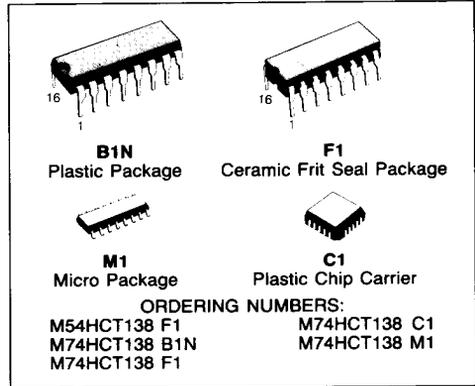


## 3 TO 8 LINE DECODER

- LOW POWER DISSIPATION  
 $I_{CC} = 4 \mu A$  (MAX.) at  $T_A = 25^\circ C$
- HIGH NOISE IMMUNITY  
 $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (MIN.)
- OUTPUT DRIVE CAPABILITY  
 10 LSTTL LOADS
- SYMMETRICAL OUTPUT IMPEDANCE  
 $|I_{OH}| = I_{OL} = 4 \text{ mA}$  (MIN.)
- BALANCED PROPAGATION DELAYS  
 $t_{PLH} = t_{PHL}$
- PIN AND FUNCTION COMPATIBLE  
 WITH 54/74LS138



### DESCRIPTION

The M54/74HCT138 is a high speed CMOS 3 TO 8 LINE DECODER fabricated in silicon gate C<sup>2</sup>MOS technology.

It has the same high speed performance of LSTTL combined with true CMOS low power consumption. If the device is enabled, 3 binary select inputs (A, B and C) determine which one of the outputs will go low.

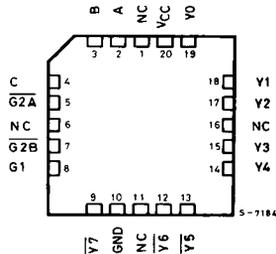
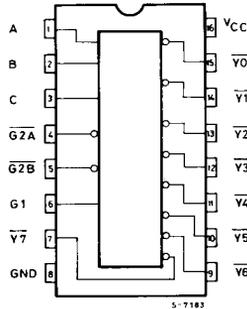
If enable input G1 is held "Low" or either  $\overline{G2A}$  or  $\overline{G2B}$  is held "High", the decoding function is inhibited and all the 8 outputs go high.

3 enable inputs are provided to ease cascade connection and application in address decoders for memory systems.

All inputs are equipped with protection circuits against static discharge and transient excess voltage. This integrated circuit has total compatibility, input and output characteristics, with standard 54/74 LSTTL logic families.

M54HCT/74HCT devices are designed to directly interface HSC<sup>2</sup>MOS systems with TTL and NMOS components. These devices are also plug in replacements for LSTTL devices giving a reduction in power consumption.

