LE low, and Inputs RBI,  $\overline{BI}$  and  $\overline{LT}$  high.**



**c. Setup and Hold Times: Input RBI and D low, Inputs A, B,  $\overline{BI}$  and  $\overline{LT}$  high.**

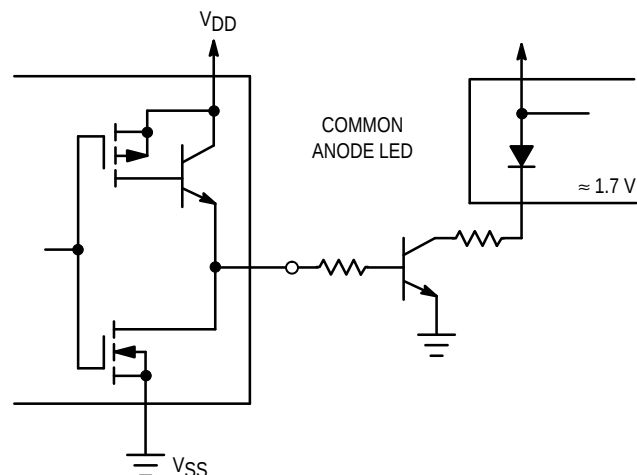
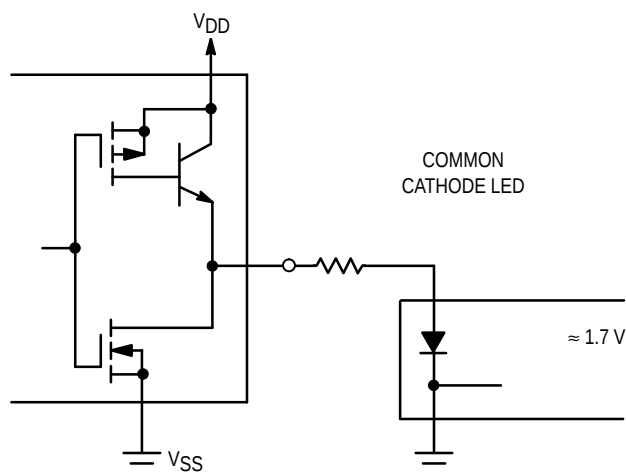


