

# MN74HC138/MN74HC138S

## 3-to-8 Line Decoder

### Outline

The MN74HC138/MN74HC138S is a high speed silicon gate CMOS 3-to-8 line decoder to decode one of the eight output lines according to the condition of the three select inputs (A, B, C) and the three enable inputs (G1, G2A, G2B).

The two active "L" enable inputs and the one active "H" enable input assure easy cascade connection of the decoder.

This line decoder has realized low power consumption and high noise immunity equivalent to those of a standard CMOS and the operation speed as high as of an LS TTL, and can directly drive ten LS TTL inputs.

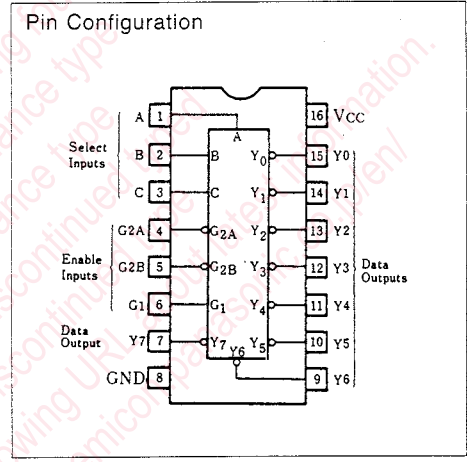
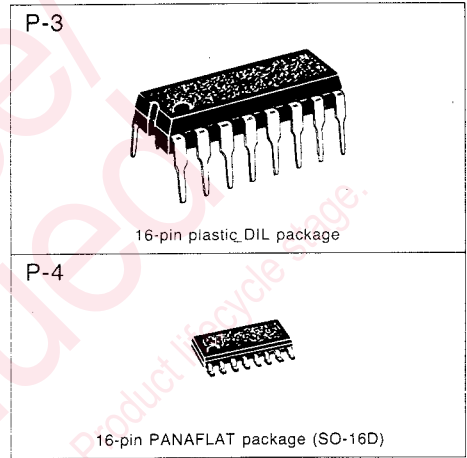
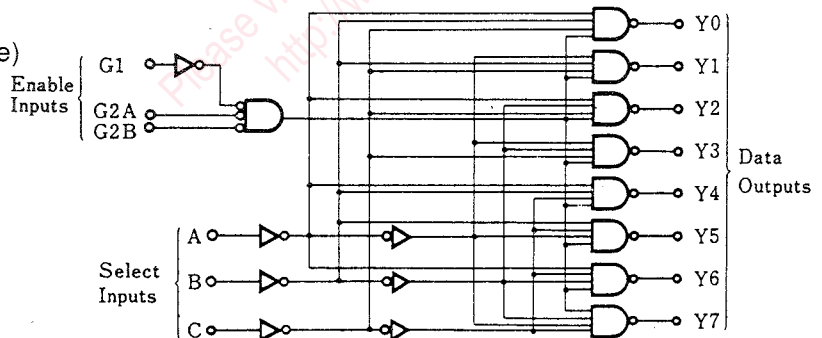
To protect the input and output against electrostatic breakdown, a resistor and a diode are used for the V<sub>CC</sub> and the GND. The pin configuration and the function are the same those of the standard 54LS/74LS logic family.

### Truth Table

Input			Output								
Enable	Select			Y0	Y1	Y3	Y2	Y4	Y5	Y6	Y7
G1	G2	C	B	A							
X	H	X	X	X	H	H	H	H	H	H	H
L	X	X	X	X	H	H	H	H	H	H	H
H	L	L	L	L	L	H	H	H	H	H	H
H	L	L	L	H	H	L	H	H	H	H	H
H	L	L	H	L	H	H	L	H	H	H	H
H	L	L	H	H	H	H	H	L	H	H	H
H	L	H	L	L	H	H	H	H	L	H	H
H	L	H	L	H	H	H	H	H	L	H	H
H	L	H	H	L	H	H	H	H	H	L	H
H	L	H	H	H	H	H	H	H	H	H	L

Note) 1. G2=G2A+G2B.  
2. x: "H" or "L" either will do.