### PIN CONNECTIONS (top view)



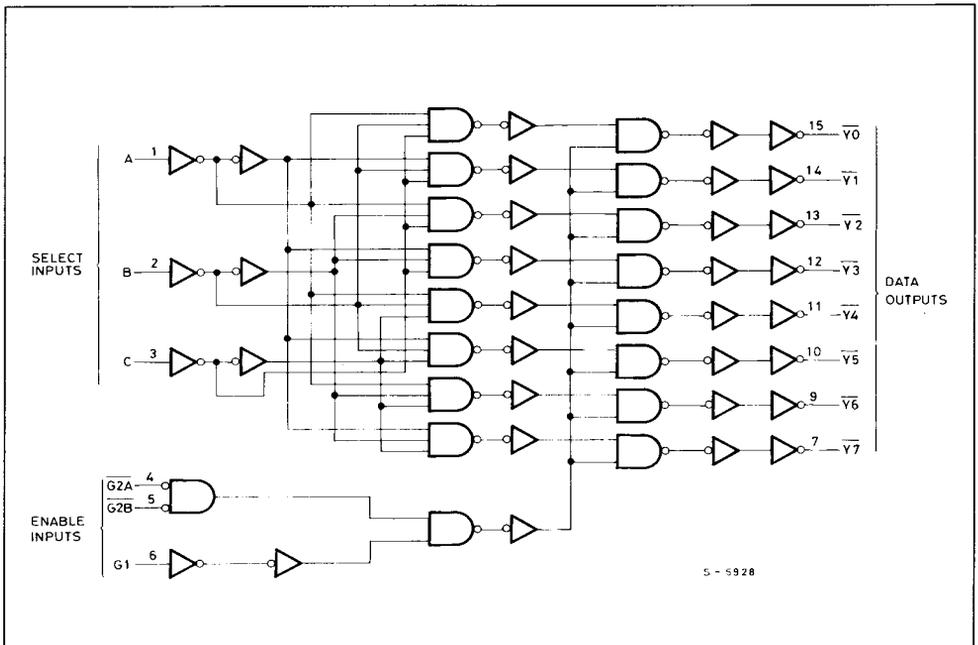
NC =  
No Internal  
Connection

TRUTH TABLE

| INPUTS           |                  |    |        |   |   | OUTPUTS         |                 |                 |                 |                 |                 |                 |                 |
|------------------|------------------|----|--------|---|---|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| ENABLE           |                  |    | SELECT |   |   | $\overline{Y0}$ | $\overline{Y1}$ | $\overline{Y2}$ | $\overline{Y3}$ | $\overline{Y4}$ | $\overline{Y5}$ | $\overline{Y6}$ | $\overline{Y7}$ |
| $\overline{G2B}$ | $\overline{G2A}$ | G1 | C      | B | A |                 |                 |                 |                 |                 |                 |                 |                 |
| X                | X                | L  | X      | X | X | H               | H               | H               | H               | H               | H               | H               | H               |
| X                | H                | X  | X      | X | X | H               | H               | H               | H               | H               | H               | H               | H               |
| H                | X                | X  | X      | X | X | H               | H               | H               | H               | H               | H               | H               | H               |
| L                | L                | H  | L      | L | L | L               | H               | H               | H               | H               | H               | H               | H               |
| L                | L                | H  | L      | L | L | L               | L               | H               | H               | H               | H               | H               | H               |
| L                | L                | H  | L      | L | L | L               | L               | L               | H               | H               | H               | H               | H               |
| L                | L                | H  | L      | L | L | L               | L               | L               | L               | H               | H               | H               | H               |
| L                | L                | H  | L      | L | L | L               | L               | L               | L               | L               | H               | H               | H               |
| L                | L                | H  | L      | L | L | L               | L               | L               | L               | L               | L               | H               | H               |
| L                | L                | H  | L      | L | L | L               | L               | L               | L               | L               | L               | L               | H               |
| L                | L                | H  | L      | L | L | L               | L               | L               | L               | L               | L               | L               | L               |

X: DON'T CARE

LOGIC DIAGRAM



## ABSOLUTE MAXIMUM RATINGS

| Symbol                | Parameter                                    | Value                  | Unit        |
|-----------------------|--|------------------------|-------------|
| $V_{CC}$              | Supply Voltage                               | -0.5 to 7              | V           |
| $V_I$                 | DC Input Voltage                             | -0.5 to $V_{CC} + 0.5$ | V           |
| $V_O$                 | DC Output Voltage                            | -0.5 to $V_{CC} + 0.5$ | V           |
| $I_{IK}$              | DC Input Diode Current                       | $\pm 20$               | mA          |
| $I_{OK}$              | DC Output Diode Current                      | $\pm 20$               | mA          |
| $I_O$                 | DC Output Source Sink Current Per Output Pin | $\pm 25$               | mA          |
| $I_{CC}$ or $I_{GND}$ | DC $V_{CC}$ or Ground Current                | $\pm 50$               | mA          |
| $P_D$                 | Power Dissipation                            | 500 (*)                | mW          |
| $T_{stg}$             | Storage Temperature                          | -65 to 150             | $^{\circ}C$ |

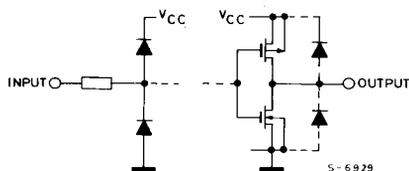
Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied.

