FAIRCHILD SEMICONDUCTOR™

August 1986
Revised April 2000

DM74S138 • DM74S139 Decoder/Demultiplexer

General Description

These Schottky-clamped circuits are designed to be used in high-performance memory-decoding or data-routing applications, requiring very short propagation delay times. In high-performance memory systems these decoders can be used to minimize the effects of system decoding. When used with high-speed memories, the delay times of these decoders are usually less than the typical access time of the memory. This means that the effective system delay introduced by the decoder is negligible.

The DM74S138 decodes one-of-eight lines, based upon the conditions at the three binary select inputs and the three enable inputs. Two active-LOW and one active-HIGH enable inputs reduce the need for external gates or inverters when expanding. A 24-line decoder can be implemented with no external inverters, and a 32-line decoder requires only one inverter. An enable input can be used as a data input for demultiplexing applications.

The DM74S139 comprises two separate two-line-to-four-line decoders in a single package. The active-LOW enable input can be used as a data line in demultiplexing applications.

All of these decoders/demultiplexers feature fully buffered inputs, presenting only one normalized load to its driving circuit. All inputs are clamped with high-performance Schottky diodes to suppress line-ringing and simplify system design.

Features

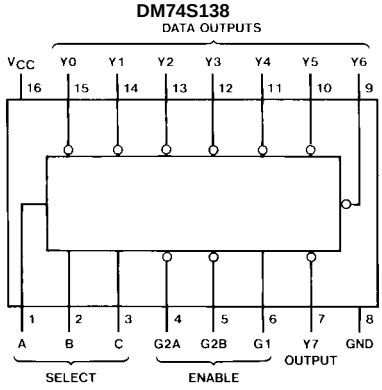
- Designed specifically for high speed:
  - Memory decoders
  - Data transmission systems
- DM74S138 3-to-8-line decoders incorporates 3 enable inputs to simplify cascading and/or data reception
- DM74S139 contains two fully independent 2-to-4-line decoders/demultiplexers
- Schottky clamped for high performance
- Typical propagation delay time (3 levels of logic)
  - DM74S138 8 ns
  - DM74S139 7.5 ns
- Typical power dissipation
  - DM74S138 245 mW
  - DM74S139 300 mW

Ordering Code:

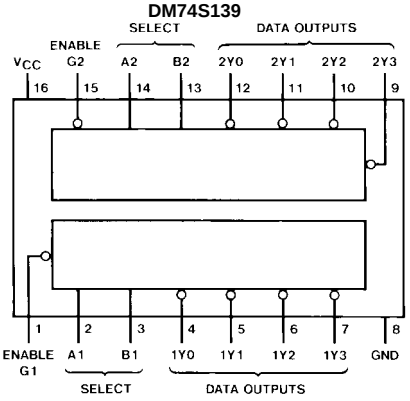
Order Number	Package Number	Package Description
DM74S138N	N16E	16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300 Wide
DM74S139N	N16E	16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300 Wide

Connection Diagrams

DM74S138



DM74S139



Function Tables

DM74S138

Inputs					Outputs							
Enable		Select										
G1	G2*	C	B	A	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7
X	H	X	X	X	H	H	H	H	H	H	H	H
L	X	X	X	X	H	H	H	H	H	H	H	H
H	L	L	L	L	L	H	H	H	H	H	H	H
H	L	L	L	H	H	L	H	H	H	H	H	H
H	L	L	H	L	H	H	L	H	H	H	H	H
H	L	L	H	H	H	H	H	L	H	H	H	H
H	L	H	L	L	H	H	H	H	L	H	H	H
H	L	H	L	H	H	H	H	H	H	L	H	H
H	L	H	H	L	H	H	H	H	H	H	L	H
H	L	H	H	H	H	H	H	H	H	H	H	L

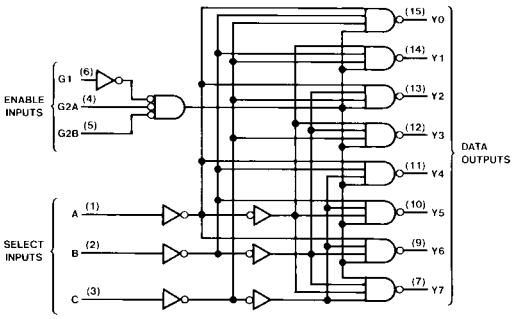
DM74S139

Inputs			Outputs			
Enable	Select					
G	B	A	Y0	Y1	Y2	Y3
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

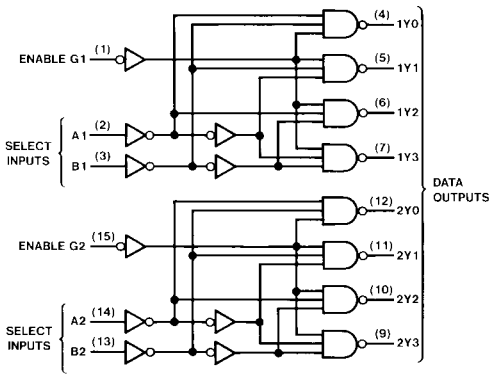
* G2 = G2A + G2B
H = HIGH level
L = LOW level
X = don't care (either LOW or HIGH logic level)

Logic Diagrams

DM74S138



DM74S139



Absolute Maximum Ratings(Note 1)

Supply Voltage	7V
Input Voltage	5.5V
Operating Free Air Temperature Range	0° C to +70°C
Storage Temperature Range	−65° C to +150° C

Note 1: The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the Electrical Characteristics tables are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

