# 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.

## MC14513B

**L SUFFIX**
CERAMIC
CASE 726
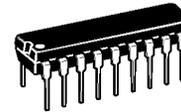
**P SUFFIX**
PLASTIC
CASE 707

### ORDERING INFORMATION

MC14XXXBCP     Plastic
MC14XXXBCL     Ceramic

$T_A$ = – 55° to 125°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
0 1 2 3 4 5 6 7 8 9

## 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

## 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 |
| 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 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 | 1 | 0 | 1 | 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 | 1 | 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 | 0 | 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

**MOTOROLA**

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

| Characteristic | Symbol | $V_{DD}$ Vdc | −55°C Min | −55°C Max | 25°C Min | 25°C Typ # | 25°C Max | 125°C Min | 125°C Max | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| Output Voltage — Segment Outputs "0" Level $V_{in} = V_{DD}$ 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 | |
| "1" Level $V_{in} = 0$ or $V_{DD}$ | $V_{OH}$ | 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 "0" Level $V_{in} = V_{DD}$ 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 | |
| "1" Level $V_{in} = 0$ or $V_{DD}$ | $V_{OH}$ | 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 # "0" Level ($V_O$ = 3.8 or 0.5 Vdc) ($V_O$ = 8.8 or 1.0 Vdc) ($V_O$ = 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 | |
| ($V_O$ = 0.5 or 3.8 Vdc) "1" Level ($V_O$ = 1.0 or 8.8 Vdc) ($V_O$ = 1.5 or 13.8 Vdc) | $V_{IH}$ | 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 ($I_{OH}$ = 0 mA) Source | $V_{OH}$ | 5.0 | 4.1 | — | 4.1 | 4.57 | — | 4.1 | — | Vdc |
| ($I_{OH}$ = 5.0 mA) | | | — | — | — | 4.24 | — | — | — | |
| ($I_{OH}$ = 10 mA) | | | 3.9 | — | 3.9 | 4.12 | — | 3.5 | — | |
| ($I_{OH}$ = 15 mA) | | | — | — | — | 3.94 | — | — | — | |
| ($I_{OH}$ = 20 mA) | | | 3.4 | — | 3.4 | 3.70 | — | 3.0 | — | |
| ($I_{OH}$ = 25 mA) | | | — | — | — | 3.54 | — | — | — | |
| ($I_{OH}$ = 0 mA) | | 10 | 9.1 | — | 9.1 | 9.58 | — | 9.1 | — | Vdc |
| ($I_{OH}$ = 5.0 mA) | | | — | — | — | 9.26 | — | — | — | |
| ($I_{OH}$ = 10 mA) | | | 9.0 | — | 9.0 | 9.17 | — | 8.6 | — | |
| ($I_{OH}$ = 15 mA) | | | — | — | — | 9.04 | — | — | — | |
| ($I_{OH}$ = 20 mA) | | | 8.6 | — | 8.6 | 8.90 | — | 8.2 | — | |
| ($I_{OH}$ = 25 mA) | | | — | — | — | 8.75 | — | — | — | |
| ($I_{OH}$ = 0 mA) | | 15 | 14.1 | — | 14.1 | 14.59 | — | 14.1 | — | Vdc |
| ($I_{OH}$ = 5.0 mA) | | | — | — | — | 14.27 | — | — | — | |
| ($I_{OH}$ = 10 mA) | | | 14 | — | 14 | 14.18 | — | 13.6 | — | |
| ($I_{OH}$ = 15 mA) | | | — | — | — | 14.07 | — | — | — | |
| ($I_{OH}$ = 20 mA) | | | 13.6 | — | 13.6 | 13.95 | — | 13.2 | — | |
| ($I_{OH}$ = 25 mA) | | | — | — | — | 13.80 | — | — | — | |

(continued)