(\*) 500 mW:  $\cong 65^{\circ}C$  derate to 300 mW by 10 mW/ $^{\circ}C$ :  $65^{\circ}C$  to  $85^{\circ}C$

## RECOMMENDED OPERATING CONDITIONS

| Symbol     | Parameter   | Value                   | Unit        |
|------------|---|-------------------------|-------------|
| $V_{CC}$   | Supply Voltage                                      | 4.5 to 5.5              | V           |
| $V_I$      | Input Voltage                                       | 0 to $V_{CC}$           | V           |
| $V_O$      | Output Voltage                                      | 0 to $V_{CC}$           | V           |
| $T_A$      | Operating Temperature<br>74HC Series<br>54HC Series | -40 to 85<br>-55 to 125 | $^{\circ}C$ |
| $t_r, t_f$ | Input Rise and Fall Time                            | 0 to 500                | ns          |

## INPUT AND OUTPUT EQUIVALENT CIRCUIT



## DC SPECIFICATIONS

| Symbol          | Parameter                 | V <sub>CC</sub> | Test Condition   |                 | T <sub>A</sub> = 25°C<br>54HC and 74HC |      |      | -40 to 85°C<br>74HC |      | -55 to 125°C<br>54HC |      | Unit |
|-----------------|---------------------------|-----------------|--|-----------------|--|------|------|---------------------|------|----------------------|------|------|
|                 |                           |                 |  |                 | Min.                                   | Typ. | Max. | Min.                | Max. | Min.                 | Max. |      |
| V <sub>IH</sub> | High Level Input Voltage  | 4.5 to 5.5      |  |                 | 2.0                                    | —    | —    | 2.0                 | —    | 2.0                  | —    | V    |
| V <sub>IL</sub> | Low Level Input Voltage   | 4.5 to 5.5      |  |                 | —                                      | —    | 0.8  | —                   | 0.8  | —                    | 0.8  | V    |
| V <sub>OH</sub> | High Level Output Voltage | 4.5             | V <sub>IN</sub>  | I <sub>OH</sub> | 4.4                                    | 4.5  | —    | 4.4                 | —    | 4.4                  | —    | V    |
|                 |                           |                 | V <sub>IH</sub> or V <sub>IL</sub>   | -20 μA          |  |      |      |                     |      |                      |      |      |
| V <sub>OL</sub> | Low Level Output Voltage  | 4.5             | V <sub>IN</sub>  | I <sub>OL</sub> | —                                      | 0    | 0.1  | —                   | 0.1  | —                    | 0.1  | V    |
|                 |                           |                 | V <sub>IH</sub> or V <sub>IL</sub>   | 20 μA           |  |      |      |                     |      |                      |      |      |
| I <sub>IN</sub> | Input Leakage Current     | 5.5             | V <sub>IN</sub> = V <sub>CC</sub> or GND   |                 | —                                      | —    | ±0.1 | —                   | ±1   | —                    | ±1   | μA   |
| I <sub>CC</sub> | Quiescent Supply Current  | 5.5             | V <sub>I</sub> = V <sub>CC</sub> or GND  |                 | —                                      | —    | 4    | —                   | 40   | —                    | 80   | μA   |
| I <sub>CC</sub> |                           |                 | Per input:<br>V <sub>IN</sub> = 0.5V or 2.4V<br>Other input:<br>V <sub>CC</sub> or GND |                 | —                                      | —    | 2.0  | —                   | 2.9  | —                    | 3.0  | mA   |

