

FEATURES

- LS138: 3-Line-to-8-Line Decoder
1-of-8 Demultiplexer
- LS139: Dual 2-Line-to-4-Line Decoder
Dual 1-of-4 Demultiplexer
- LS138 is expandable to 5-lines-to-32-lines decoder using 4 LS138's and one inverter.

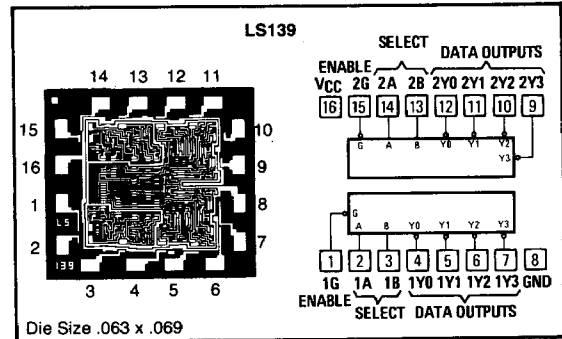
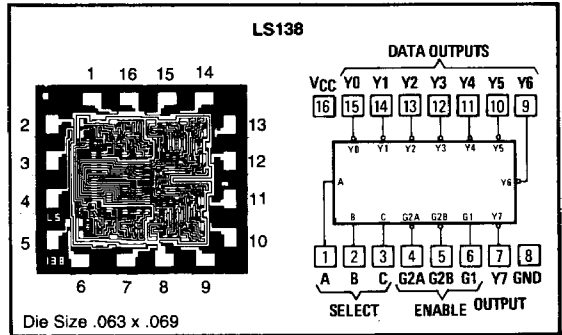
DESCRIPTION

The LS138 decodes one-of-eight lines dependent on 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 without 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 LS139 comprises two individual 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.

These circuits are designed to be used in high-performance memory-decoding and data-routing applications requiring very short delay times.

PIN-OUT DIAGRAMS



**LS138
FUNCTION TABLE**

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

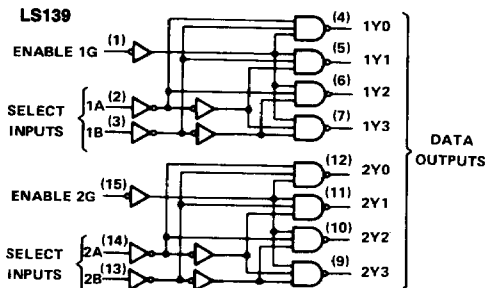
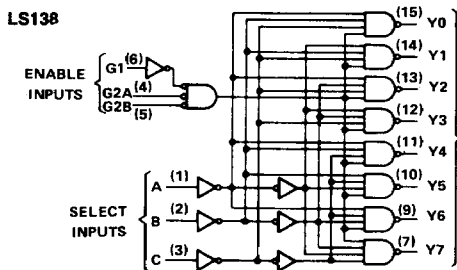
*G2 = G2A + G2B
H = high level, L = low level, X = don't care

**LS139
FUNCTION TABLE (1/2)**

INPUTS			OUTPUTS			
ENABLE	SELECT					
G	B	A	Y0	Y1	Y2	Y3
H	X	X	H	H	H	H
L	L	L	L	L	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 DIAGRAMS



Recommended Operating Conditions

	9LS/54LS			9LS/74LS			Unit
	Min	Nom	Max	Min	Nom	Max	
Supply voltage, V_{CC}	4.5	5	5.5	4.75	5	5.25	V
High-level output current, I_{OH}			-400			-400	μA
Low-level output current, I_{OL}			4			8	mA
Operating free-air temperature, T_A	-55		125	0		70	$^{\circ}C$

Electrical Characteristics Over Recommended Free-Air Temperature Range (Unless Otherwise Noted)