# ELECTRICAL CHARACTERISTICS — continued (Voltages Referenced to $V_{SS}$)

| Characteristic | Symbol | $V_{DD}$ Vdc | −55°C Min | −55°C Max | 25°C Min | 25°C Typ # | 25°C Max | 125°C Min | 125°C Max | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| Output Drive Current — RBO Output | $I_{OH}$ | | | | | | | | | mAdc |
| ($V_{OH}$ = 2.5 V)      Source | | 5.0 | − 0.40 | — | − 0.32 | − 0.64 | — | − 0.22 | — | |
| ($V_{OH}$ = 9.5 V) | | 10 | − 0.21 | — | − 0.17 | − 0.34 | — | − 0.12 | — | |
| ($V_{OH}$ = 13.5 V) | | 15 | − 0.81 | — | − 0.66 | − 1.30 | — | − 0.46 | — | |
| ($V_{OL}$ = 0.4 V)      Sink | $I_{OL}$ | 5.0 | 0.18 | — | 0.15 | 0.29 | — | 0.10 | — | mAdc |
| ($V_{OL}$ = 0.5 V) | | 10 | 0.47 | — | 0.38 | 0.75 | — | 0.26 | — | |
| ($V_{OL}$ = 1.5 V) | | 15 | 1.80 | — | 1.50 | 2.90 | — | 1.0 | — | |
| Output Drive Current — Segments | $I_{OL}$ | | | | | | | | | mAdc |
| ($V_{OL}$ = 0.4 V)      Sink | | 5.0 | 0.64 | — | 0.51 | 0.88 | — | 0.36 | — | |
| ($V_{OL}$ = 0.5 V) | | 10 | 1.6 | — | 1.3 | 2.25 | — | 0.9 | — | |
| ($V_{OL}$ = 1.5 V) | | 15 | 4.2 | — | 3.4 | 8.8 | — | 2.4 | — | |
| Input Current | $I_{in}$ | 15 | — | ± 0.1 | — | ±0.00001 | ± 0.1 | — | ± 1.0 | μAdc |
| Input Capacitance | $C_{in}$ | — | — | — | — | 5.0 | 7.5 | — | — | pF |
| Quiescent Current | $I_{DD}$ | 5.0 | — | 5.0 | — | 0.005 | 5.0 | — | 150 | μAdc |
| (Per Package) $V_{in}$ = 0 or $V_{DD}$, | | 10 | — | 10 | — | 0.010 | 10 | — | 300 | |
| $I_{out}$ = 0 μA | | 15 | — | 20 | — | 0.015 | 20 | — | 600 | |
| Total Supply Current**† (Dynamic plus Quiescent, Per Package) ($C_L$ = 50 pF on all outputs, all buffers switching) | $I_T$ | 5.0 10 15 | $I_T$ = (1.9 μA/kHz) f + $I_{DD}$    $I_T$ = (3.8 μA/kHz) f + $I_{DD}$    $I_T$ = (5.7 μA/kHz) f + $I_{DD}$ | | | | | | | μAdc |

\#Noise immunity specified for worst–case input combination.
   Noise Margin for both "1" and "0" level =
          1.0 Vdc min @ $V_{DD}$ = 5.0 Vdc
          2.0 Vdc min @ $V_{DD}$ = 10 Vdc
          2.5 Vdc min @ $V_{DD}$ = 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: $I_T$ is in μA (per package), $C_L$ in pF, $V_{DD}$ in Vdc, and f in kHz is input frequency.

Input LE and RBI low, and Inputs D, $\overline{BI}$ and $\overline{LT}$ high.
f in respect to a system clock.
All outputs connected to respective $C_L$ loads.
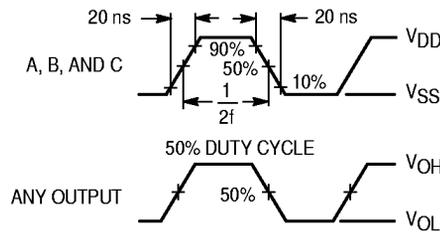


**Figure 1. Dynamic Power Dissipation Signal Waveforms**

**SWITCHING CHARACTERISTICS*** ($C_L$ = 50 pF, $T_A$ = 25°C)

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

* The formulas given are for the typical characteristics only.