### Logic Diagram (1 Gate)



### ■ Absolute Maximum Ratings

Item		Symbol	Rating	Unit
Supply voltage		$V_{CC}$	-0.5~+7.0	V
Input output voltage		$V_I, V_O$	-0.5~ $V_{CC}+0.5$	V
Input protective diode current		$I_{IK}$	±20	mA
Output parasitic diode current		$I_{OK}$	±20	mA
Output current		$I_O$	±25	mA
Supply current		$I_{CC}, I_{GND}$	±50	mA
Storage temperature		$T_{stg}$	-65~+150	°C
Power dissipation	MN74HC138	$T_a = -40 \sim +60^\circ\text{C}$	400	mW
		$T_a = +60 \sim +85^\circ\text{C}$	Decrease to 200mW at the rate of 8mW/°C	
	MN74HC138S	$T_a = -40 \sim +60^\circ\text{C}$	275	mW
		$T_a = +60 \sim +85^\circ\text{C}$	Decrease to 200mW at the rate of 3.8mW/°C	

### ■ Recommended Operating Conditions

Item	Symbol	$V_{CC}(V)$	Rating	Unit
Operating power supply voltage	$V_{CC}$		1.4~6.0	V
Input output voltage	$V_I, V_O$		0~ $V_{CC}$	V
Operating temperature	$T_A$		-40~+85	°C
Input rise, fall time	$t_r, t_f$	2.0	0~1000	ns
		4.5	0~500	ns
		6.0	0~400	ns

### ■ DC Characteristics (GND=0V)

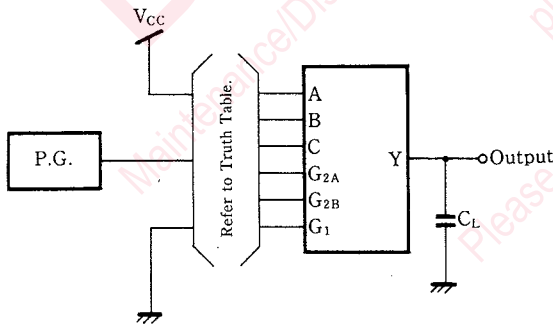
Item	Symbol	$V_{CC}$ (V)	Test Condition		Temperature					Unit
			$V_I$	$V_O$	$T_a = 25^\circ\text{C}$			$T_a = -40 \sim +85^\circ\text{C}$		
					Unit	min.	typ.	max.	min.	
Input voltage high level	$V_{IH}$	2.0				1.5			1.5	V
		4.5				3.15			3.15	
		6.0				4.2			4.2	
Input voltage low level	$V_{IL}$	2.0						0.3	0.3	V
		4.5						0.9	0.9	
		6.0						1.2	1.2	
Output voltage high level	$V_{OH}$	2.0		-20.0	μA	1.9	2.0		1.9	V
		4.5	$V_{IH}$	-20.0	μA	4.4	4.5		4.4	
		6.0	or	-20.0	μA	5.9	6.0		5.9	
		4.5	$V_{IL}$	-4.0	mA	3.92			3.84	
		6.0		-5.2	mA	5.48			5.34	
Output voltage low level	$V_{OL}$	2.0		20.0	μA		0.0	0.1	0.1	V
		4.5	$V_{IH}$	20.0	μA		0.0	0.1	0.1	
		6.0	or	20.0	μA		0.0	0.1	0.1	
		4.5	$V_{IL}$	4.0	mA			0.26	0.33	
		6.0		5.2	mA			0.26	0.33	
Input leakage current	$I_I$	6.0	$V_I = V_{CC}$ or GND					±0.1	±1.0	μA
Static supply current	$I_{CC}$	6.0	$V_I = V_{CC}$ or GND, $I_O = 0$					8.0	80.0	μA

■ AC Characteristics (GND=0V, Input transition time ≤ 6ns, C<sub>L</sub> = 50pF)