Recommended Operating Conditions

Symbol	Parameter	Min	Nom	Max	Units
V_{CC}	Supply Voltage	4.75	5	5.25	V
V_{IH}	HIGH Level Input Voltage	2			V
V_{IL}	LOW Level Input Voltage			0.8	V
I_{OH}	HIGH Level Output Current			−1	mA
I_{OL}	LOW Level Output Current			20	mA
T_A	Free Air Operating Temperature	0		70	°C

Electrical Characteristics

over recommended operating free air temperature (unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ (Note 2)	Max	Units
V_I	Input Clamp Voltage	V_{CC} = Min, I_I = −18 mA			−1.2	V
V_{OH}	HIGH Level Output Voltage	V_{CC} = Min, I_{OH} = Max V_{IL} = Max, V_{IH} = Min	2.7	3.4		V
V_{OL}	LOW Level Output Voltage	V_{CC} = Min, I_{OL} = Max V_{IH} = Min, V_{IL} = Max			0.5	V
I_I	Input Current @ Max Input Voltage	V_{CC} = Max, V_I = 5.5V			1	mA
I_{IH}	HIGH Level Input Current	V_{CC} = Max, V_I = 2.7V			50	µA
I_{IL}	LOW Level Input Current	V_{CC} = Max, V_I = 0.5V			−2	mA
I_{OS}	Short Circuit Output Current	V_{CC} = Max (Note 3)	−40		−100	mA
I_{CC}	Supply Current (DM74S138)	V_{CC} = Max (Note 4)		49	74	mA
I_{CC}	Supply Current (DM74S139)	V_{CC} = Max (Note 4)		60	90	mA

Note 2: All typicals are at V_{CC} = 5V, T_A = 25°C.

Note 3: Not more than one output should be shorted at a time, and the duration should not exceed one second.

Note 4: I_{CC} is measured with all outputs enabled and OPEN.

DM74S138 Switching Characteristics

at V_{CC} = 5V and T_A = 25°C

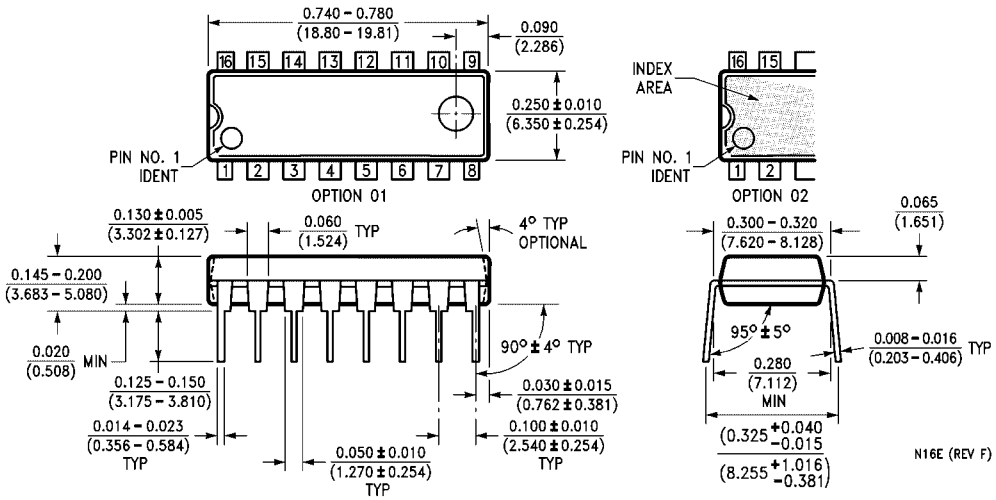
Symbol	Parameter	From (Input) To (Output)	Levels of Delay	R_L = 280Ω				Units
				C_L = 15 pF		C_L = 50 pF		
				Min	Max	Min	Max	
t_{PLH}	Propagation Delay Time LOW-to-HIGH Level Output	Select to Output	2		7		9	ns
t_{PHL}	Propagation Delay Time HIGH-to-LOW Level Output	Select to Output	2		10.5		14	ns
t_{PLH}	Propagation Delay Time LOW-to-HIGH Level Output	Select to Output	3		12		14	ns
t_{PHL}	Propagation Delay Time HIGH-to-LOW Level Output	Select to Output	3		12		15	ns
t_{PLH}	Propagation Delay Time LOW-to-HIGH Level Output	Enable to Output	2		8		10	ns
t_{PHL}	Propagation Delay Time HIGH-to-LOW Level Output	Enable to Output	2		11		14	ns
t_{PLH}	Propagation Delay Time LOW-to-HIGH Level Output	Enable to Output	3		11		13	ns
t_{PHL}	Propagation Delay Time HIGH-to-LOW Level Output	Enable to Output	3		11		14	ns

DM74S139 Switching Characteristics

at V_{CC} = 5V and T_A = 25°C

Symbol	Parameter	From (Input) To (Output)	Levels of Delay	R_L = 280Ω				Units
				C_L = 15 pF		C_L = 50 pF		
				Min	Max	Min	Max	
t_{PLH}	Propagation Delay Time LOW-to-HIGH Level Output	Select to Output	2		7.5		10	ns
t_{PHL}	Propagation Delay Time HIGH-to-LOW Level Output	Select to Output	2		10		13	ns
t_{PLH}	Propagation Delay Time LOW-to-HIGH Level Output	Select to Output	3		12		13	ns
t_{PHL}	Propagation Delay Time HIGH-to-LOW Level Output	Select to Output	3		12		15	ns
t_{PLH}	Propagation Delay Time LOW-to-HIGH Level Output	Enable to Output	2		8		10	ns
t_{PHL}	Propagation Delay Time HIGH-to-LOW Level Output	Enable to Output	2		10		13	ns

Physical Dimensions inches (millimeters) unless otherwise noted



16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300 Wide
Package Number N16E