**d. Pulse Width: Data DCBA strobed into latches.**

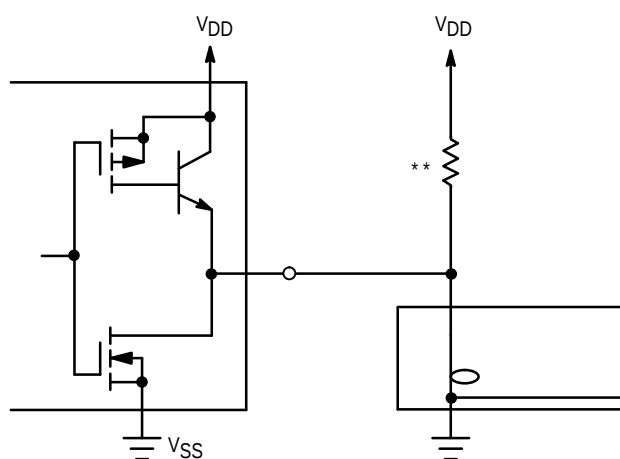
**Figure 2. Dynamic Signal Waveforms**

## CONNECTIONS TO VARIOUS DISPLAY READOUTS

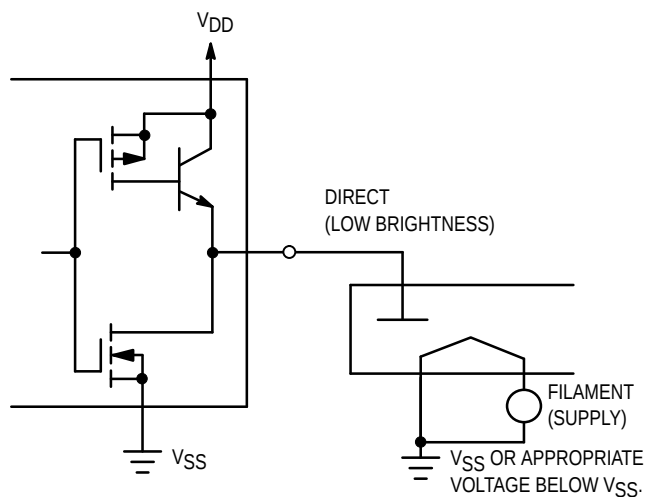
### LIGHT EMITTING DIODE (LED) READOUT



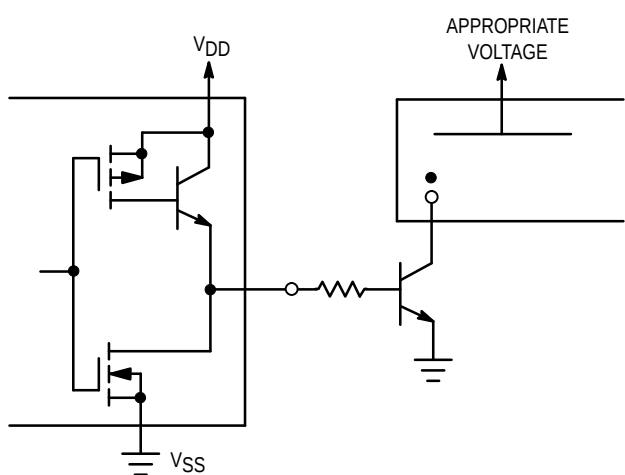
### INCANDESCENT READOUT



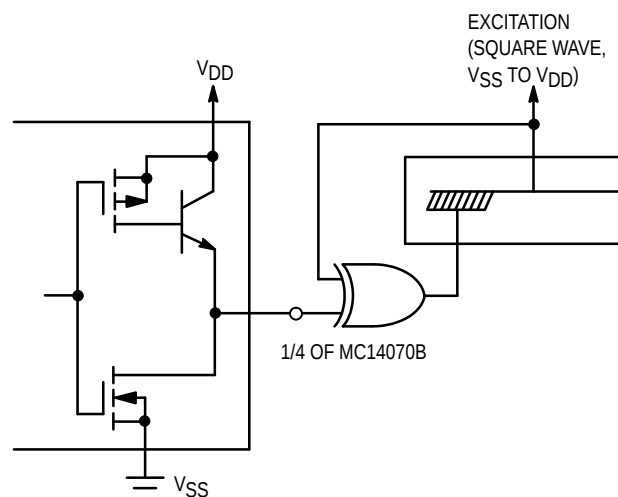
### FLUORESCENT READOUT



### GAS DISCHARGE READOUT



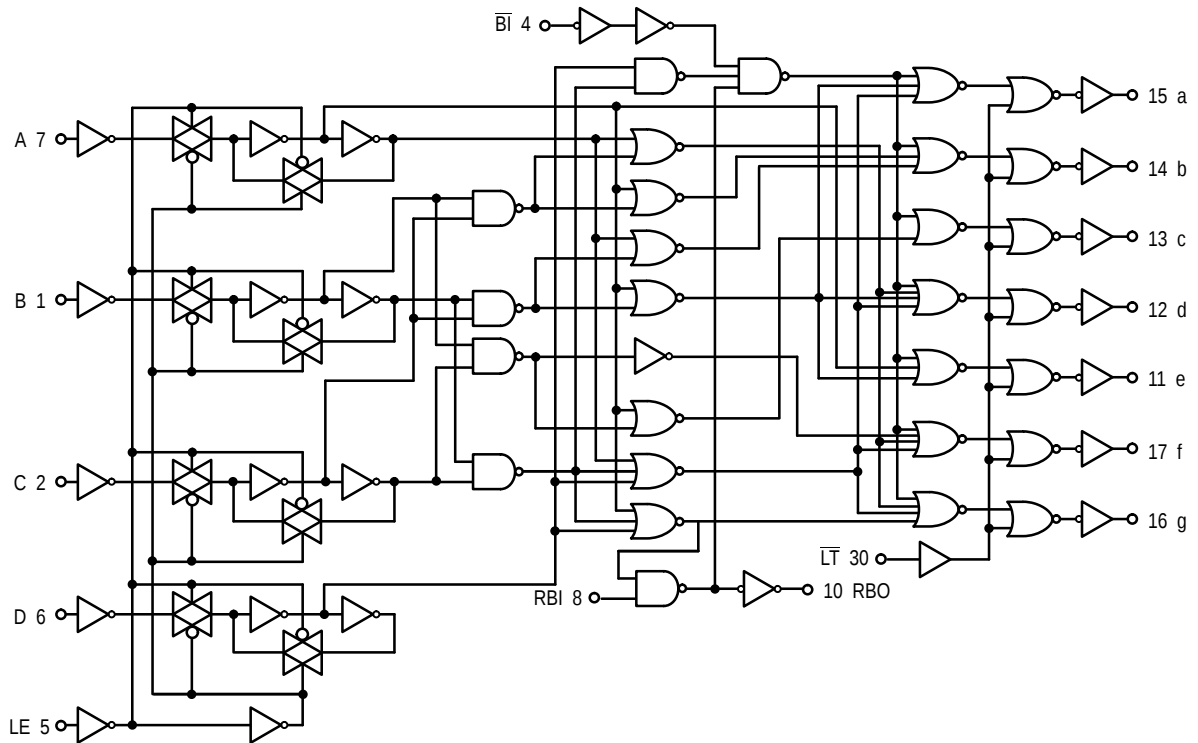
### LIQUID CRYSTAL (LC) READOUT



\*\* A filament pre-warm resistor is recommended to reduce filament thermal shock and increase the effective cold resistance of the filament.

