

# MM54HCT139/MM74HCT139 Dual 2-To-4 Line Decoder

## General Description

The MM54HCT139/MM74HCT139 is a high speed silicon-gate CMOS decoder that is well suited to memory address decoding or data routing applications. It possesses an input threshold and output drive similar to LS-TTL and the low standby power of CMOS logic.

The device is comprised of two independent one-of-four decoders each with a single active low enable input (G1 or G2). Data on the select inputs (A1, B1 or A2, B2) cause one of the four normally high outputs to go low.

All inputs to the decoder are protected from damage due to electrostatic discharge by diodes to  $V_{CC}$  and ground. The

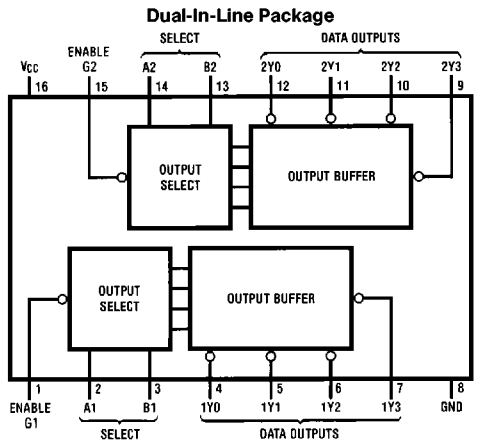
device is capable of driving 10 low power Schottky TTL equivalent loads.

The MM54HCT139/MM74HCT139 is functionally and pin equivalent to the 54LS139/74LS139 and can be used as a plug-in replacement to reduce system power consumption in existing systems.

## Features

- Typical propagation delays: 20 ns
- Low quiescent current: 40  $\mu A$  maximum (74HCT Series)
- Fanout of 10 LS-TTL loads

## Connection Diagram



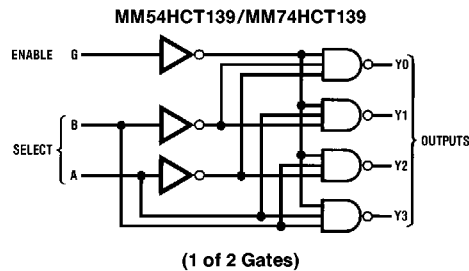
Top View  
Order Number MM54HCT139 or MM74HCT139

## Truth Table

| Inputs |        |   | Outputs |    |    |    |
|--------|--------|---|---------|----|----|----|
| Enable | Select |   | Y0      | Y1 | Y2 | Y3 |
| G      | B      | A |         |    |    |    |
| H      | X      | X | H       | H  | H  | H  |
| L      | L      | L | L       | H  | H  | H  |
| L      | L      | H | H       | L  | H  | H  |
| L      | H      | L | H       | H  | L  | H  |
| L      | H      | H | H       | H  | H  | L  |

H = high level, L = low level, X = don't care

## Logic Diagram



(1 of 2 Gates)

## 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 ( $I_{IK}, I_{OK}$ )         | 20 mA                   |
| DC Output Current, per Pin ( $I_{OUT}$ )         | 25 mA                   |
| DC $V_{CC}$ or GND Current, per Pin ( $I_{CC}$ ) | 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 Temp. ( $T_L$ )                             |                         |
| (Soldering 10 seconds)                           | 300°C                   |

## Operating Conditions

|  | Min | Max      | Units |
|--|-----|----------|-------|
| Supply Voltage ( $V_{CC}$ )                      | 4.5 | 5.5      | V     |
| DC Input or Output Voltage ( $V_{IN}, V_{OUT}$ ) | 0   | $V_{CC}$ | V     |
| Operating Temp. Range ( $T_A$ )                  |     |          |       |
| MM74HCT  | -40 | +85      | C     |
| MM54HCT  | -55 | +125     | C     |
| Input Rise/Fall Time ( $t_r, t_f$ )              |     | 500      | ns    |