AC ELECTRICAL CHARACTERISTICS (V<sub>CC</sub> = 5V, T<sub>A</sub> = 25°C, C<sub>L</sub> = 15pF, Input t<sub>r</sub> = t<sub>f</sub> = 6ns)

| Symbol                               | Parameter                                     | 54HC and 74HC |      |      | Unit |
|--------------------------------------|---|---------------|------|------|------|
|                                      |   | Min.          | Typ. | Max. |      |
| t <sub>TLH</sub><br>t <sub>THL</sub> | Output Transition Time                        |               | 4    | 8    | ns   |
| t <sub>PLH</sub><br>t <sub>PHL</sub> | Propagation Delay Time (G1- $\bar{Y}$ )       |               | 23   | 36   | ns   |
| t <sub>PLH</sub><br>t <sub>PHL</sub> | Propagation Delay Time (G2- $\bar{Y}$ )       |               | 26   | 41   | ns   |
| t <sub>PLH</sub><br>t <sub>PHL</sub> | Propagation Delay Time (A, B, C - $\bar{Y}$ ) |               | 28   | 44   | ns   |

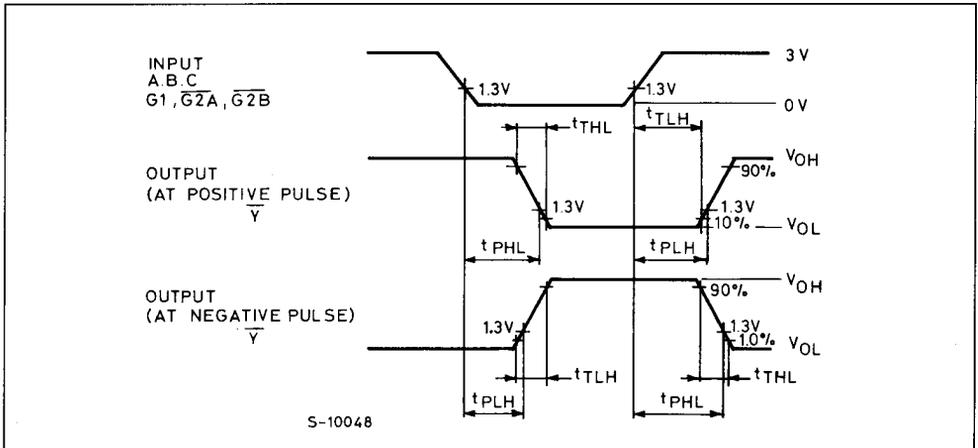
AC ELECTRICAL CHARACTERISTICS ( $C_L = 50\text{pF}$ , Input  $t_r = t_f = 6\text{ns}$ )

| Symbol                 | Parameter   | $V_{CC}$ | Test Condition | $T_A = 25^\circ\text{C}$<br>54HC and 74HC |      |      | $-40$ to $85^\circ\text{C}$<br>74HC |      | $-55$ to $125^\circ\text{C}$<br>54HC |      | Unit |
|------------------------|---|----------|----------------|---|------|------|-------------------------------------|------|--------------------------------------|------|------|
|                        |   |          |                | Min.                                      | Typ. | Max. | Min.                                | Max. | Min.                                 | Max. |      |
| $t_{TLH}$<br>$t_{THL}$ | Output Transition Time                            | 4.5      |                | —   | 8    | 15   | —                                   | 19   | —                                    | 22   | ns   |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay Time<br>( $G1-\bar{Y}$ )        | 4.5      |                | —   | 25   | 41   | —                                   | 51   | —                                    | 62   | ns   |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay Time<br>( $G2-\bar{Y}$ )        | 4.5      |                | —   | 30   | 47   | —                                   | 59   | —                                    | 71   | ns   |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay Time<br>( $A, B, C - \bar{Y}$ ) | 4.5      |                | —   | 32   | 50   | —                                   | 63   | —                                    | 75   | ns   |
| $C_{IN}$               | Input Capacitance                                 |          |                | —   | 5    | 10   | —                                   | 10   | —                                    | 10   | pF   |
| $C_{PD} (*)$           | Power Dissipation Capacitance                     |          |                | —   | 65   | —    | —                                   | —    | —                                    | —    | pF   |

Note (\*)  $C_{PD}$  is defined as the value of IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit)

Average operating current can be obtained from the equation:  $I_{CC(opr.)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$

## SWITCHING CHARACTERISTICS TEST WAVEFORM



TEST CIRCUIT  $I_{CC}$  (Opr.)