Direct dc drive of LC's not recommended for life of LC readouts.

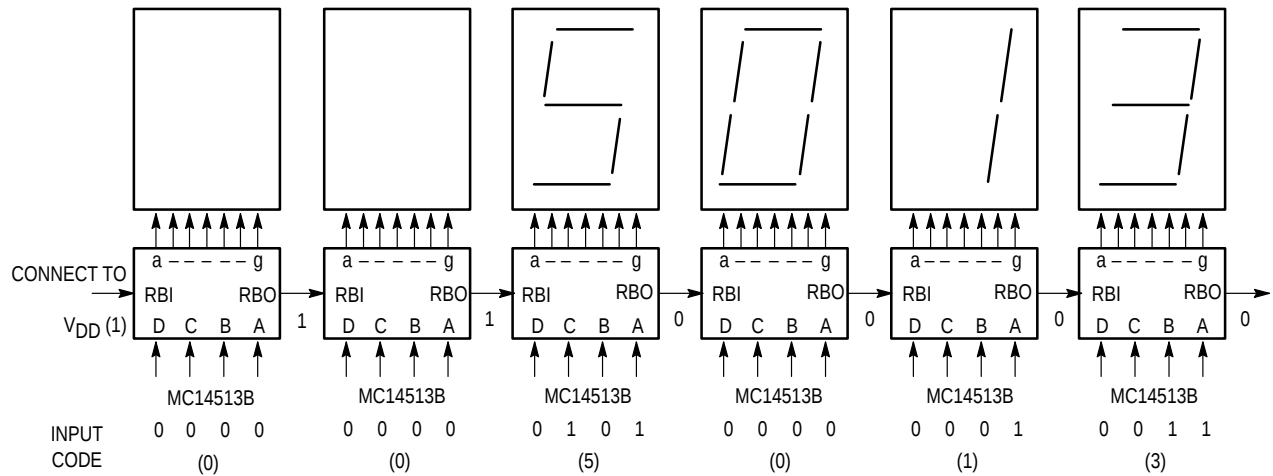
## LOGIC DIAGRAM



## TYPICAL APPLICATIONS FOR RIPPLE BLANKING

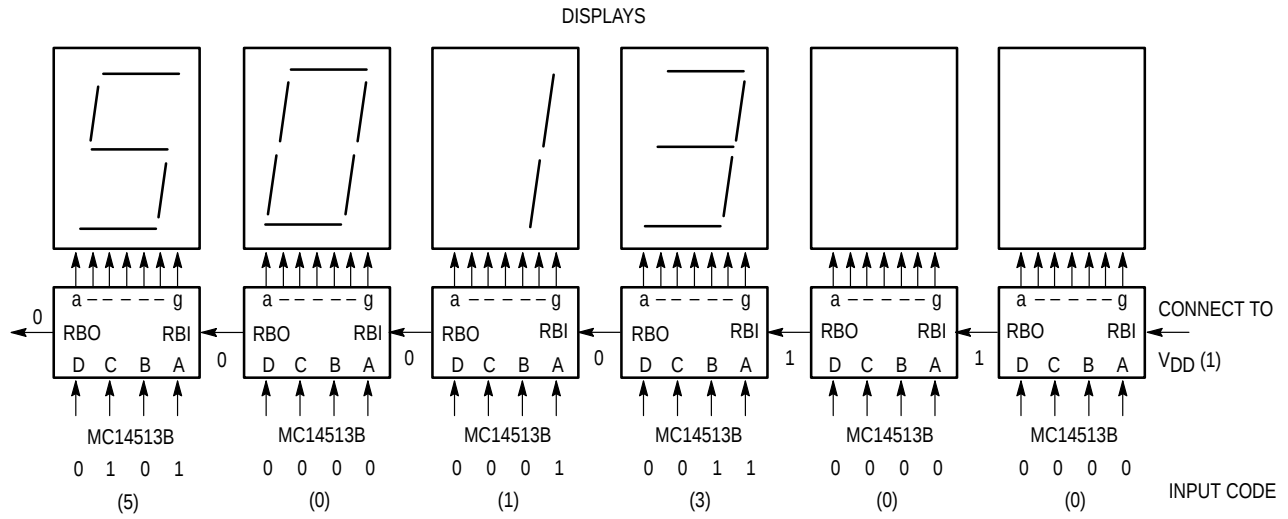
### LEADING EDGE ZERO SUPPRESSION

#### DISPLAYS



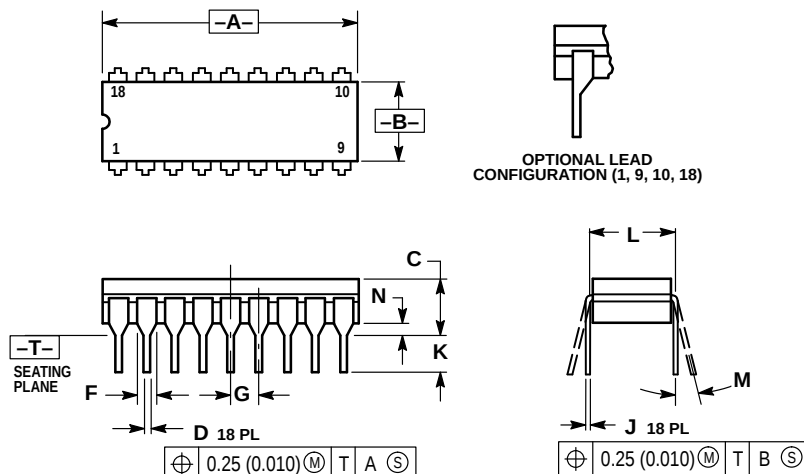
## TYPICAL APPLICATIONS FOR RIPPLE BLANKING (Cont)

### TRAILING EDGE ZERO SUPPRESSION



## OUTLINE DIMENSIONS

### L SUFFIX CERAMIC DIP PACKAGE CASE 726-04 ISSUE G

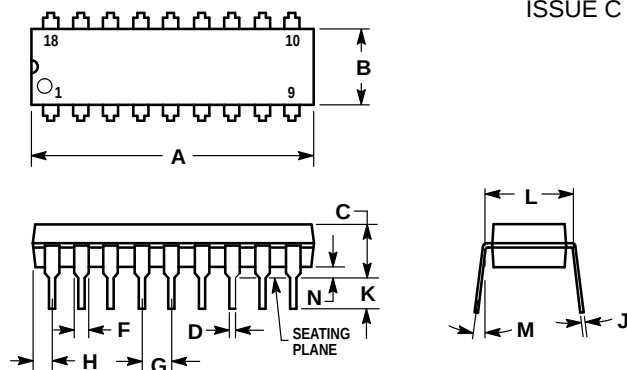


#### NOTES:

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 FOR FULL LEADS. HALF LEADS OPTIONAL AT LEAD POSITIONS 1, 9, 10, AND 18.

| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 0.880     | 0.910 | 22.35       | 23.11 |
| B   | 0.240     | 0.295 | 6.10        | 7.49  |
| C   | —         | 0.200 | —           | 5.08  |
| D   | 0.015     | 0.021 | 0.38        | 0.53  |
| F   | 0.055     | 0.070 | 1.40        | 1.78  |
| G   | 0.100 BSC | —     | 2.54 BSC    | —     |
| J   | 0.008     | 0.012 | 0.20        | 0.30  |
| K   | 0.125     | 0.170 | 3.18        | 4.32  |
| L   | 0.300 BSC | —     | 7.62 BSC    | —     |
| M   | 0°        | 15°   | 0°          | 15°   |