## DC Electrical Characteristics (Note 4)

| Symbol   | Parameter                         | Conditions  | $V_{CC}$ | Typ                    | Guaranteed Limits             |   | Units                       |  |
|----------|-----------------------------------|---|----------|------------------------|-------------------------------|---|-----------------------------|--|
|          |                                   |   |          | $T = 25^\circ\text{C}$ | $T = 25^\circ\text{C}$        | 74HCT<br>$T = -40 \text{ to } 85^\circ\text{C}$ |                             | 54HCT<br>$T = -55 \text{ to } 125^\circ\text{C}$ |
|          |                                   |   |          |                        |                               |   |                             |  |
| $V_{IH}$ | Minimum High Level Input Voltage  |   |          |                        | 2.0                           | 2.0   | 2.0                         | V  |
| $V_{IL}$ | Maximum Low Level Input Voltage   |   |          |                        | 0.8                           | 0.8   | 0.8                         | V  |
| $V_{OH}$ | Minimum High Level Output Voltage | $V_{IN} = V_{IH}$ or $V_{IL}$<br>$ I_{OUT}  = 20 \mu\text{A}$<br>$ I_{OUT}  = 4.0 \text{ mA}, V_{CC} = 4.5V$<br>$ I_{OUT}  = 4.8 \text{ mA}, V_{CC} = 5.5V$ |          | $V_{CC}$               | $V_{CC} - .1$<br>3.98<br>4.98 | $V_{CC} - .1$<br>3.84<br>4.84                   | $V_{CC} - .1$<br>3.7<br>4.7 | V  |
| $V_{OL}$ | Maximum Low Level Output Voltage  | $V_{IN} = V_{IH}$ or $V_{IL}$<br>$ I_{OUT}  = 20 \mu\text{A}$<br>$ I_{OUT}  = 4.0 \text{ mA}, V_{CC} = 4.5V$<br>$ I_{OUT}  = 4.8 \text{ mA}, V_{CC} = 5.5V$ |          |                        | 0.10<br>0.26<br>0.26          | 0.10<br>0.33<br>0.33                            | 0.1<br>0.4<br>0.4           | V  |
| $I_{IN}$ | Maximum Input Current             | $V_{IN} = V_{CC}$ or GND<br>$V_{IN} = V_{IH}$ or $V_{IL}$   |          |                        | $\pm 0.1$                     | $\pm 1.0$                                       | $\pm 1.0$                   | $\mu\text{A}$                                    |
| $I_{CC}$ | Maximum Quiescent Supply Current  | $V_{IN} = V_{CC}$ or GND<br>$I_{OUT} = 0 \mu\text{A}$ (Note 4)  |          |                        | 4                             | 40  | 80                          | $\mu\text{A}$                                    |
|          |                                   | $V_{IN} = 2.4V$ or $0.5V$<br>$I_{OUT} = 0 \mu\text{A}$ (Note 4)   |          |                        | 0.3                           | 0.4   | 0.5                         | mA   |

**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:** Measured per input, other inputs at  $V_{CC}$  or GND.

### AC Electrical Characteristics ( $V_{CC}$ , temperature and loading of LS-TTL)

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

| Symbol                | Parameter  | Conditions | Typ | Guaranteed Limits | Units |
|-----------------------|--|------------|-----|-------------------|-------|
| $t_{PLH}$ , $t_{PHL}$ | Maximum Propagation Delay, Binary Select to any Output |            | 18  | 30                | ns    |
| $t_{PLH}$ , $t_{PHL}$ | Maximum Propagation Delay, Enable to any Output        |            | 18  | 30                | ns    |

