

January 1988

# MM54HC253/MM74HC253 Dual 4-Channel TRI-STATE® Multiplexer

## General Description

The MM54HC253/MM74HC253 utilizes advanced silicon-gate CMOS technology to achieve the low power consumption and high noise immunity of standard CMOS integrated circuits, along with the capability to drive 10 LS-TTL loads. The large output drive and TRI-STATE features of this device make it ideally suited for interfacing with bus lines in bus organized systems. When the output control input is taken high, the multiplexer outputs are sent into a high impedance state.

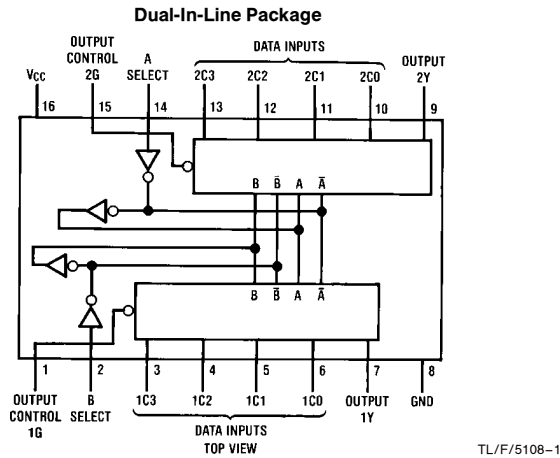
When the output control is held low, the associated multiplexer chooses the correct output channel for the given input signals determined by the select A and B inputs.

The 54HC/74HC logic family is functionally and pinout compatible with the standard 54LS/74LS logic family. All inputs are protected from damage due to static discharge by internal diode clamps to  $V_{CC}$  and ground.

## Features

- Typical propagation delay: 24 ns
- Wide power supply range: 2V–6V
- Low quiescent current: 80  $\mu$ A maximum (74HC Series)
- Low input current: 1  $\mu$ A maximum
- Fanout of 10 LS-TTL loads

## Connection Diagram



Order Number MM54HC253 or MM74HC253

TL/F/5108-1

## Truth Table

| Select Inputs |   | Data Inputs |    |    |    | Output Control | Output |
|---------------|---|-------------|----|----|----|----------------|--------|
| B             | A | C0          | C1 | C2 | C3 | G              | Y      |
| X             | X | X           | X  | X  | X  | H              | Z      |
| L             | L | L           | X  | X  | X  | L              | L      |
| L             | L | H           | X  | X  | X  | L              | H      |
| L             | H | X           | L  | X  | X  | L              | L      |
| L             | H | X           | H  | X  | X  | L              | H      |
| H             | L | X           | X  | L  | X  | L              | L      |
| H             | L | X           | X  | H  | X  | L              | H      |
| H             | H | X           | X  | X  | L  | L              | L      |
| H             | H | X           | X  | X  | H  | L              | H      |

Select inputs A and B are common to both sections.  
H = high level, L = low level, X = irrelevant, Z = high impedance (off).

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MM54HC253/MM74HC253 Dual 4-Channel TRI-STATE Multiplexer

### Absolute Maximum Ratings (Notes 1 & 2)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

|                                                   |                         |
|---------------------------------------------------|-------------------------|
| Supply Voltage ( $V_{CC}$ )                       | -0.5 to +7.0V           |
| DC Input Voltage ( $V_{IN}$ )                     | -1.5 to $V_{CC} + 1.5V$ |
| DC Output Voltage ( $V_{OUT}$ )                   | -0.5 to $V_{CC} + 0.5V$ |
| Clamp Diode Current ( $I_{IK}, I_{OK}$ )          | $\pm 20$ mA             |
| DC Output Current, per pin ( $I_{OUT}$ )          | $\pm 25$ mA             |
| DC $V_{CC}$ or GND Current, per pin ( $I_{CC}$ )  | $\pm 50$ mA             |
| Storage Temperature Range ( $T_{STG}$ )           | -65°C to +150°C         |
| Power Dissipation ( $P_D$ ) (Note 3)              | 600 mW                  |
| S.O. Package only                                 | 500 mW                  |
| Lead Temperature ( $T_L$ ) (Soldering 10 seconds) | 260°C                   |