| N   | 0.020     | 0.040 | 0.51        | 1.02  |

### P SUFFIX PLASTIC DIP PACKAGE CASE 707-02 ISSUE C



#### NOTES:

1. POSITIONAL TOLERANCE OF LEADS (D), SHALL BE WITHIN 0.25 (0.010) AT MAXIMUM MATERIAL CONDITION, IN RELATION TO SEATING PLANE AND EACH OTHER.
2. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
3. DIMENSION B DOES NOT INCLUDE MOLD FLASH.

| DIM | MILLIMETERS |       | INCHES    |       |
|-----|-------------|-------|-----------|-------|
|     | MIN         | MAX   | MIN       | MAX   |
| A   | 22.22       | 23.24 | 0.875     | 0.915 |
| B   | 6.10        | 6.60  | 0.240     | 0.260 |
| C   | 3.56        | 4.57  | 0.140     | 0.180 |
| D   | 0.36        | 0.56  | 0.014     | 0.022 |
| F   | 1.27        | 1.78  | 0.050     | 0.070 |
| G   | 2.54 BSC    | —     | 0.100 BSC | —     |
| H   | 1.02        | 1.52  | 0.040     | 0.060 |
| J   | 0.20        | 0.30  | 0.008     | 0.012 |
| K   | 2.92        | 3.43  | 0.115     | 0.135 |
| L   | 7.62 BSC    | —     | 0.300 BSC | —     |
| M   | 0°          | 15°   | 0°        | 15°   |
| N   | 0.51        | 1.02  | 0.020     | 0.040 |

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