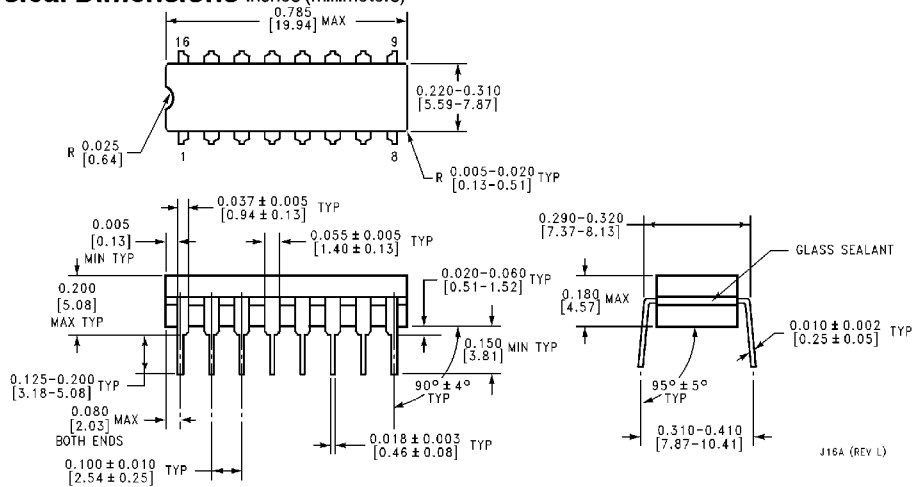
### AC Electrical Characteristics

(Full range of  $V_{CC}$  and temperature)  $V_{CC} = 5V \pm 10\%$ ,  $C_L = 50 \text{ pF}$  (unless otherwise specified)

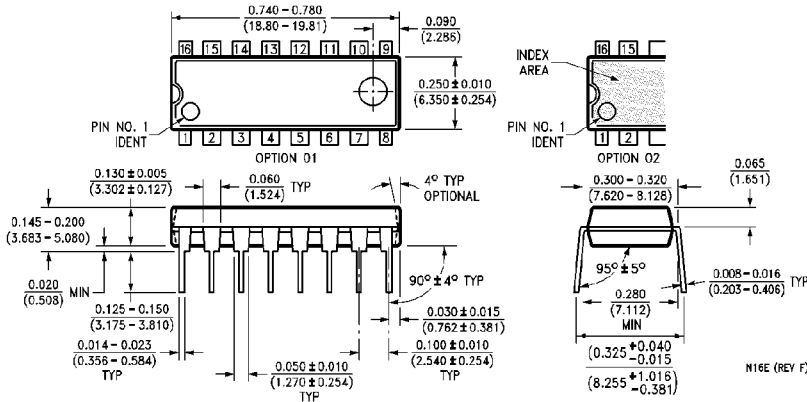
| Symbol                | Parameter  | Conditions | Typ                |                    | Guaranteed Limits                           |  | Units |
|-----------------------|--|------------|--------------------|--------------------|---|--|-------|
|                       |  |            | $T_A = 25^\circ C$ | $T_A = 25^\circ C$ | 74HCT<br>$T_A = -40 \text{ to } 85^\circ C$ | 54HCT<br>$T_A = -55 \text{ to } 125^\circ C$ |       |
| $t_{PLH}$ , $t_{PHL}$ | Maximum Propagation Delay, Binary Select to any Output |            | 20                 | 35                 | 44  | 51   | ns    |
| $t_{PLH}$ , $t_{PHL}$ | Maximum Propagation Delay, Enable to any Output        |            | 21                 | 35                 | 44  | 51   | ns    |
| $t_{TLH}$ , $t_{THL}$ | Maximum Output Rise and Fall Time                      |            | 9                  | 15                 | 19  | 22   | ns    |
| $C_{PD}$              | Power Dissipation Capacitance                          | Note 5     | 36                 |                    |   |  | pF    |
| $C_{IN}$              | Minimum Input Capacitance                              |            | 5                  | 10                 | 10  | 10   | 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,  $I_S = C_{PD} V_{CC} f + I_{CC}$ .

**Physical Dimensions** inches (millimeters)



Order Number MM54HCT139J or MM74HCT139J  
NS Package J16A



Order Number MM74HCT139N  
NS Package N16E

**LIFE SUPPORT POLICY**

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.



**National Semiconductor Corporation**  
1111 West Bardin Road  
Arlington, TX 76017  
Tel: (800) 272-9959  
Fax: (800) 737-7018

**National Semiconductor Europe**  
Fax: (+49) 0-180-530 85 86  
Email: onjwge@tevm2.nsc.com  
Deutsch Tel: (+49) 0-180-530 85 85  
English Tel: (+49) 0-180-532 78 32  
Français Tel: (+49) 0-180-532 93 58  
Italiano Tel: (+49) 0-180-534 16 80

**National Semiconductor Hong Kong Ltd.**  
13th Floor, Straight Block,  
Ocean Centre, 5 Canton Rd.  
Tsimshatsui, Kowloon  
Hong Kong  
Tel: (852) 2737-1600  
Fax: (852) 2736-9960

**National Semiconductor Japan Ltd.**  
Tel: 81-043-299-2309  
Fax: 81-043-299-2408

National does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and National reserves the right at any time without notice to change said circuitry and specifications.