### Operating Conditions

|                                                  | Min | Max      | Units |
|--------------------------------------------------|-----|----------|-------|
| Supply Voltage ( $V_{CC}$ )                      | 2   | 6        | V     |
| DC Input or Output Voltage ( $V_{IN}, V_{OUT}$ ) | 0   | $V_{CC}$ | V     |
| Operating Temp. Range ( $T_A$ )                  |     |          |       |
| MM74HC                                           | -40 | +85      | °C    |
| MM54HC                                           | -55 | +125     | °C    |
| Input Rise or Fall Times ( $t_r, t_f$ )          |     |          |       |
| $V_{CC} = 2.0V$                                  |     | 1000     | ns    |
| $V_{CC} = 4.5V$                                  |     | 500      | ns    |
| $V_{CC} = 6.0V$                                  |     | 400      | ns    |

### DC Electrical Characteristics (Note 4)

| Symbol   | Parameter                                | Conditions                                                                          | $V_{CC}$ | $T_A = 25^\circ C$ |                   |           | 74HC                        | 54HC                         | Units |
|----------|------------------------------------------|-------------------------------------------------------------------------------------|----------|--------------------|-------------------|-----------|-----------------------------|------------------------------|-------|
|          |                                          |                                                                                     |          |                    |                   |           | $T_A = -40$ to $85^\circ C$ | $T_A = -55$ to $125^\circ C$ |       |
|          |                                          |                                                                                     |          | Typ                | Guaranteed Limits |           |                             |                              |       |
| $V_{IH}$ | Minimum High Level Input Voltage         |                                                                                     | 2.0V     |                    | 1.5               | 1.5       | 1.5                         | V                            |       |
|          |                                          |                                                                                     | 4.5V     |                    | 3.15              | 3.15      | 3.15                        | V                            |       |
|          |                                          |                                                                                     | 6.0V     |                    | 4.2               | 4.2       | 4.2                         | V                            |       |
| $V_{IL}$ | Maximum Low Level Input Voltage**        |                                                                                     | 2.0V     |                    | 0.5               | 0.5       | 0.5                         | V                            |       |
|          |                                          |                                                                                     | 4.5V     |                    | 1.35              | 1.35      | 1.35                        | V                            |       |
|          |                                          |                                                                                     | 6.0V     |                    | 1.8               | 1.8       | 1.8                         | V                            |       |
| $V_{OH}$ | Minimum High Level Output Voltage        | $V_{IN} = V_{IH}$ or $V_{IL}$<br>$ I_{OUT}  \leq 20 \mu A$                          | 2.0V     | 2.0                | 1.9               | 1.9       | 1.9                         | V                            |       |
|          |                                          |                                                                                     | 4.5V     | 4.5                | 4.4               | 4.4       | 4.4                         | V                            |       |
|          |                                          |                                                                                     | 6.0V     | 6.0                | 5.9               | 5.9       | 5.9                         | V                            |       |
|          |                                          | $V_{IN} = V_{IH}$ or $V_{IL}$<br>$ I_{OUT}  \leq 4.0$ mA<br>$ I_{OUT}  \leq 5.2$ mA | 4.5V     | 4.2                | 3.98              | 3.84      | 3.7                         | V                            |       |
|          |                                          |                                                                                     | 6.0V     | 5.7                | 5.48              | 5.34      | 5.2                         | V                            |       |
|          |                                          |                                                                                     |          |                    |                   |           |                             |                              |       |
| $V_{OL}$ | Maximum Low Level Output Voltage         | $V_{IN} = V_{IH}$ or $V_{IL}$<br>$ I_{OUT}  \leq 20 \mu A$                          | 2.0V     | 0                  | 0.1               | 0.1       | 0.1                         | V                            |       |
|          |                                          |                                                                                     | 4.5V     | 0                  | 0.1               | 0.1       | 0.1                         | V                            |       |
|          |                                          |                                                                                     | 6.0V     | 0                  | 0.1               | 0.1       | 0.1                         | V                            |       |
|          |                                          | $V_{IN} = V_{IH}$ or $V_{IL}$<br>$ I_{OUT}  \leq 4.0$ mA<br>$ I_{OUT}  \leq 5.2$ mA | 4.5V     | 0.2                | 0.26              | 0.33      | 0.4                         | V                            |       |
|          |                                          |                                                                                     | 6.0V     | 0.2                | 0.26              | 0.33      | 0.4                         | V                            |       |
|          |                                          |                                                                                     |          |                    |                   |           |                             |                              |       |
| $I_{IN}$ | Maximum Input Current                    | $V_{IN} = V_{CC}$ or GND                                                            | 6.0V     |                    | $\pm 0.1$         | $\pm 1.0$ | $\pm 1.0$                   | $\mu A$                      |       |
| $I_{OZ}$ | Maximum TRI-STATE Output Leakage Current | Strobe = $V_{CC}$<br>$V_{OUT} = V_{CC}$ or GND                                      | 6.0V     |                    | $\pm 0.5$         | $\pm 5.0$ | $\pm 10$                    | $\mu A$                      |       |
| $I_{CC}$ | Maximum Quiescent Supply Current         | $V_{IN} = V_{CC}$ or GND<br>$I_{OUT} = 0 \mu A$                                     | 6.0V     |                    | 8.0               | 80        | 160                         | $\mu A$                      |       |