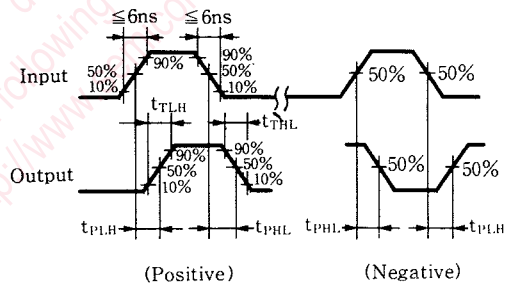
Item	Symbol	V <sub>CC</sub> (V)	Test Condition	Temperature					Unit
				T <sub>a</sub> = 25°C			T <sub>a</sub> = -40~+85°C		
				min.	typ.	max.	min.	max.	
Output rise time	t <sub>TLH</sub>	2.0			25	75		95	ns
		4.5			8	15		19	
		6.0			7	13		16	
Output fall time	t <sub>THL</sub>	2.0			18	75		95	ns
		4.5			6	15		19	
		6.0			5	13		16	
Propagation time A, B, C → Y (L → H)	t <sub>PLH</sub>	2.0			47	200		250	ns
		4.5			19	40		50	
		6.0			15	34		43	
Propagation time A, B, C → Y (H → L)	t <sub>PHL</sub>	2.0			44	175		220	ns
		4.5			16	35		44	
		6.0			13	30		37	
Propagation time Enable G1 → Y (L → H)	t <sub>PLH</sub>	2.0			49	200		250	ns
		4.5			19	40		50	
		6.0			16	34		43	
Propagation time Enable G1 → Y (H → L)	t <sub>PHL</sub>	2.0			44	175		220	ns
		4.5			16	35		44	
		6.0			12	30		37	
Propagation time Enable G2A, G2B → Y (L → H)	t <sub>PLH</sub>	2.0			53	200		250	ns
		4.5			20	40		50	
		6.0			17	34		43	
Propagation time Enable G2A, G2B → Y (H → L)	t <sub>PHL</sub>	2.0			50	175		220	ns
		4.5			18	35		44	
		6.0			14	30		37	

• Switching time measuring circuit and waveforms

1. Measuring circuit



2. Switching waveforms



## Request for your special attention and precautions in using the technical information and semiconductors described in this book

- (1) If any of the products or technical information described in this book is to be exported or provided to non-residents, the laws and regulations of the exporting country, especially, those with regard to security export control, must be observed.
- (2) The technical information described in this book is intended only to show the main characteristics and application circuit examples of the products. No license is granted in and to any intellectual property right or other right owned by Panasonic Corporation or any other company. Therefore, no responsibility is assumed by our company as to the infringement upon any such right owned by any other company which may arise as a result of the use of technical information described in this book.
- (3) The products described in this book are intended to be used for standard applications or general electronic equipment (such as office equipment, communications equipment, measuring instruments and household appliances).  
Consult our sales staff in advance for information on the following applications:
  - Special applications (such as for airplanes, aerospace, automobiles, traffic control equipment, combustion equipment, life support systems and safety devices) in which exceptional quality and reliability are required, or if the failure or malfunction of the products may directly jeopardize life or harm the human body.
  - Any applications other than the standard applications intended.
- (4) The products and product specifications described in this book are subject to change without notice for modification and/or improvement. At the final stage of your design, purchasing, or use of the products, therefore, ask for the most up-to-date Product Standards in advance to make sure that the latest specifications satisfy your requirements.
- (5) When designing your equipment, comply with the range of absolute maximum rating and the guaranteed operating conditions (operating power supply voltage and operating environment etc.). Especially, please be careful not to exceed the range of absolute maximum rating on the transient state, such as power-on, power-off and mode-switching. Otherwise, we will not be liable for any defect which may arise later in your equipment.
  - Even when the products are used within the guaranteed values, take into the consideration of incidence of break down and failure mode, possible to occur to semiconductor products. Measures on the systems such as redundant design, arresting the spread of fire or preventing glitch are recommended in order to prevent physical injury, fire, social damages, for example, by using the products.
- (6) Comply with the instructions for use in order to prevent breakdown and characteristics change due to external factors (ESD, EOS, thermal stress and mechanical stress) at the time of handling, mounting or at customer's process. When using products for which damp-proof packing is required, satisfy the conditions, such as shelf life and the elapsed time since first opening the packages.
- (7) This book may be not reprinted or reproduced whether wholly or partially, without the prior written permission of our company.