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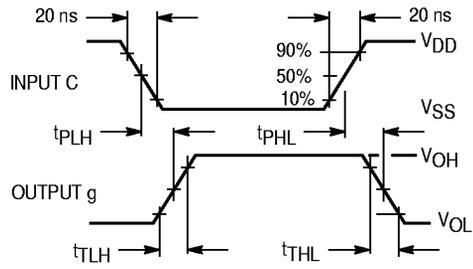
**a. Data Propagation Delay: Inputs RBI, D and LE low, and Inputs A, B, $\overline{\text{BI}}$ and $\overline{\text{LT}}$ high.**
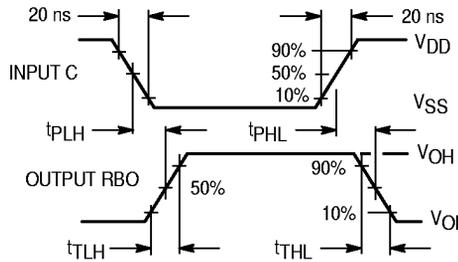


**b. Inputs A, B, D and LE low, and Inputs RBI, $\overline{\text{BI}}$ and $\overline{\text{LT}}$ high.**
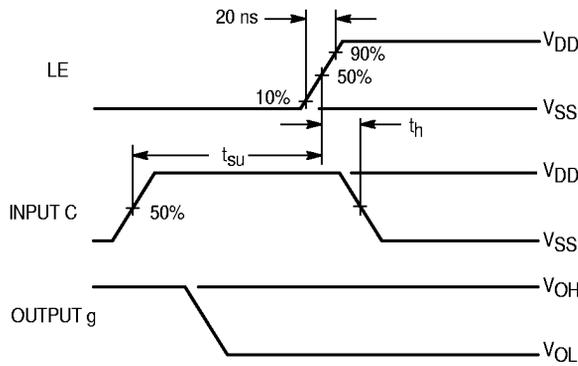


**c. Setup and Hold Times: Input RBI and D low, Inputs A, B, $\overline{\text{BI}}$ and $\overline{\text{LT}}$ high.**
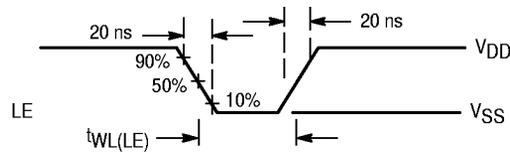


**d. Pulse Width: Data DCBA strobed into latches.**

**Figure 2. Dynamic Signal Waveforms**

# CONNECTIONS TO VARIOUS DISPLAY READOUTS

## LIGHT EMITTING DIODE (LED) READOUT



$V_{DD}$

COMMON
CATHODE LED

$\approx 1.7$ V

$V_{SS}$

$V_{DD}$

COMMON
ANODE LED

$\approx 1.7$ V

$V_{SS}$
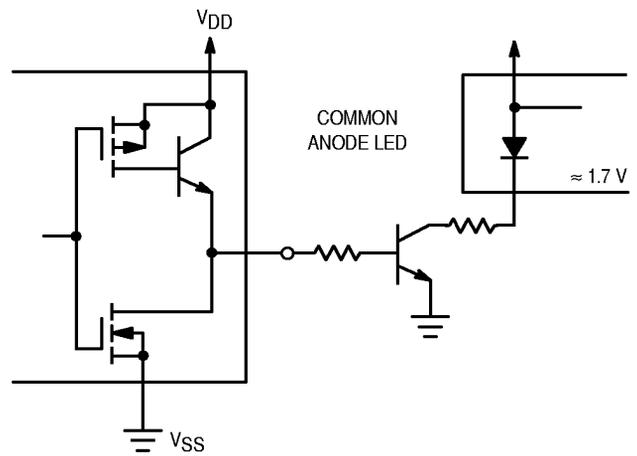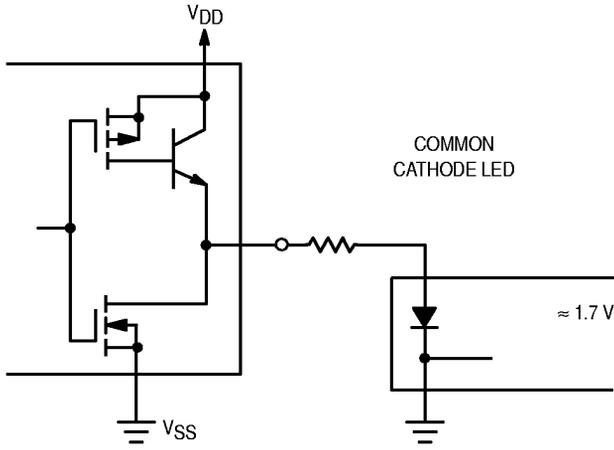
## INCANDESCENT READOUT