**Note 1:** Absolute Maximum Ratings are those values beyond which damage to the device may occur.

**Note 2:** Unless otherwise specified all voltages are referenced to ground.

**Note 3:** Power Dissipation temperature derating — plastic "N" package: -12 mW/°C from 65°C to 85°C; ceramic "J" package: -12 mW/°C from 100°C to 125°C.

**Note 4:** For a power supply of  $5V \pm 10\%$  the worst case output voltages ( $V_{OH}$  and  $V_{OL}$ ) occur for HC at 4.5V. Thus the 4.5V values should be used when designing with this supply. Worst case  $V_{IH}$  and  $V_{IL}$  occur at  $V_{CC} = 5.5V$  and 4.5V respectively. (The  $V_{IH}$  value at 5.5V is 3.85V.) The worst case leakage current ( $I_{IN}$ ,  $I_{CC}$ , and  $I_{OZ}$ ) occur for CMOS at the higher voltage and so the 6.0V values should be used.

\*\*  $V_{IL}$  limits are currently tested at 20% of  $V_{CC}$ . The above  $V_{IL}$  specification (30% of  $V_{CC}$ ) will be implemented no later than Q1, CY'89.

**AC Electrical Characteristics**  $V_{CC}=5V, T_A=25^{\circ}C, t_r=t_f=6\text{ ns}, C_L=15\text{ pF}$

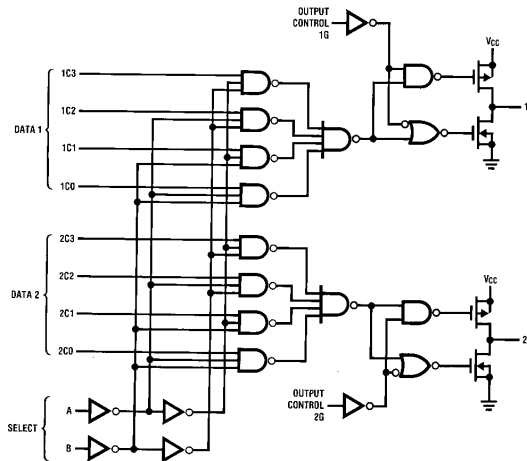
| Symbol             | Parameter                                                    | Conditions               | Typ | Guaranteed Limit | Units |
|--------------------|--------------------------------------------------------------|--------------------------|-----|------------------|-------|
| $t_{PHL}, t_{PLH}$ | Maximum Propagation Delay, Select A or B to Y                |                          | 24  | 30               | ns    |
| $t_{PHL}, t_{PLH}$ | Maximum Propagation Delay, any Data to Y                     |                          | 18  | 23               | ns    |
| $t_{PZH}, t_{PZL}$ | Maximum Output Enable Time Y Output to a Logic Level         | $R_L = 1\text{ k}\Omega$ | 13  | 18               | ns    |
| $t_{PHZ}, t_{PLZ}$ | Maximum Output Disable Time Y Output to High Impedance State | $R_L = 1\text{ k}\Omega$ | 18  | 27               | ns    |

**AC Electrical Characteristics**  $C_L=50\text{ pF}, t_r=t_f=6\text{ ns}$  (unless otherwise specified)

| Symbol             | Parameter                                     | Conditions                                           | $V_{CC}$ | $T_A = 25^{\circ}C$ |                   | $T_A = -40\text{ to }85^{\circ}C$ |     | $T_A = -55\text{ to }125^{\circ}C$ |  | Units |
|--------------------|-----------------------------------------------|------------------------------------------------------|----------|---------------------|-------------------|-----------------------------------|-----|------------------------------------|--|-------|
|                    |                                               |                                                      |          | Typ                 | Guaranteed Limits |                                   |     |                                    |  |       |
| $t_{PHL}, t_{PLH}$ | Maximum Propagation Delay, Select A or B to Y |                                                      | 2.0V     | 131                 | 158               | 198                               | 237 | ns                                 |  |       |
|                    |                                               |                                                      | 4.5V     | 29                  | 35                | 44                                | 53  | ns                                 |  |       |
|                    |                                               |                                                      | 6.0V     | 24                  | 30                | 38                                | 45  | ns                                 |  |       |
| $t_{PHL}, t_{PLH}$ | Maximum Propagation Delay, any Data to Y      |                                                      | 2.0V     | 99                  | 126               | 158                               | 189 | ns                                 |  |       |