Parameter	Test Conditions*	9LS/54LS			9LS/74LS			Unit	
		Min	Typ**	Max	Min	Typ**	Max		
V_{IH}		2			2			V	
V_{IL}				0.7			0.8	V	
V_I	$V_{CC} = \text{MIN}, I_I = -18 \text{mA}$			-1.5			-1.5	V	
V_{OH}	$V_{CC} = \text{MIN}, V_{IH} = 2\text{V}, V_{IL} = V_{IL \text{max}}, I_{OH} = -400 \mu A$	2.5	3.4		2.7	3.4		V	
V_{OL}	$V_{CC} = \text{MIN}, V_{IH} = 2\text{V}, V_{IL} = V_{IL \text{max}}$	$I_{OL} = 4 \text{mA}$		0.25	0.4		0.25	0.4	V
		$I_{OL} = 8 \text{mA}$					0.35	0.5	
I_I	$V_{CC} = \text{MAX}, V_I = 7\text{V}$			0.1			0.1	mA	
I_{IH}	$V_{CC} = \text{MAX}, V_I = 2.7\text{V}$			20			20	μA	
I_{IL}	$V_{CC} = \text{MAX}, V_I = 0.4\text{V}$			-0.4			-0.4	mA	
I_{OS}^{\dagger}	$V_{CC} = \text{MAX}$	-15		-100	-15		-100	mA	
I_{CC}	$V_{CC} = \text{MAX},$ Outputs enabled and open	LS138		6.3	10		6.3	10	mA
		LS139		6.8	11		6.8	11	

*For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions for the applicable device type.

**All typical values are at $V_{CC} = 5\text{V}, T_A = 25^{\circ}C$.

\dagger Not more than one output should be shorted at a time.

LS138

Switching Characteristics, $V_{CC} = 5V$ Over Recommended Free-Air Temperature Range

Parameter	Levels of Delay	From (input)	To (output)	-55°C			+25°C			+125°C			Unit
				Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
Test Conditions: $C_L = 15pF, R_L = 2k\Omega$ (See Fig. A, page 2-174)													
t _{PLH}	2	Binary Select	Any		11	16		10	15		13	18	ns
t _{PHL}					17	24		17	24		21	27	ns
t _{PLH}	3				16	22		16	21		21	28	ns
t _{PHL}					22	30		21	28		24	32	ns
t _{PLH}	2	Enable	Any		11	16		10	15		13	18	ns
t _{PHL}					19	26		18	25		23	30	ns
t _{PLH}	3				16	22		16	22		21	27	ns
t _{PHL}					22	30		20	28		24	31	ns
Test Conditions: $C_L = 50pF, R_L = 2k\Omega$ (See Fig. A, page 2-174)													
t _{PLH}	2	Binary Select	Any		13	19		12	17		14	20	ns
t _{PHL}					23	31		22	29		26	33	ns
t _{PLH}	3				17	24		17	23		23	29	ns
t _{PHL}					26	35		25	32		28	36	ns
t _{PLH}	2	Enable	Any		11	16		12	18		15	20	ns
t _{PHL}					23	30		24	33		26	34	ns
t _{PLH}	3				18	24		18	23		24	30	ns
t _{PHL}					26	34		24	32		28	37	ns

Note: AC specification shown under -55°C and +125°C are for 9LS devices only. All 50pF specifications are for 9LS devices only.

LS139

Switching Characteristics, $V_{CC} = 5V$ Over Recommended Free-Air Temperature Range

Parameter	Levels of Delay	From (input)	To (output)	-55°C			+25°C			+125°C			Unit	
				Min	Typ	Max	Min	Typ	Max	Min	Typ	Max		
Test Conditions: $C_L = 15pF, R_L = 2k\Omega$ (See Fig. A, page 2-174)														
t _{PLH}	2	Binary Select	Any		12	21		12	17		13	20	ns	
t _{PHL}					13	21		12	17		13	20	ns	
t _{PLH}	3				16	28		15	22		17	27	ns	
t _{PHL}					18	30		17	25		18	30	ns	
t _{PLH}	2	Enable	Any		12	22		11	15		11	22	ns	
t _{PHL}					11	22		11	16		12	22	ns	
Test Conditions: $C_L = 50pF, R_L = 2k\Omega$ (See Fig. A, page 2-174)														
t _{PLH}	2			Binary Select	Any		15	26		15	21		16	25
t _{PHL}			16			26		15	21		16	25	ns	
t _{PLH}	3		19			33		18	26		20	32	ns	
t _{PHL}			21			35		20	29		21	35	ns	
t _{PLH}	2	Enable	Any		15	27		14	19		14	27	ns	
t _{PHL}					14	27		14	20		15	27	ns	

Note: AC specification shown under -55°C and +125°C are for 9LS devices only. All 50pF specifications are for 9LS only.