$V_{DD}$

$V_{DD}$

**

$V_{SS}$

## FLUORESCENT READOUT



$V_{DD}$

DIRECT
(LOW BRIGHTNESS)

FILAMENT
(SUPPLY)

$V_{SS}$

$V_{SS}$ OR APPROPRIATE
VOLTAGE BELOW $V_{SS}$.
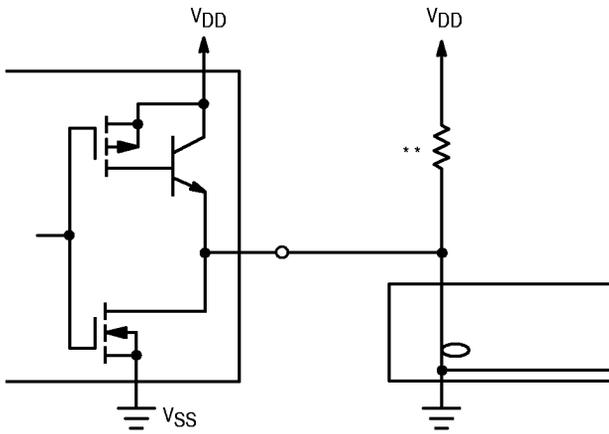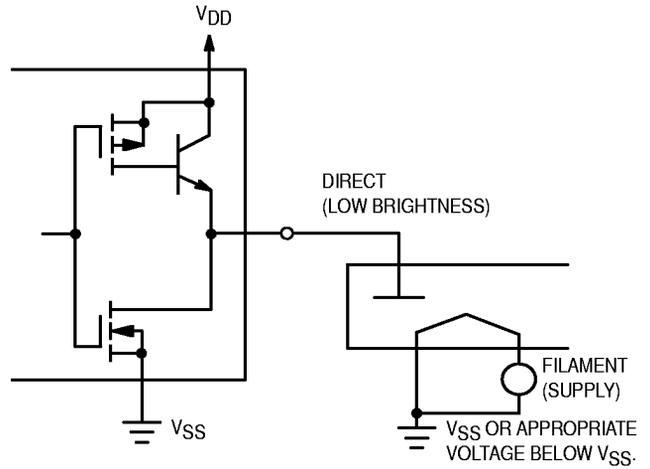
## GAS DISCHARGE READOUT



$V_{DD}$

APPROPRIATE
VOLTAGE

$V_{SS}$
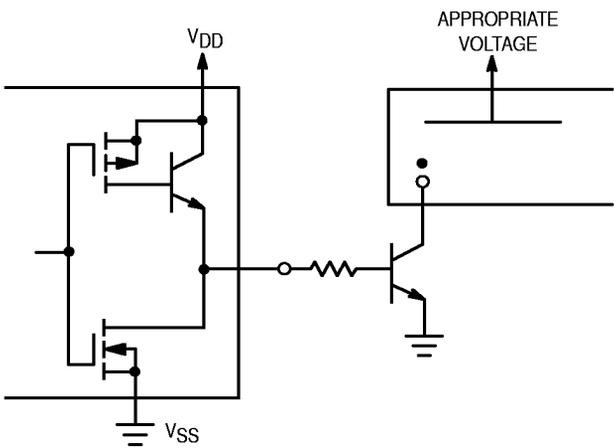
## LIQUID CRYSTAL (LC) READOUT



EXCITATION
(SQUARE WAVE,
$V_{SS}$ TO $V_{DD}$)

$V_{DD}$

1/4 OF MC14070B

$V_{SS}$
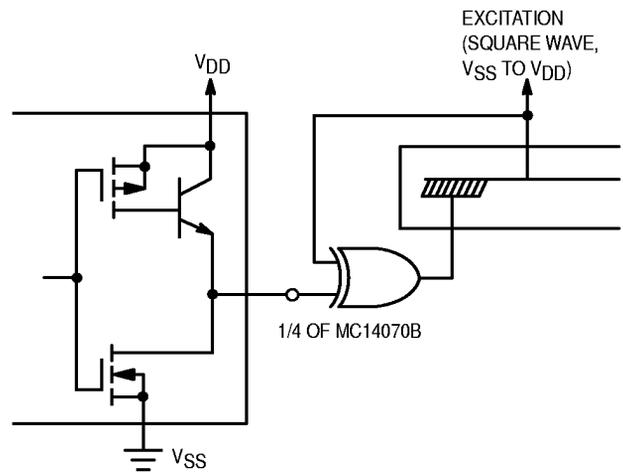
** A filament pre–warm resistor is recommended to reduce
filament thermal shock and increase the effective cold
resistance of the filament.