|                    |                                               |                                                      | 4.5V     | 22                  | 28                | 35                                | 42  | ns                                 |  |       |
|                    |                                               |                                                      | 6.0V     | 19                  | 23                | 29                                | 35  | ns                                 |  |       |
| $t_{PZH}, t_{PZL}$ | Maximum Output Enable Time                    | $R_L = 1\text{ k}\Omega$                             | 2.0V     | 63                  | 90                | 113                               | 135 | ns                                 |  |       |
|                    |                                               |                                                      | 4.5V     | 14                  | 20                | 25                                | 30  | ns                                 |  |       |
|                    |                                               |                                                      | 6.0V     | 12                  | 17                | 21                                | 26  | ns                                 |  |       |
| $t_{PHZ}, t_{PLZ}$ | Maximum Output Disable Time                   | $R_L = 1\text{ k}\Omega$                             | 2.0V     | 90                  | 135               | 169                               | 203 | ns                                 |  |       |
|                    |                                               |                                                      | 4.5V     | 20                  | 30                | 38                                | 45  | ns                                 |  |       |
|                    |                                               |                                                      | 6.0V     | 17                  | 25                | 31                                | 38  | ns                                 |  |       |
| $t_{THL}, t_{TLH}$ | Maximum Output Rise and Fall Time             |                                                      | 2.0V     | 30                  | 75                | 95                                | 110 | ns                                 |  |       |
|                    |                                               |                                                      | 4.5V     | 8                   | 15                | 19                                | 22  | ns                                 |  |       |
|                    |                                               |                                                      | 6.0V     | 7                   | 13                | 16                                | 19  | ns                                 |  |       |
| $C_{IN}$           | Maximum Input Capacitance                     |                                                      |          | 5                   | 10                | 10                                | 10  | pF                                 |  |       |
| $C_{PD}$           | Power Dissipation Capacitance (Note 5)        | (per package)<br>Outputs Enabled<br>Outputs Disabled |          | 90                  |                   |                                   |     | pF                                 |  |       |
|                    |                                               |                                                      |          | 25                  |                   |                                   |     | pF                                 |  |       |