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

## LOGIC DIAGRAM
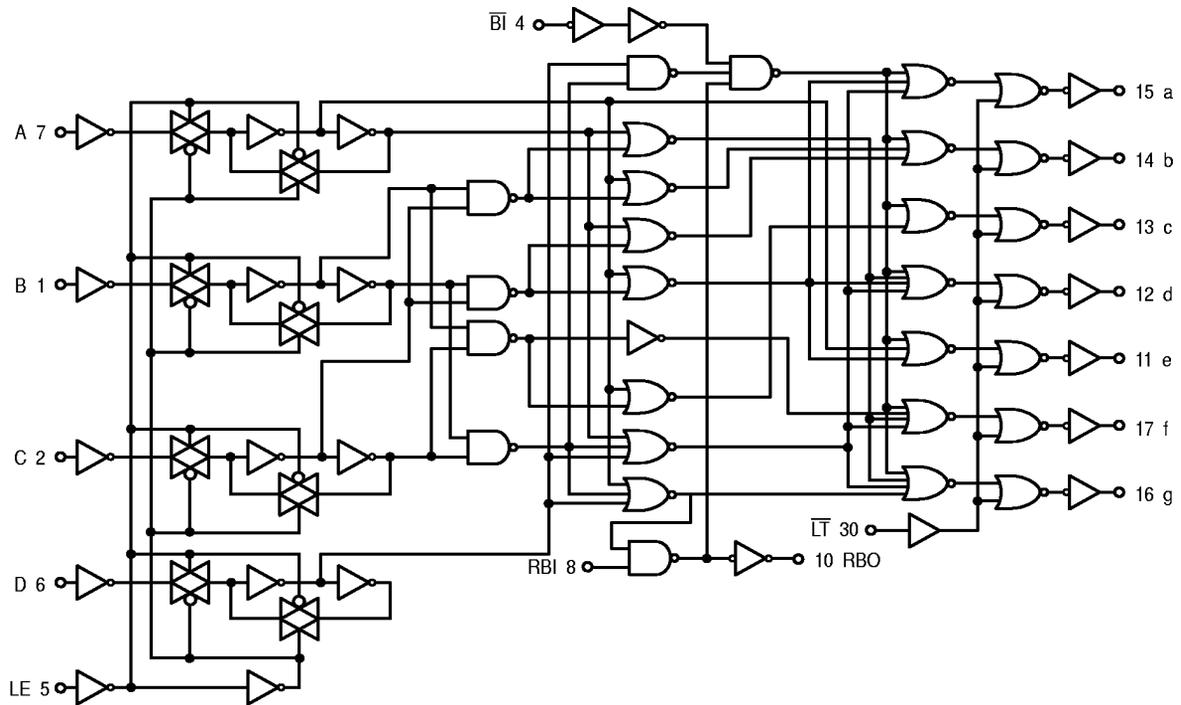


## TYPICAL APPLICATIONS FOR RIPPLE BLANKING

### LEADING EDGE ZERO SUPPRESSION

DISPLAYS

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## TRAILING EDGE ZERO SUPPRESSION

DISPLAYS

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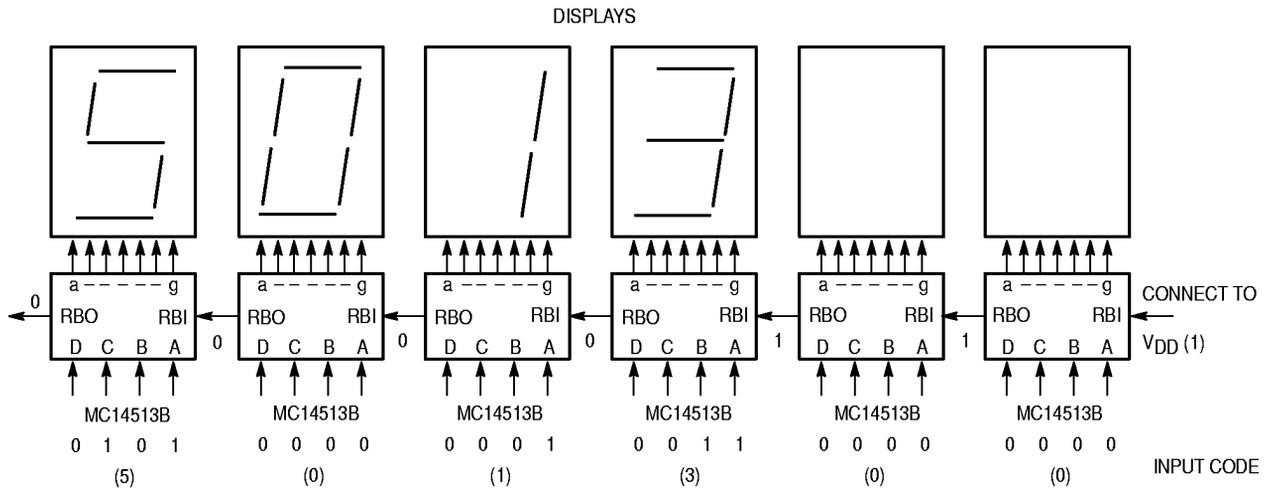
# OUTLINE DIMENSIONS

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



**OPTIONAL LEAD CONFIGURATION (1, 9, 10, 18)**

SEATING PLANE

⊕ | 0.25 (0.010) Ⓜ | T | A Ⓢ

⊕ | 0.25 (0.010) Ⓜ | T | B Ⓢ
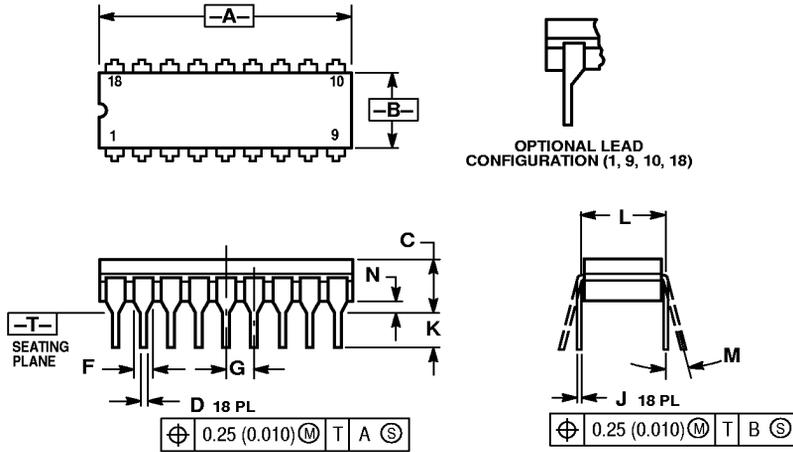
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
4. DIMENSION F FOR FULL LEADS. HALF LEADS OPTIONAL AT LEAD POSITIONS 1, 9, 10, AND 18.

| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | 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
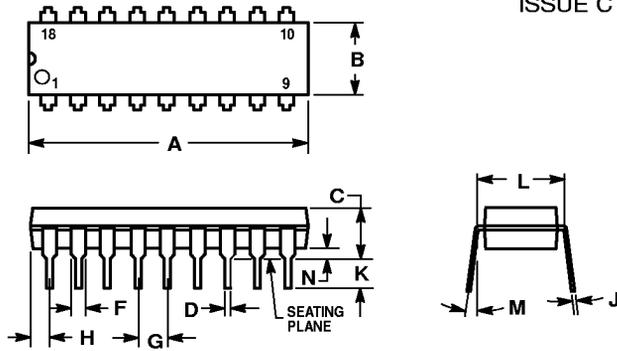


SEATING PLANE

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.

| | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| DIM | 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 |

**Ⓜ MOTOROLA**

◊

MC14513B/D