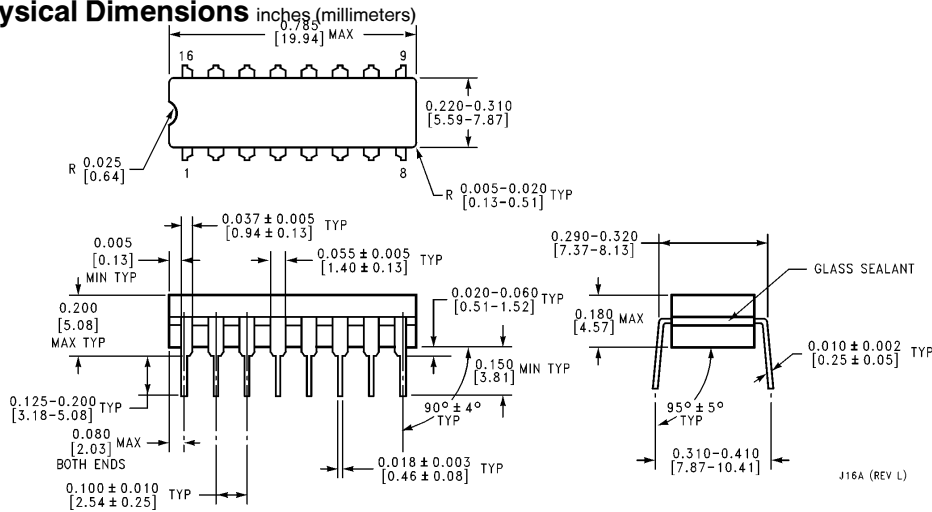
Note 5:  $C_{PD}$  determines the no load dynamic power consumption,  $P_D = C_{PD} V_{CC}^2 f + I_{CC} V_{CC}$ , and the no load dynamic current consumption,  $I_S = C_{PD} V_{CC} f + I_{CC}$ .

### Logic Diagram

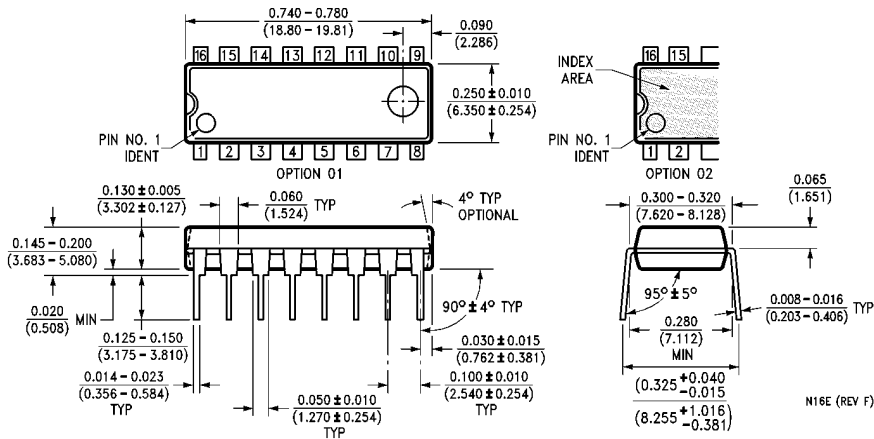


TL/F/5108-2

**Physical Dimensions** inches (millimeters)



**Order Number MM54HC253J or MM74HC253J, N  
NS Package J16A**



**Order Number MM54HC253J or MM74HC253J, N  
NS Package N16E**

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